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Engineering News-Record

A Consolidation of Engineering News and Engineering Record

A JOURNAL OF CIVIL ENGINEERING AND CONSTRUCTION

ISSUED WEEKLY

VOLUME 89

July 1 to December 31, 1922

McGRAW-HILL COMPANY, INC.
10TH AVENUE AT 36TH STREET
NEW YORK

ENGINEERING NEWS-RECORD

INDEX TO VOLUME 89

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A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*

Volume 89 — NEW YORK, JULY 6, 1922 — Number 1

Engineering News-Record is a consolidation of *Engineering News* and *Engineering Record*, effected in 1917.

Engineering News was founded in 1874 by George H. Frost, as the *Engineer and Surveyor*, which title subsequently became the *Engineer, Architect and Surveyor*, then *Engineering News and American Railway Journal* and finally, *Engineering News*, under the successive editorships of D. McN. Stauffer, Arthur M. Wellington and Charles Whiting Baker.

Engineering Record was established in 1877 by Henry C. Meyer as the *Plumber and Sanitary Engineer*. The name was subsequently changed to the *Sanitary Engineer, Engineering and Building Record* and, finally, to *Engineering Record*. During his ownership of the paper, Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor in 1902, and was succeeded by E. J. Mehren.

The Contractor was consolidated with *Engineering News-Record* in 1918.

The Licensing Issue Reviewed

LICENSING or registration of engineers is now required in nineteen of the states. It is, therefore, for a large number of engineers an accomplished fact, something to be observed in practice rather than to be argued about. Nevertheless, argument continues. Engineering Council's committee only a few weeks ago discussed the matter as though it were still something to be settled. The licensing committee of the American Society of Civil Engineers, which has been sitting for a year, has not yet arrived at any conclusion justifying a report. Clearly the bulk of the profession has not made up its mind on this so important a subject. For this reason we think it worth while to set before our readers elsewhere in this issue some well-stated arguments in favor of licensing by one who has had some experience in administering a license law and an impartial editorial analysis of the licensing question, which it is hoped will help to clarify the issue in the mind of the engineer who is considering it.

Where Posterity Can Read It

IT WAS well said at last week's dinner in honor of J. Waldo Smith that he has indelibly written his name into the annals of New York and into the records of great American engineering achievements. Even the general public today reads with interest of the leaden pipe distribution systems and the aqueducts of ancient Rome. Shall not the people several centuries hence point to the Catskill Aqueduct as one of the essential factors in permitting the tremendous growth of the metropolitan city of this continent. They of that time will probably have even more stupendous works, but will they not look back, as we do now to the aqueduct builders of ancient Rome, with reverence to then man who had the vision and the engineering ability to put through the greatest aqueduct of his time? Fundamentally there is but little change in the human race over the centuries. Human impulses will probably be basically the same in the year 2500 as they are today and, if they are, the achievements of J. Waldo Smith will still be inspiring, will still be a tribute to the might of the man who, with machinery inadequate as measured by the developments of the year A.D. 2500, builded structures that supplied the water needs of New York's millions.

The Milk of Human Kindness

CELEBRATIONS of the kind referred to in the previous note are not unusual. Nevertheless we never assist at a function in honor of the achievement or retirement of some important man without feeling that we do not often enough express our appreciation of those who have done well by their fellows or by the public. We forget that it is far better to pin a single rose on a man's coat than to put a bushel of them on his coffin. Such functions—dinners we mean, not funerals—are good for the recipient of the honor. They show him that beneath the formal business exterior of his associates is a warm human heart. They cheer him up. They send him on with new vigor and furnish memories that are a solace in the days of reminiscence. But these functions are equally beneficial to those who participate in the rendering of the honor. To them such affairs are an inspiration to higher endeavor. They are evidence of the reward that comes to those who have served well their fellow men. They give occasion to reflect upon those human qualities which must be added to sheer intellectual ability if one is to achieve a worth-while success in this our world. Let us have more dinners or other celebrations that put a human note into our business and professional occupations.

Defining the Issue

CHAIRMAN HOOPER of the Railroad Labor Board scores a bulls-eye in his statement that "the people of the United States are sick and tired of having railway transportation and traffic periodically interrupted by controversies between railway managements and employees." The Labor Board itself is the tangible evidence not only of that state of disgust but also of their determination that in the settlement of such controversies the rule of reason must prevail. Since its establishment the authority of the Board has been invoked on several occasions, both by the managements and by the employees, to the incalculable advantage of all parties at interest, including the public. We have

made progress; there must be no retreat. The present attack on the board is more than an industrial incident, more than a matter of wages, hours or working conditions. It is not a "strike" or a "walkout" at all. It is a gesture of defiance toward an arm of the government lawfully exercising its authority in the public interest. No greater disservice to the members of the shop crafts unions could be performed by their leaders than to flout the American people with regard to this issue. They are too determined; they have come too far. We suggest that the "Little Six" hesitate long before rushing in where the "Big Four" feared to tread last October.

Mt. Everest Named for an Engineer

APROPOS the expedition struggling to scale Mount Everest, engineers will be interested to know that this, the loftiest summit on earth, bears the name of an engineer. Sir George Everest spent much of his life on engineering works in India becoming surveyor-general in 1830. In 1841 he completed the trigonometrical survey of the Himalayas and first determined the position and altitude of the peak that bears his name.

"Selling" Highways to the Public

A NEW phase of the highway problem is assuming importance in the minds of engineers. Until recently chief consideration has been given to financing, design, construction, and maintenance. Now that the state departments have made substantial progress in spinning their traffic webs between important centers to form an interconnected system the problem of operation looms large. For the most part the highway departments have reasoned thus: Our job ends with the construction and maintenance of roads; let the public use them as it will. Today, however, we find certain highway departments—Wisconsin is an example—going a step further, by *selling* its product to the road user. To accomplish this end the Wisconsin department has each year for several years issued an excellent map of the state trunk highway system. The latest edition contains forty-eight pages folded to a convenient pocket size. There is shown first a key map of the entire state, followed by maps, on a larger scale, of different sections. All routes are numbered and the condition and surfacing are indicated in every case by the use of different conventions, red, black, and purple ink being employed. In addition, the maps indicate points of historical, scenic, and industrial interest, camping sites, state parks. There is a real business return for the state in such a publication as this. Increased highway traffic turns revenue not only into the hotels and shops, but into industries of all kinds. In this country the development of tourist traffic as a means of paying indirectly for road construction and maintenance has been almost entirely neglected. Highways can be made to yield dollar-and-cents returns just as surely as does Swiss scenery if the technical conception of them can be leavened by a proper amount of promotional instinct.

Settle the Next Strike Now

AS THIS is written President Harding is assembling in Washington representatives of both parties to the coal strike. It is to be hoped, of course, that this conference will bring about a resumption of coal mining, for the country now stands face to face with the long-expected shortage. The wish of the President, we are told, is to have the operators and miners work out their own settlement. The government wishes neither to use compulsion nor to enter the coal business. All this is worth while, so far as it goes. But we cannot quite see how mere composition of the present differences can lead to any result more far-reaching than a truce. Elsewhere in this issue appears a discussion of the coal industry by George Otis Smith, director of the U. S. Geological Survey. Its problems, as he presents them, are beyond the scope of the present conference. They involve, root and branch, the entire economic organization of the industry; the volume of capital invested, the number of workers dependent on it, the relation between productive capacity and market demands, the buying habits of the people, and the coordination of all these in the general interest. We fear that the statesmanship of operators and miners combined is unequal to the needs of the situation, and that if we are to get anywhere the government must play a part more active than that of the friendly advisor. This does not mean that the government should get into the coal business. It does mean that sooner or later the coal industry complete, from mine to consumer, must be reorganized and that the leadership in this tremendous undertaking must be assumed by some agency with the authority and the resources of the government behind it. We believe that now is the time to put this job in hand and we hope that the President will not be turned aside from it by any disposition to smooth over the present difficulties by leaving the morrow to care for itself.

A Twenty-fifth Anniversary

NEARLY eight hundred engineers and manufacturers gathered at the Atlantic City meeting of the American Society for Testing Materials last week, the twenty-fifth meeting since a small but hopeful group founded the society in 1898. They celebrated a twenty-fifth anniversary—or a twenty-fourth, depending on one's preferences in arithmetic. Within the margin of experimental error, as the testing-laboratory man likes to say, the society can look back on a quarter century of useful existence. That is a proud and justified diversion, and also a salutary one, for societies as for individuals. President Young's review of the career of the society was an instructive retrospect upon a great amount of work well done.

Industry and the general public have been benefited by this work through better regulated production and more assured quality of materials. The engineer, who has benefited fully as much, finds in the society's career a remarkable example of effective group activity, the kind of activity on which much of his daily work depends for its effect. From every point of view the society has achieved success.

In view of this success the reasons why the society came into existence and why it prospered claim attention. A quarter-century back, a few men saw clearly that an essential step in the country's productive processes was unprovided for: the exchange of material between maker and user in mutually satisfactory manner. They reasoned that this step required the work of the engineer, who would use rule and line and testing machine and weighing scales to appraise demand and per-

formance and to harmonize them. They took up this work courageously, even though well-established organizations of engineers had declined to concern themselves with it.

That the purposes of the society are rooted deep in economy and efficiency of production is doubtless a main factor of its consistent success. But a truly democratic system of working and wise and just direction of its functioning played a part. Some of the many societies of more recent creation might fitly test their own prospects for a useful career by comparison.

As to the American Society for Testing Materials itself, now that it is entering on its third dozen of years it has the pleasant privilege of appraising its condition with an eye to its future growth. It is a lusty youth and needs exercise, more exercise than the crowded limits of one meeting a year fairly supplies: a certain lack of vigor in some of the meetings already gives warning that flabbiness of the muscles may supervene. It has made its growth on labor in practical fields, and it must stick to work of real utility: The danger of drifting off into the extreme or the fanciful, of trying to draft specifications for Ground and Polished House Numbers (Grades A and B) for Families of Moderate Income, for example, is worth keeping in view. Simple principles and purposes and the sanity of common sense will keep it sound.

But along with practical work the society now needs to do some thinking—study and research work, for which there has been little leisure in the past. A serious-minded beginning in this direction has already been made, and with a research man as new head of the society the efforts in this direction are sure to receive well-merited encouragement.

The big opportunity which the immediate future holds out to the American Society for Testing Materials —so it seems to us—lie in intellectual growth. If this opportunity is taken, a real science of materials can be created, to fertilize the soil from which spring our practical arts of production and engineering.

Water Power Auxiliary to Steam

HYDRO-ELECTRIC power in its earlier days was used mainly to supply the needs of a given market. Sometimes, especially in the West and South, such development constituted the first central station power supply available to a market. In other cases, especially in the East, the aim was to supersede steam central stations by the output of hydro-electric plants, either because the former were more antiquated and inefficient or because of high cost of fuel. Steam plants where built or retained in connection with water power were auxiliary to that power, either acting as a "stand-by," to insure reliability of service because of real or fancied shortcomings of the older transmission lines, or to supplement the output of hydro plants during periods of deficiencies in stream flow. This phase of water power development is changing in the sections of the country where coal is available and a situation has arisen where frequently water power to be considered at all must be thought of only as an auxiliary to steam.

The use of hydro-electric power primarily to reduce the fuel and labor bills of a power system is common enough. From the standpoint of hydro operation the requisite is merely to utilize the stream flow to the greatest extent, allowing a minimum to be wasted over the spillway. On the other hand, the best interests of the entire system require taking into account the characteristics of the steam-electric units, giving each as uniform a load as possible and a high capacity factor. There must also be taken into account the load characteristics of the system, for the hydro power can be utilized only when the market can absorb the energy. For this purpose pondage for daily regulation of flow is important, especially upon the larger streams.

The possibilities of using hydro power for peak-carrying purposes are not so well appreciated. Susquehanna River power from the plant at Holtwood, Pa., is used during low-water periods to "iron out" the peaks on the steam electric plants of the Baltimore market. The report of the Superpower Survey of 1921, covering the Boston-Washington territory, sets forth in general terms the advantages of using hydro plants for carrying the peaks of the combined systems. But the fact is that present day development has hardly scratched the surface of the possibilities of using water power for this purpose.

One of the outstanding facts is the very low load factor of the top load as one may style the uppermost part of the peak load of a power system. In a typical load of 100,000 kw., with an annual load factor of about 50 per cent, the load factor of the top load of 20,000 kw. rarely exceeds 10 per cent. This, in the case of a 20,000 kw. hydro-electric plant, charged with the duty of carrying the corresponding top load of the system, the plant would theoretically require not more than 10 per cent of the quantity of water that would be necessary to generate 10,000 kw. continuously. Actual operating conditions involve a departure from the theoretical, and a safe margin of stream flow or energy must be supplied; but even so the total energy requirement is surprisingly low.

Evidently wonders can be accomplished with relatively low stream flow and limited storage capacity. As a rule the desired results are most economically attained in developments of relatively high head with little or no length of waterway and with short penstocks. The direct type of development, with power plant at a high dam, is best adapted so far as physical conditions are concerned. Naturally, reliability of stream flow and of electrical transmission to the power market are of prime importance wherever the scheme is to be carried to its logical and most desirable development, namely, that of allowing the hydro capacity to be a reliable substitute for additions to the steam-electric capacity of a central station or power system.

There are also business considerations. Obviously, a given hydro-electric possibility may be operated to the best advantage if it is under the same control as the major steam-electric system. Such control may be exercised either by complete ownership or through an operating contract or lease covering the hydro plant.

From this standpoint of reliable peak-carrying capacity many an otherwise unattractive water power can be used advantageously as an auxiliary to a steam-electric system and a more extensive use of hydro-electric power for this purpose appears clearly to be indicated. The economies involved are a most interesting study in themselves, though it might be pointed out that the savings resulting from the use of water power to carry the top of the peak load are dependent primarily on the cost of installing and maintaining steam-electric generating capacity rather than on local cost of fuel.

Removal of Three First-Story Columns in Twenty-Seven Story Building

Transfer of Load Accomplished by Using Cantilever Trusses as Levers — Elastic Distortion of Columns Taken Up By Jacking — Procedure Checked by Strain-Gage Readings

BY EDWARD F. WEISKOPF
Engineer with S. C. Weiskopft, Consulting Engineer, New York

IN CONSTRUCTING an addition to the American Telephone and Telegraph Building at Broadway and Fulton St., New York, just completed, some extremely heavy column loads had to be transferred to new columns in order to obtain the desired space arrangement at the connection with the old building. Three columns carrying the side wall and end floor bays for the full height of 27 stories were relieved of their loads at the third-floor level, the 24-story upper sections carried by cantilever trusses in the new building, and the lower sections removed in the first story.

The old building occupies the corner of Broadway and Dey St., with a narrow wing running through to Fulton St. at the middle of the block. The addition is on the Broadway-Fulton St. corner, filling out the rectangle. Together, the old and new structures unite into one finished building covering the whole Broadway block front. As it was desired to have the new building match the old in every detail, the ground floor was carried through both in a lofty hall, 35 ft. high, open in the interior and finished to give the effect of a Greek temple. This effect is produced mainly by 5-ft. marble columns spaced about 17 ft. on centers. In order to carry out this arrangement, three of the old building columns had to be removed in this story.

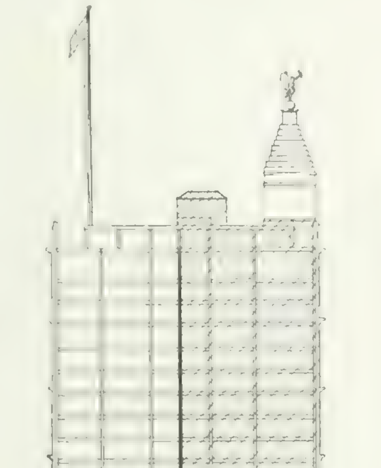
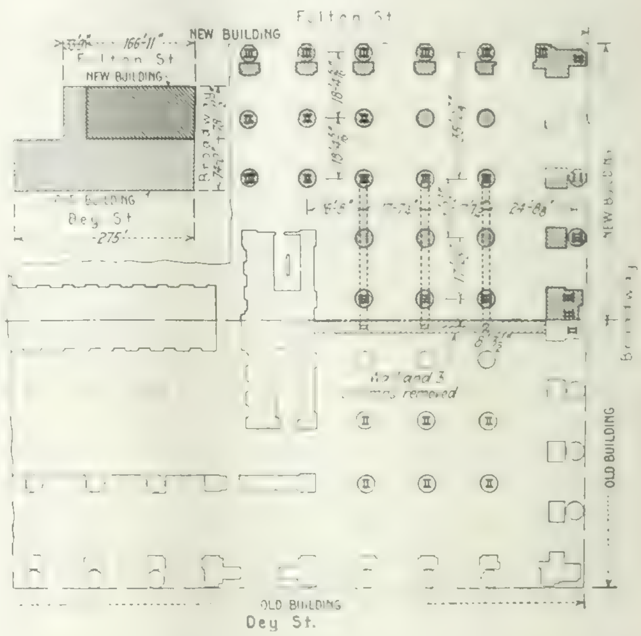


FIG. 1. ADDITION TO A. T. & T. BLDG., NEW YORK; COLUMN LOADS TRANSFERRED BY CANTILEVER TRUSS SYSTEM

These three conflicting columns were in the side wall parallel to Dey St., and, as is seen by the plan, would come at about the middle of a column bay. Before the design was made the owners inquired whether it would be possible to remove these three columns and carry the upper 24 stories while the work was being done. It was decided to be entirely feasible and several schemes were studied.

Choice of Method—In order to arrive at a solution of the problem, only those schemes which would accomplish the transfer of load very gradually, eliminating any



sudden jar, were considered. The scheme of carrying the columns on the ends of three cantilever trusses built as part of the new building was finally adopted. The merits of this scheme in addition to permitting of a very gradual transfer of the load are that it would allow full and undisturbed use of the existing building, a thing that the owners most urgently desired, that it required a minimum of falsework, that it did not involve any dangerous underpinning, and that it was the most economical of all the methods contemplated.

The three columns to be carried were (see framing plan, Fig. 2), Col. 52-A, 471 tons; Col. 56, 1,171 tons; and Col. 60, 1,325 tons, the loads stated being the maximum (dead and live) load at third-floor level. The truss cantilever arms are 8½ ft. long. The trusses were run back two bays, giving a back arm of 34 ft. The main floor column under the middle of the back arm (see section in Fig. 1) is then a dummy. The truss depth, 15 ft. between centers of chords, is slightly greater than the third-story height. Each truss carries one upper floor column located 8½ ft. back of the fulcrum point; it will be seen that the columns in the upper stories in part are offset with respect to the columns below.

When a transfer of loads of such magnitude is to

be undertaken, it is obvious that this transfer should take place very gradually. The most gradual and steady method, and in this case also the simplest, was to use the trusses as levers by letting the anchor end hang free. Then, as the erection proceeded in the new structure, the load of the old columns would automatically be lifted off.

As the column on the truss is located a distance back of the fulcrum point equal to the length of the cantilever arm, and the anchor column (at the end of the back arm) is four times as far away, the relieving of load during the progress of erection proceeded in the ratio of one to one for the truss column and four to one for the anchor column. The maximum load on the cantilever end was of course the full column-schedule load for the column at the third floor. The minimum load was taken as the full dead load plus 15 lb. per sq.ft. live load. It was found that maximum stress occurred in the chord members, the cantilever end post and the adjacent web member when the cantilever end was fully loaded and the back arm fixed. The maximum stress in the rest of the web members occurred when the cantilever arm was fully loaded and the back arm free. All members were checked for maximum and minimum loading with the back arm both fixed and free.

Trusses and Connections—The chord members were made of plate-and-angle double-H section, and the web

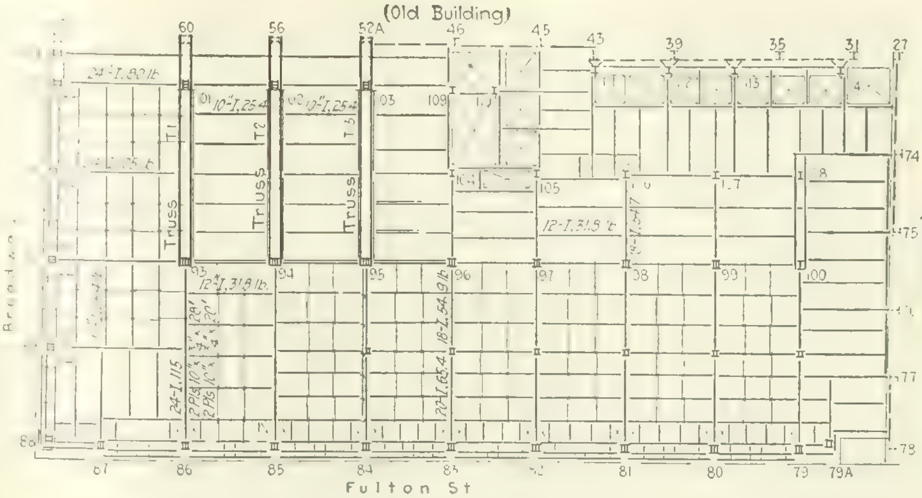


FIG. 2. POSITION OF CANTILEVER TRUSSES IN THIRD-FLOOR FRAMING PLAN

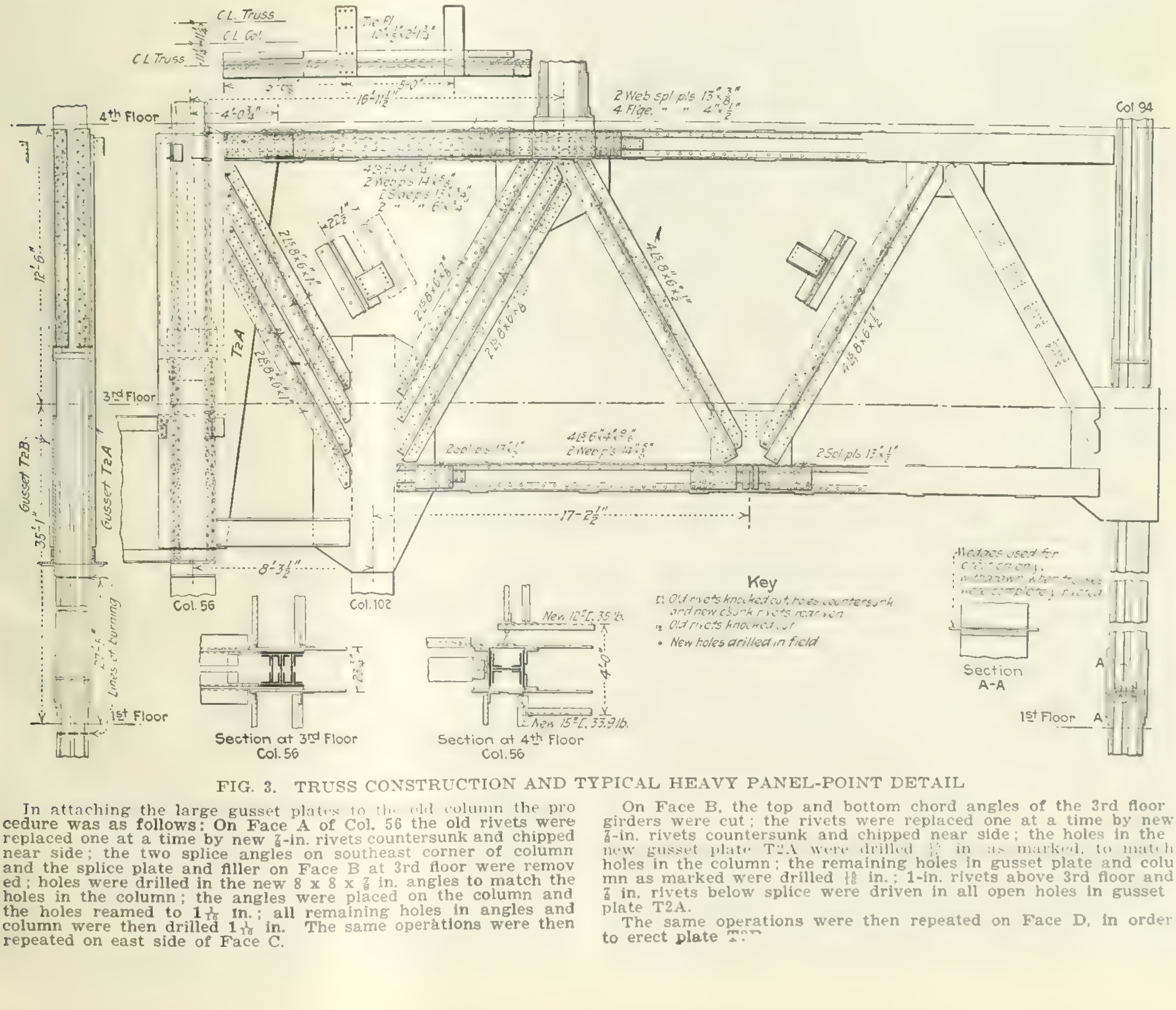


FIG. 3. TRUSS CONSTRUCTION AND TYPICAL HEAVY PANEL-POINT DETAIL

In attaching the large gusset plates to the old column the procedure was as follows: On Face A of Col. 56 the old rivets were replaced one at a time by new ⅞-in. rivets countersunk and chipped near side; the two splice angles on southeast corner of column and the splice plate and filler on Face B at 3rd floor were removed; holes were drilled in the new 8 x 8 x ⅞ in. angles to match the holes in the column; the angles were placed on the column and the holes reamed to $1\frac{1}{16}$ in.; all remaining holes in angles and column were then drilled $1\frac{1}{16}$ in. The same operations were then repeated on east side of Face C.

On Face B, the top and bottom chord angles of the 3rd floor girders were cut; the rivets were replaced one at a time by new ⅞-in. rivets countersunk and chipped near side; the holes in the new gusset plate T2A were drilled $\frac{15}{16}$ in. as marked, to match holes in the column; the remaining holes in gusset plate and column as marked were drilled $\frac{15}{16}$ in.; 1-in. rivets above 3rd floor and ⅞ in. rivets below splice were driven in all open holes in gusset plate T2A.

The same operations were then repeated on Face D, in order to erect plate T2B.

members were made of eight angles arranged in pairs. Two 1¼-in. gusset plates were used at each joint. All truss rivets were 1-in. The members were fabricated from steel templets, the gusset plates being used for this purpose. They were assembled in the shop and all holes reamed to a true fit.

Making the cantilever connection to the old building columns was the most serious problem of detail. Two 1¼-in. plates were used to effect this connection. As these columns had to carry their full load for the whole time it was necessary to proceed carefully and not to cut more rivets than necessary. The procedure given on the erection sheet (Fig. 3) lays this out in great detail. The plates were drilled in the shop with holes for the column connection only, the truss member connection being left plain for fitting in the field. In the case of Column 56, where two girders frame into it at the third floor, the plates were made long enough to act as two wedges were inserted, which were tightened by screw jacks as the column was lifted. These wedges tapered 1:16, and their motion gave an accurate measurement of the amount of lifting done. The readings of the jack pressure gages gave an accurate measurement of the total load on the columns.

The anchor arm columns (93, 94 and 95) were detailed with a special splice at the first-floor level to allow the back arm to hang free. The splice plates were attached to the lower sections; the upper sections were left plain for the length of the splice plates. An opening of about 1½ in. was left between the upper and lower sections to allow play. To secure this opening, the columns were erected on temporary wedges, and when the trusses were completely erected and riveted these wedges were drawn, leaving the back arm hanging free. The load of the old building columns would then be relieved gradually as erection progressed.

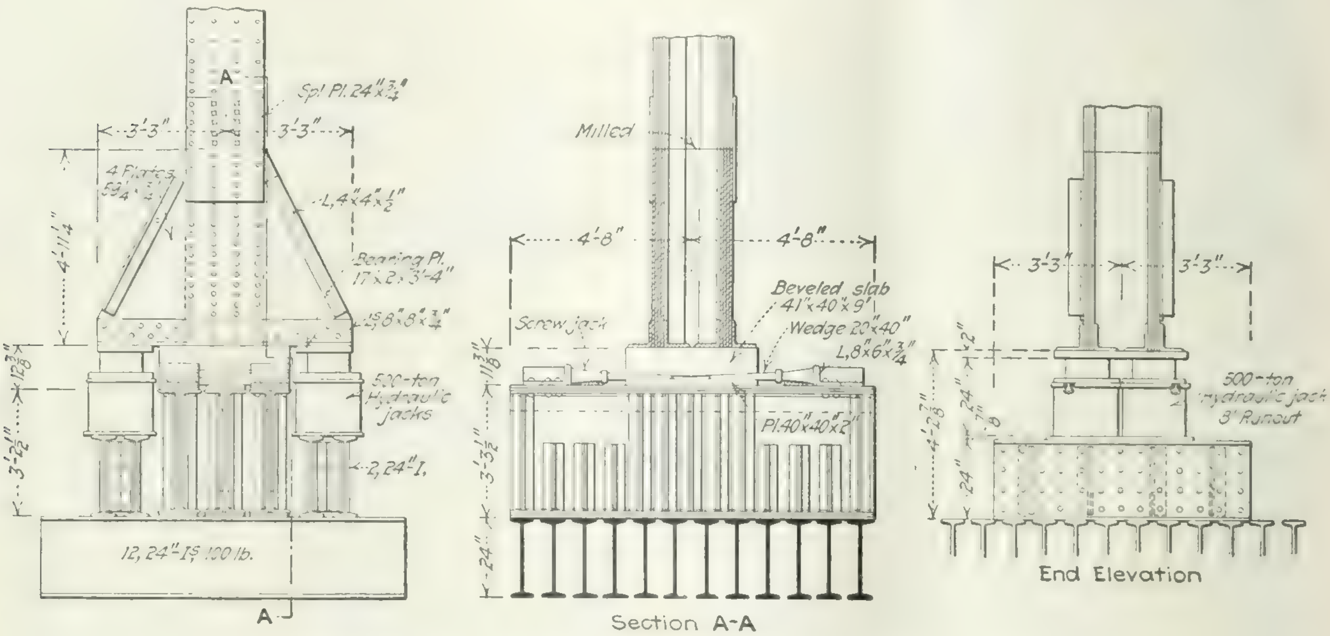


FIG 4. PROVISION FOR JACKING FULCRUM COLUMNS TO TAKE UP COMPRESSION

hangers to carry these girders, since a column splice coming between did not have the necessary strength to permit using the column as a hanger. Col. 52-A stops at the third floor under a skylight and carries two girders. In this case the plates were made long enough to pick up the column from the fourth floor, the column section itself being used as a hanger to carry part of the load.

Taking Up the Elastic Distortion—The fulcrum point of each truss had to be kept at constant elevation throughout the operation. As the load on the trusses increased, the fulcrum columns (Cols. 101, 102 and 103) would compress; and, correspondingly, the old building columns would lengthen as they were relieved of their load. This would tip the system. To offset such effect, the fulcrum column was raised when found necessary to maintain its level. This raising was done by the use of four hydraulic jacks under each column at the grillage.

Four 500-ton jacks were therefore placed under Cols. 101 and 102 and four 200-ton jacks under Col. 52-A. They rested on the lower layer of grillage and received the load of the column through wing plates. The heavy slabs of the permanent column bases were beveled and

As soon as the trusses were erected, the first-floor splices of the old columns were cut, leaving these columns free to be lifted off their bases at that level without lifting the basement load. The relieving of these columns was observed by extensometer readings, in connection wtih extensometer readings on the truss members. When these readings showed that all load was out of the first-story sections of the old columns, the gap in each anchor column at the first-floor splice was closed with fillers, the column was drilled to fit the holes in the upper half of the splice plates, and these splices were riveted. The old columns were not burned off immediately, but were left in place till sufficient load was erected on the back arm to give a big factor of safety.

In erection the cantilever gusset plates were attached to the old building columns before any other steel was erected. As the truss connection of these plates had been left plain for fitting in the field, the end posts were first fitted to the fulcrum gussets and the cantilever gussets then drilled to match the posts The connection was then riveted, whereupon the rest of the truss members could be erected in order.

Operation Checked by Strain-Gage Readings—Ex-

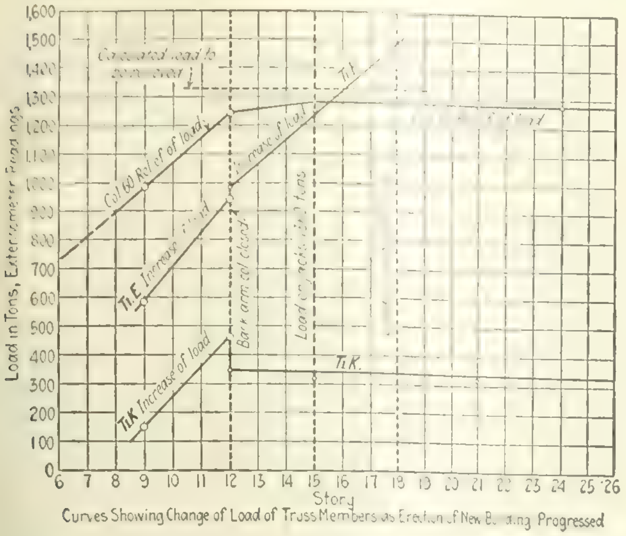


FIG. 5. LOAD TRANSFER MEASURED BY STRAIN-GAGE

tensometer readings were taken on all members and supporting columns before any load was on, before the back-arm wedges were drawn, after these wedges were drawn, and thereafter as increments of load were added, using the material shipments of three stories each as a basis of the weight calculations. The extensometer used was a 20-in. Berry strain-gage reading to 0.0001 in. The points were marked by $\frac{1}{16}$-in. round holes drilled to such depth that the point of the instrument would not reach the bottom of the hole. Four readings were taken on each member to give a good average.

In taking such extensometer readings various difficulties are likely to result from the natural conditions of the work. As instanced in this case the temperature cannot be measured with any accuracy, since the different members or even different portions of the same member vary in temperature due to pouring of concrete, streams of water flowing near a member, partial exposure to the sun or other causes. To illustrate the range of temperature conditions: the initial readings were taken at the end of July, at a temperature of 92 deg. F.; by the time of the next measurement a tier of steel had been added and floor arches were in process of pouring, so that the columns were in the shade; the last set was taken in December, after the building had been enclosed, at a temperature of 52 deg. F. Difficulty was met in the unusual amount of dirt that would clog up the gage-point holes, the holes were cleaned with waste and oil before each reading, but this did not eliminate the inaccuracy entirely. Nevertheless the extensometer readings were fairly accurate and served excellently to check the calculated stresses.

Levels were maintained daily on the fulcrum point of each truss, and the fulcrum columns were jacked into position from time to time.

The wedges in the anchor columns were drawn when the trusses were completely riveted and inspected. By this time the sixth-floor steel had been erected and much steel was lying on the deck, so that the back arms were cut loose under a load corresponding to steel up to the ninth floor. The fulcrum column was held on the jacks at the proper level, while the wedges were withdrawn gradually from the four sides in rotation to avoid a shock. The levels showed a drop of $\frac{1}{16}$ in. at the truss fulcrum point, which was immediately taken up on the jacks. The splices were filled and riveted at the time when the old columns were completely relieved, as indicated by computation, checked by the extensometer. This time was, in the case of Trusses 1 and 2, when erection had proceeded to the twelfth floor and floor-arch construction to the eighth, and in the case of Truss 3 when steel was erected to the twelfth floor with arches to the fifth.

The jacks under the fulcrum columns had to be removed earlier than was desirable, because of the cofferdam bracing which framed into these columns. A concrete engine bed, which carried up to Basement "C" was to be placed near these columns, and the floor beams for the basements below had to be framed between the columns and this bed. As the jacks occupied part of the space where this engine bed was to be put, the pouring of this mass was omitted and the basement beams framing into it were left out till it became necessary to put them in. This was done at the last

FIG. 6. OLD COLUMNS READY FOR LIFTING TRUSSES

possible minute short of delaying the job. The cofferdam was held on temporary wooden shores during this time. It therefore became necessary to take the jacks out before the transfer was finally completed.

Column 52-A was cut when erection had proceeded to the 26th floor, with floor arches built to the 20th floor. A new set of extensometer readings was taken on the section before and after burning. Level readings on the cantilever end showed no deflection, but the extensometer showed a remaining load of about 50 tons in the column. Column 60 was cut when the steel was entirely erected, all floor arches in and the old building wall partially removed. The burning was a much longer job in the case of this column and in that of Column 56, as it was necessary to burn out a 6-in. length to get at the center web. The level showed a drop of slightly less than $\frac{1}{16}$ in. Column 56 was cut two days after Column 60 and showed the same results.

The work was most successfully accomplished. The following were instrumental in carrying it through: Welles Bosworth, architect; S. C. Weiskopf, consulting engineer; Marc Eidlitz & Sons, Inc., builders; Post & McCord, Inc., steel contractors and erectors.

A Rational Approach to the Licensing Problem

An Effort to Suggest a Viewpoint and to Formulate the Principles that Should Govern Consideration of the Problem

An Editorial Discussion

EVERYONE has heard the adage about not being able to see the forest because of the trees. It is a situation of this sort that has complicated the thinking of many engineers on the licensing question. They have found themselves almost overnight in the midst of the problem, touched closely here and there by special phases of it, but so far as they have been able to see, wholly unaffected by others. It has been difficult for them to grasp the entire scope of the subject, to explore its recesses, to skirt its boundaries.

What follows is designed to offer a viewpoint and to indicate an approach for those who would broaden their thinking on the question. It is not intended to be a definitive and exhaustive discussion leading to an inevitable and rigid conclusion. It is intended to present an airplane view of the forest rather than to plot its contour by metes and bounds. It aims only to focus attention and to provoke thought.

To begin with, we would submit the principle that the question of licensing engineers under the law is essentially a public and not a professional question. It concerns an exercise of the police power of the state to protect its citizens against exploitation or injury that they individually would find it difficult or impossible to avert. Laws are not properly made to subserve the interests of any profession or vocation. The enactment of such laws would constitute class legislation, and as such violate the spirit of our institutions. The benefits that might be derived by engineers from the operation of a licensing law is, therefore, not a legitimate argument for its enactment and will avail nothing with conscientious lawmaking authority. There is, then, but one question to be answered. *Does the public interest require that the right to follow the vocation known as engineering be restricted and regulated by the state?* Unless we can answer yes to this question there is no case for licensing, whatever might be its influence on the interests of the profession and those that compose it.

To answer this question we must begin by asking other questions. What, for example, do we mean by the "vocation of engineering"? How does it touch the public interest? By what form of regulation can that interest be most effectively safeguarded?

* * *

In some of the licensing laws that have been enacted an effort has been made to describe the activities of the "professional engineer." The result of that effort is the following, extracted from one such law:

"Professional engineering" means the practice of any branch of the profession of engineering other than military engineering. The practice of said profession embraces the design and the supervision of the construction of public and private utilities, such as railroads, bridges, canals, harbors, river improvements, lighthouses, wet docks, dry docks, ships, barges, dredges, cranes, floating docks and other floating property, the design and the supervision of the construction of steam engines, turbines, internal combustion engines and other mechanical structures, electrical machinery and apparatus, and of works for the development, transmission or application of power, and the design and the supervision of the construction of municipal works, irrigation works, water supply works, sewage works, drainage works, industrial works, sanitary works, hydraulic works, structural works and other public and private utilities or works which require for their design or the supervision of their construction such experience and technical knowledge as are required by this Act.

We question the value to the public of a licensing certificate that professes to vouch for its bearer as competent to undertake this comprehensive and diverse lot of activities. And if the bearer of the certificate is not competent to perform them all how is the client to know which of them he is qualified for? How, under this license, is a designer of gas engines to be prevented from attempting to design a motion-picture theater? And if the client must go behind the license and satisfy himself by other means as to the competence of the engineer to handle his particular piece of work, of what avail is the license? We would submit as a second principle, that if the state undertake to vouch by license for the technical qualifications of an engineer it should define accurately the type of engineering work it has found him competent to undertake.

* * *

Having examined the fields of work ranged by the "professional engineer," we may next try to define the activities of the individual engineer in those fields. Unfortunately, the word "engineer," even when limited to a particular field, does not convey a clear-cut and definite image. We need not be detained here by its traditional use to describe the locomotive engineman and the operator of other machinery, but will consider only those who may be included under the term "professional engineer." Who are they? How may we define them? The word "engineer" has come to define a general type of education and training rather than a vocation. Those who have received such an education and training may be found employed in any one of three classes of engineering work.

The first, by far the greatest of the three, includes those that have no ultimate technical responsibility. Their titles may range from "tracer" or "rodman" to "deputy chief engineer." Their distinctive characteristic is that their judgment and their work are subject to technical review and technical direction by superior technical officers who assume full technical responsibility for them.

The second is made up of those upon whom rests ultimate technical responsibility. These men report in general to laymen or to lay boards or commissions, who are unqualified to pass judgment on technical matters and who, in consequence, are wholly dependent on the technical skill and judgment of their advisors. This class divides into two groups. In the first is found the engineer that is employed, usually for his full time, at a salary. He is part of an organization and often performs, in addition to his technical services, certain administrative duties. His title usually is "chief engineer." The second group of the class includes the "consulting engineers" as that term is broadly used to describe the independently practicing engineer who will undertake for a client, on a fee basis, investigations, designs, or the supervision of works. In general such men are essentially specialists, without executive responsibilities, but having ultimate technical responsibility.

The third class includes those that apply their engi-

neering training and talents to a business, industrial or mercantile, in which they are predominantly interested in the commercial aspect. They may be contractors, manufacturers, or salesmen. In general, this class is not included under the operation of licensing laws.

We cannot see that the state licensing of all the engineers employed on a certain piece of work or in a certain industry would be either necessary or desirable. As in every enterprise there is some individual who bears ultimate technical responsibility, why should the state extend its voucher beyond this person? If it does, where should it draw the line? We are inclined to formulate as a third principle that any licensing requirement should apply to those engineers only who are called upon to bear ultimate technical responsibility. It is possible that this is the intent of some of the laws already enacted but much uncertainty prevails concerning it.

* * *

Obviously, the work of some of these men touches the public welfare and security, and its conduct is legitimately a matter of public concern. But in seeking to conserve the public interest in this respect, we must avoid being misled by the analogy so often drawn between the engineer, on the one hand, and the doctor and lawyer on the other, both of whom practice subject to license but for reasons that have scarcely any bearing on the case of the engineer. Reasoning by analogy is quite legitimate provided the analogy is sound. But the assumption that because doctors, lawers and engineers are all "professional" men, that which may be desirable or necessary in the case of the first two is also desirable or necessary in the case of the last, is not "reasoning" at all. It is simply an illogical and slovenly mental process that seeks, for one cause or another, to avoid reasoning. And this process has been responsible for much of the loose so-called "thinking" on the licensing question.

The doctor and the lawyer, in the main, both deal with the individual. Every man, woman, and child is a prospective client of the doctor and the lawyer. However poor, illiterate, or ignorant, any citizen may at any time require the services of a doctor or a lawyer. When he enters the office of the man who displays his shingle as a doctor or lawyer the plain citizen has the right to feel that this man has been vouched for by the state. There is no other way to protect him. The state cannot examine and approve the prescriptions of the doctor; it cannot scrutinize the briefs of the attorney, for these may involve intimate personal matters in which, indeed, the state may be at odds with the individual. The citizen, in general, has neither the time, the ability, nor the resources to investigate the qualifications or standing of this individual into whose hands he is about to entrust his liberty, perhaps, or his very life. So in lieu of a more effective method, public policy demands that the doctor and the lawyer receive the seal of the state before they offer their services to the general public.

But do these considerations apply in the retaining or hiring of an engineer? We think not. From the very nature of the case, those who seek the services of an engineer possess capital or command capital. They are, in general, responsible and of substance. They may be assumed to have the intelligence, the resources, and the time to determine the fitness of an engineer to counsel them wisely and to handle their property with technical discretion. The standards of their investigation will probably be higher, and will certainly be more specialized than any that might be prescribed by the state in any reasonable licensing law. We would submit, then, as a fourth principle, that there is little if any ground for licensing engineers in order to protect their employers against charlatans.

* * *

Yet, as has been pointed out, certain works usually carried out under the direction of, or according to the plans of engineers may have a bearing on the public security quite aside from the interests of those who own them. Buildings and public works of many sorts will come under this head; it is unnecessary to go into detail. Carelessness or incompetence here may have a far-reaching public effect. That this is recognized is indicated by the enactment of building laws and other protective measures designed to provide technical supervision by the state over certain structures and appliances, failure of which would create public peril.

But before leaping to the conclusion that this situation demands the state licensing of engineers we must answer these questions: Are present laws for the protection of the public against such failures inadequate? Has state supervision over plans and operations been carried to its maximum usefulness? Does the public safety demand that the state go back of the work itself and certify to the competence of all those who may be called on to plan and execute such works? Will the net results of such a procedure measured in increased public safety justify the labor and expense involved in its administration? From all of this we would formulate a fifth principle: If the state is to license engineers it should confine such licensing to fields which have been shown by experience to harbor possibilities of public peril, and which cannot be more effectively supervised by other methods. In this connection we should remember also that many failures of engineering structures have resulted not from faulty design but from faulty execution, so we would submit as a sixth principle that if the state is to license engineers at all it should provide for supervision of work by licensed engineers from plan to completion. Experience has demonstrated the futility of adequate designs in the face of incompetent inspection.

* * *

To summarize the principles that have been here laid down we submit the following:

1. Licensing must be justified wholly on the ground of the public welfare and not at all on that of professional advantage.
2. To be of value to the public a license must define accurately the kind of engineering work in which the licensee is qualified.
3. The requirement of license need apply only to those having ultimate technical responsibility.
4. Licensing is not required to protect those who need the services of an engineer against imposition by charlatans.
5. Public protection by licensing should be considered only for those fields in which experience has demonstrated the possibilities of a public peril that cannot be more effectively provided against by other methods.

6. Public protection by license should cover every phase of the fields so protected in order to insure unbroken technical responsibility from inception of plan to completion.

We believe that if the licensing of engineers is to be justified it must be established on the basis of these principles. Some of them have been observed in some of the laws that have already been enacted. We are persuaded that the closer the licensing movement clings to the requirements of public policy and the more nearly it conforms to all these principles, the more likely it is to accomplish the public service that is the avowed purpose of its advocates.

Defends Licensing of Engineers

Urges Need of Laws for Protection of Qualified Engineers and the Public, and to Make Engineering a Real Profession

By Harry Tucker
Professor of [illegible]
North Carolina State College of Agriculture and Engineering

DURING the past few months *Engineering News-Record* has contained letters and editorials on the licensing of engineers, some of which have not been favorable. It is believed that most of these criticisms arise from a lack of appreciation of the need for registration laws. For two years the writer was secretary of a state society of engineers and had an unusual opportunity to become thoroughly familiar with conditions in the engineering profession in this section of the country. Based on these, the most important needs for registration of engineers are: First, for the protection of the qualified engineer; second, for the protection of the name "engineer"; third, that the standards of the profession may be raised; fourth, for the protection of the public.

It is not possible here to discuss fully each of these reasons. Suffice to say that, before the enactment of registration laws in certain states, many persons practiced engineering and styled themselves "engineers" who, apparently, had no qualifications for the profession. To cite instances; plumbers and steam fitters advertised their firms as "expert heating engineers," wiremen called themselves "electrical engineers," many land surveyors styled themselves "civil engineers," and nationally known manufacturers advertised their agents as "heating and sanitary engineers." These are not isolated cases; they were all too common in this section. There would, perhaps, be no serious objection to these men using the word "engineer," except that they were qualified neither by experience nor education for the profession. They simply thrust themselves bodily into the profession, and made a bid for strictly professional engineering work, often in competition with highly qualified real engineers. In view of this is it any wonder that there has been confusion in the public mind as to just what is an engineer? It would seem that in fairness to the qualified engineer, a suitable standard should be set up for his profession.

The ease with which any one can enter the engineering profession will not be discussed at length here. A letter from "A Civil Engineer's Wife" in *Engineering News-Record*, May 25, 1922, p. 883, gives a typical instance. Many similar instances in this section might be cited. Is education and extended experience necessary to make a good engineer? Undoubtedly yes. But many men have left the grammar school, worked as rodmen for a year or two and then entered upon the *practice* of engineering as an "engineer." It is granted that a technical education is not always necessary to success in the field of engineering. But certainly, without at least a good high school education, a broad experience, coupled with natural ability, is necessary for engineering success. Those who, without natural ability, education or broad experience, enter the engineering profession, lower its standard in the estimation of the public by just that amount. Is it not just to require a man to be duly qualified before entering a profession so important as that of engineering? We boast of the importance of our profession, of the highly technical requirements of a successful engineer; we have great schools for the education of engineers, to fit them for the profession; but in the eyes of the public the profession is one that can be entered by any one upon payment of the general professional license tax in some states, and by merely styling oneself an "engineer" in others.

That the public needs the better protection afforded by licensing is all too evident. Any well-informed engineer can recall many cases of public money wasted by inefficient engineers; many failures of engineering structures due to faulty design; and of the loss of life through such failures. It is not claimed that perfection in engineering works will be attained through licensing. Unfortunately, mistakes will always be made; and more so in engineering where we are building with the successes and failures of our predecessors so much in mind. But engineering works designed and directed by competent engineers are surely more likely to be successful than those built by incompetent engineers. And remember that the main reason for licensing engineers is to set a standard which the would-be engineer must attain before entering the profession.

Every one who has the interest of the profession at heart must admit that there are certain practices carried on by some engineers that are not strictly ethical. Most of these unethical practices may be attributed to the pseudo-engineers. There is the salesman who acts as engineer; the man who is both engineer and contractor on the same job; the material supply man; the manufacturing company that sells engineering products and at the same time undertakes the engineering. Certainly not all such engineers are guilty of unprofessional practice; but in these situations it is easy to infringe the provisions of any satisfactory code of ethics. How can these practices be corrected? The most feasible suggestion is that the engineers formulate a code of ethics, even as the professions of law and medicine. However desirable this may be, a code of ethics will hardly be of much service unless its provisions can be enforced. How can this be done? Through engineering societies? How many of the men guilty of violating such a code of ethics would belong to the societies? Without a means of enforcing its provisions a code of ethics is worthless to correct unprofessional practice. One great advantage to be derived from licensing laws is the means for determining who are engineers, and of setting up standards and rules of conduct. With the enactment of such laws, engineers will be in a position to enforce the provisions of a suitable code of ethics.

That license laws will accomplish any good either

for the engineers or for the public has been questioned by eminent members of the profession. The actions of the Boston and Baltimore engineers indicate the feelings of certain groups. It has even been claimed that the licensing of doctors and lawyers has resulted in no advantage to the professions and the public. This contention has been admirably answered by F. F. Carmiencke, engineer for the Willys-Overland Company, in a letter published in *Engineering News-Record*, March 30, 1922, p. 540.

In this section criticisms of license laws have come from three sources. First, from eminent engineers who have risen high in their profession. These engineers cannot see any need for registration laws. Certainly, they believe that such laws will be of no advantage to themselves. It is believed that this criticism is based largely on selfish considerations. These engineers usually belong to technical societies and see in such societies the means of furthering the good of the profession without license laws. They overlook the fact that there are thousands of engineers just beginning the struggle for existence in the profession and that these young engineers are the ones who later on will answer for the mistakes of the profession. These engineers have also criticized the manner in which the various laws are applied. Those who criticize the application of the laws must remember the difficulties with which the various state boards are confronted. Many of the laws are not perfect, and tedious questions of qualifications and classifications must be considered. It is not possible always to carry out the provisions of any law to the satisfaction of all concerned. Time is needed to perfect their workings. It might be noted that the various engineering examining boards are striving to perfect their organizations so that the full benefits of the license laws may be obtained. It must also be remembered that the benefits of such laws will not always appear immediately. The laws furnish merely the machinery by which the standards of the profession can be raised. The process is strictly one of evolution.

Secondly, criticisms of license laws have come from pseudo-engineers, and those who are not competent to qualify for the practice of engineering under the existing laws. These criticisms, to a certain extent, point the need for such laws. Fortunately, critics of this class are few. Most of those to whom registration has been denied because of lack of engineering education or experience, have accepted the decision of the examining board without question; and many of them have taken steps to gain the education and experience necessary to meet the requirements. This is a further indication that the licensing of engineers will tend to raise the standards of the profession.

A third class of critics consists of certain public officials and citizens; the officials fearful of the growth of the movement for the licensing of all professions; the citizens afraid that, under licensing laws, an engineers' "trust" will be created and that the public will be held up for increased engineering fees. Every effort should be made by engineers to discountenance even a suspicion that their desire to better the profession through license laws is really an aim to create a "trust." It is believed that this criticism is wholly unfounded.

It is unfortunate that there should be any division of opinion among engineers concerning this movement. That there is considerable division is all too evident. The writer believes absolutely that such laws are needed. The question should be thoroughly discussed among the engineers themselves and a unanimity of action be obtained. It must not be forgotten that the proponents of these laws see in them a means for making the profession a real *profession;* and this can only be done by setting up standards which all must pass in order to enter the profession. Except in those states that now have registration laws, there are no standards. It is believed that the registration laws provide the machinery for fixing such standards.

Concrete on Seattle Stadium Fill Did Not Crack

WHEN THE University of Washington stadium was completed near Seattle, Wash., eighteen months ago, an article was prepared for *Engineering News-Record* (Feb. 24, 1921, p. 326) explaining how an earth fill 36 ft. high in places had been built and a concrete surfacing placed upon it immediately without allowing any time for the fill to settle. An editorial accompanying the article suggested that after a year had elapsed there would be better opportunity to judge whether the builders were justified in their claims of the stability of a fill made in this way.

In order to report the present condition of the concrete placed on the fill, R. H. Thomson, for many years city engineer of Seattle and now well known as a consulting engineer of that city, was asked to inspect the stadium and report his observation to editors of *Engineering News-Record.* Colonel Thomson wrote under date of June 9 that he had just made a careful examination of the structure throughout without finding any defects. He says:

"I followed this work during construction with more than ordinary interest because of the novel methods used. W. C. Morse, one of the engineers in charge made the assumption which was accepted by the contractors, that he could forecast the length of time which must elapse before the final settlement of the fill. The curve of actual settlement was carefully checked with Morse's curve of anticipated settlement with the result that the final time required corresponded to within 36 hours and the depth to perfection.

"In order to allow for any settlement which might occur, every third riser was divided so that if settlements did occur the upper part of the riser might tilt back on the lower part and the settlement would be taken care of by the opening of the expansion joints on the face of the riser. This expansion was also placed with the thought of caring for any thermal stresses. In construction the edges of these expansion joints were not tooled and in many places the final brushing of the surface of the concrete put a skin coat over them. In some parts this skin coat has been split by an irregular hair line which to one not acquainted with the form of construction might appear to indicate a defect in or a settlement of the structure but careful instrumental levels fail to reveal any settlement more than 1/100 of 1 in. Critical examination made after the expiration of eighteen months has failed to reveal any defect of construction due to settlement and justifies the prosecution of the work by the methods adopted."

Santa Fe Ry. Has Large Steel-Frame Shop with Glass Walls

Glazing Outside Structural Framing—T-Columns Carry 250-Ton Crane—Folding Track Doors—Repair Pits and Floor Track Construction

EXCEPTIONALLY effective daylight lighting throughout a large new locomotive repair shop, 239 x 604 ft., on the Atchison, Topeka & Santa Fe Ry., has been obtained by the use of glass side walls, supplemented by skylights and by large window areas in the concrete end walls. As the steel sash is placed outside of the wall columns it forms an unbroken glazed surface extending from sill line to roof and for the entire 604-ft. length. This building, of steel frame construction, is the most important feature in the enlargement

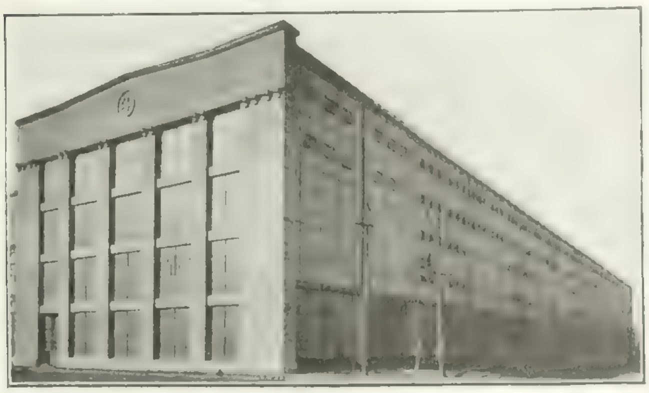


FIG. 1. MACHINE SHOP WITH GLASS WALL 6[illegible] [illegible] FT.

of the railway company's locomotive and car repair facilities at Albuquerque, N. M. The general views Figs. 1 and 2 show the exterior of the building and the well-lighted appearance of the interior.

Improvements at this point were undertaken early in 1921, having been delayed during the war and the period of government control of the railways. The steel-frame repair shop or machine shop is the most important feature of the work, but with it will rank a large boiler shop 135 x 415 ft., which is to be built later to replace the old machine shop, these two large shops being served by the transfer table in the space between them. In addition to the new machine shop there have been built seven smaller structures, all of which are of reinforced-concrete construction with steel sash and steel doors. These include a flue shop, 46 x 196 ft., power house extension, 78 x 126 ft., waste cleaning shop, cab painting shop, pattern shop, babbitt shop and fire department headquarters. The views of the flue shop, Fig. 3, show the typical design.

Repair Shop Layout—As shown by the general plan, Fig. 4, and shop plan, Fig. 5, an electric transfer table serves the new machine shop, which has 29 transverse tracks, with engine pits in 26 tracks. Two push-car tracks at the east end, for handling material, are connected with a yard track. At the west end is a third push-car track. All are stub tracks, except that the east end push-car tracks are connected to a yard track and the middle engine track is extended through the building and into the adjacent roundhouse. Two of the stub tracks also extend beyond the building to the tire shop and babbitt shop. Engine repair pits, spaced 22 ft. c. to c., are 63 ft. long, with the end 7 ft. from the side wall fronting on the transfer table.

Reinforced-concrete footings constitute the foundations, as shown in Fig. 6, piles being used under columns carrying heavy loads. The soil is sand, with muck below. In the bottom of each footing are four layers of bars for lateral and diagonal reinforcement. Anchor bolts attached to anchor plates and set in 4-in. pipe sleeves are embedded in the concrete, the sleeves giving space to permit adjustment of the bolts to fit the holes in the column base plate. As the concrete was placed the pipe sleeves were jarred and moved up and down to prevent adhesion and when the concrete had set the sleeves were removed. After the column had been secured in place the bolts were grouted into the 4-in. holes. Rough concrete is covered with a 1-in. layer of cement grout which is finished off at grade line and upon which the column base plate is laid.

Structural Design—In its width the shop is divided into four bays, as shown in Fig. 6. Adjacent to the transfer table is the 90-ft. erecting bay, 57 ft. high, in which the repair pits are located. Beyond this are the 65-ft. heavy machine bay, the 40-ft. light machine bay and the 40-ft. bench bay, all of which except the last are 35 ft. high. A balcony or upper floor extends the full length of the bench bay, and a mezzanine floor 88 ft. long is arranged between the main floor and balcony. Two electric traveling cranes serve the erecting bay, a 250-ton crane above and a 15-ton crane below. The heavy machinery bay has a 15-ton traveling crane, and the wall columns of the bench bay carry

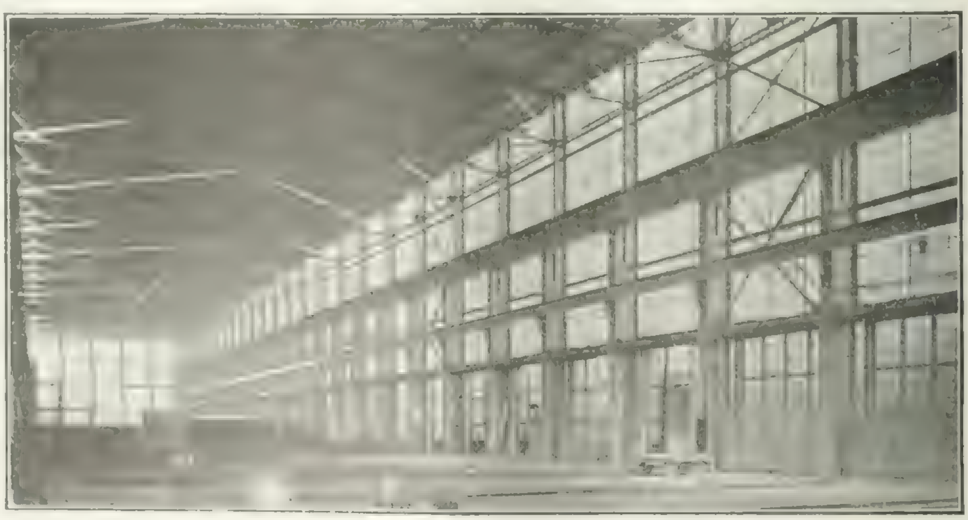


FIG. 2 LIGHT INTERIOR OF SHOP WITH GLASS WALL

the runway girder for a 15-ton yard crane. In the light machine bay is a 5-ton monorail trolley carrier.

Wide columns of T-section are employed in the erecting bay in order to carry the crane girders and to give the necessary stiffness for a structure of this height, braced transversely only by the roof trusses. In the lower portion each column is formed by two plates at right angles to each other with connection angles at their junction and flange angles on the edges, as shown in Fig. 6. In the upper portion the width is reduced by using a 24-in. plate for the stem, the offset forming a seat for the upper runway girders. The I-beam runways for the lower crane are carried by brackets. Other columns are mainly of H-section, composed of a 16-in. web plate, four angles and two 15-in. channels with flanges inward, as shown.

Longitudinal trusses, laid flat and framed between the columns, are placed just above the doorways and at the level of the bottom chords of the roof trusses. Vertical diagonal bracing between the columns is provided at intervals of from three to five panels.

Steel roof trusses framed between the columns carry I-beam purlins. Plank sheathing covered with composition roofing is the only wood work in the construction of the building. Over the three rear or lower bays are transverse steel-frame skylights, one in each 22-ft. panel. These are of A-section, glazed with wire glass and have the upper portions hinged for ventilation. At two points the high roof of the erecting bay is extended over into the next bay, forming rectangular monitors, glazed on three sides, the other side being open to the shop. These spaces form the fan rooms and contain the heating apparatus.

Steel-Sash Walls and Doors—All the steel sash for the side walls is set 4-in. beyond the faces of the outer columns, to which it is attached by means of lugs. The purpose of this unusual arrangement is to simplify the construction as compared with sash framed between the columns, and also to avoid any exposure of the structural steel to the weather. The sash is for panes 14 x 20 in., using factory ribbed glass. The same size and kind of glass is used in the doors, which have bottom panels of steel plate. Fig. 7 shows the sash in place before glazing.

Except for short concrete panels 6-ft. high between the door-ways and the steel plates in the lower parts of the doors, the entire side wall is of steel sash and glass from floor to roof, as shown in Fig. 1. Ventilating sash, operated mechanically, represents about 14 per cent of the wall area above the doors. In most cases the movable frames are pivoted at the middle, but at some points they are hinged at the bottom and arranged to swing inward. These ventilators are operated in groups, as this arrangement minimizes the work of regulation and makes it possible to lock a number of ventilators in the same position with one movement.

Hinged steel folding doors of a novel type are used for the track openings, which are 16 ft. 4 in. wide and 18 ft. high. The opening has two doors, each of which is in two sections which fold together, as shown in Fig. 8. The door rails are of heavy steel tubing, well braced, and having steel plate on the bottom panels and steel sash above. When the doors are fully open they project only about 4 ft. beyond the building. In this position they are latched to bumper posts extending the full length of the doorway and braced to the wall columns. The doors are carried by rollers on overhead runways, so that they are operated easily. Some of these doors are provided with hinged pilot doors 2 ft. 6 in. x 6 ft. 3 in., so that men may pass in and out readily. Steel sash is painted dark green on the outside. All the interior steel work is a light gray, thus adding to the general light appearance of the shop.

Concrete walls for the ends of the building have reinforcement placed to form lintels over the window openings. Dressed and close-fitted wooden forms were used to give a smooth surface and to avoid form marks. After removal of the forms the concrete surface was rubbed down and given a coat of cement.

FIG. 3. INTERIOR AND EXTERIOR OF FLUE SHOP

Repair Pits—An unusual section is used for the engine repair pits, Fig. 9, the width being 43 in. in the lower portion and then increased by sloping the sides to a top width of 48 in., in order to give greater convenience for men working in the pits. The depth below rail head is from 2 ft. 8 in. at the inner end to 3 ft. at the outer end, where a sump and drain are provided. At each end and near the middle are side pockets for power wires, air and gas pipes and electric connections. These pockets are covered with removable steel plates secured by bolts. Above each pocket the concrete curb is reinforced by stirrups and bent rods as shown.

The 90-lb. track rails are seated on ½-in. base plates spaced 30 in. c. to c. and are secured by clips and nuts on U-bolts embedded in the pit walls. No jacking planks are used but concrete is filled against the outside of the rail and leveled off at ½ in. below top of rail. Tracks beyond the pits have the rails laid on concrete stringers, with the same arrangement of base plates

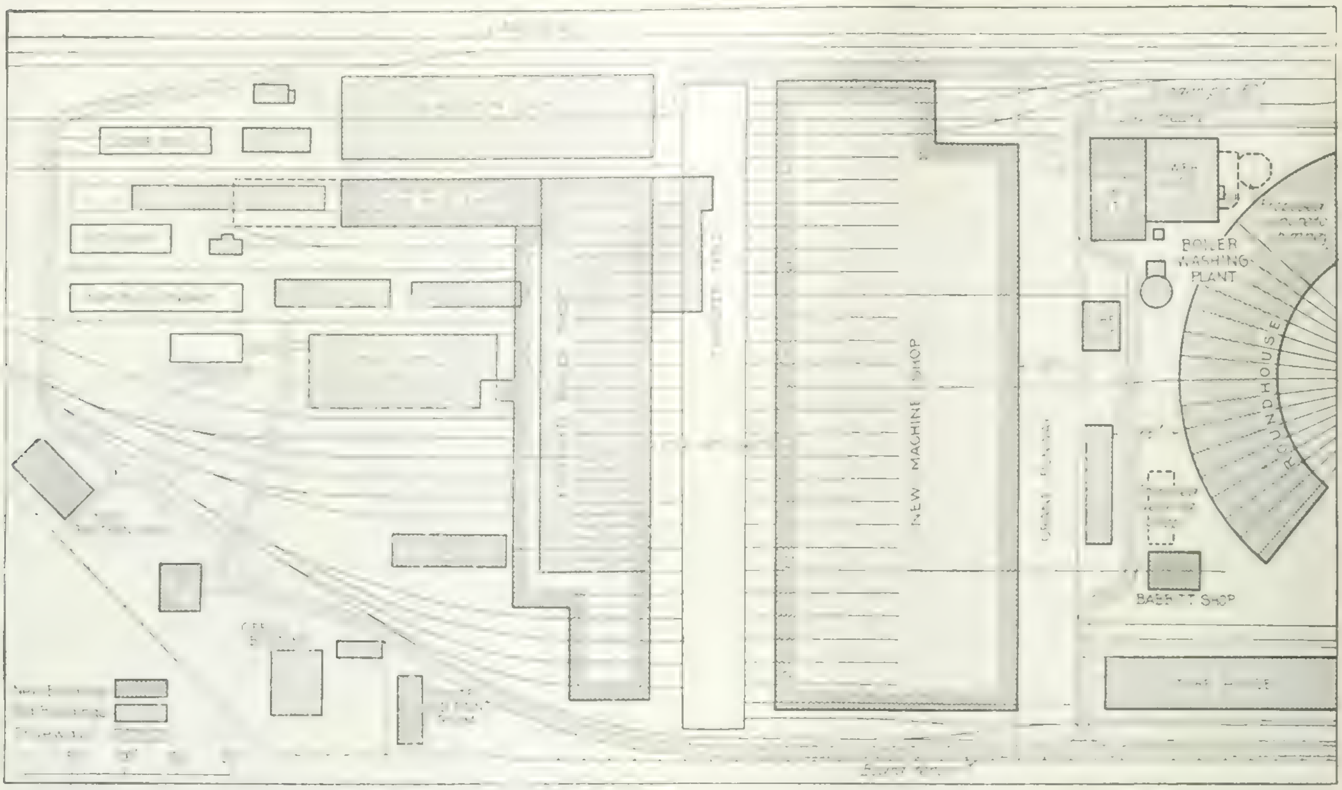


FIG. 1. LAYOUT OF SHOP IMPROVEMENTS AT ALBUQUERQUE, N. M.

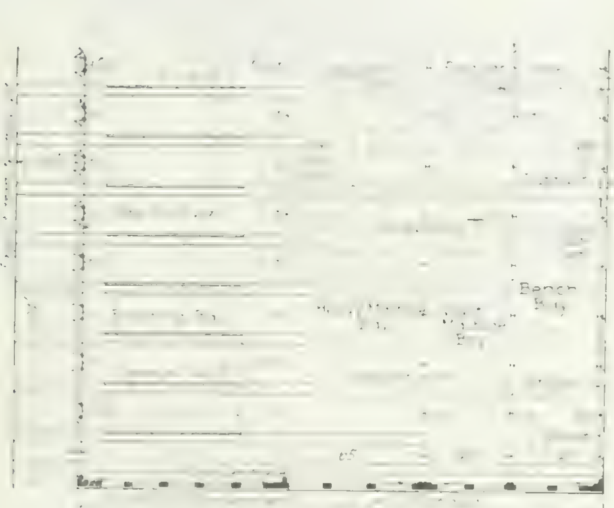


FIG. 5. PLAN OF LOCOMOTIVE REPAIR SHOP

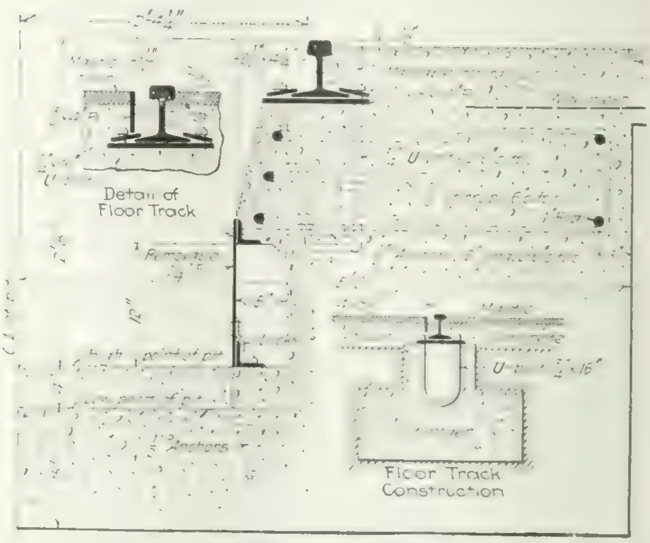


FIG. 7. REPAIR PIT AND FLOOR TRACK

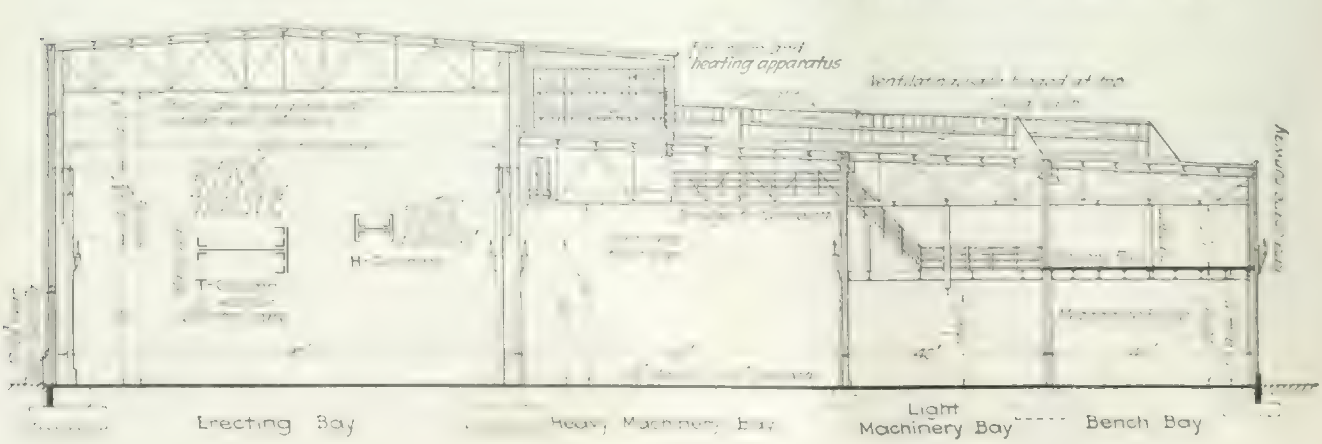


FIG. 6. CROSS-SECTION OF SHOP

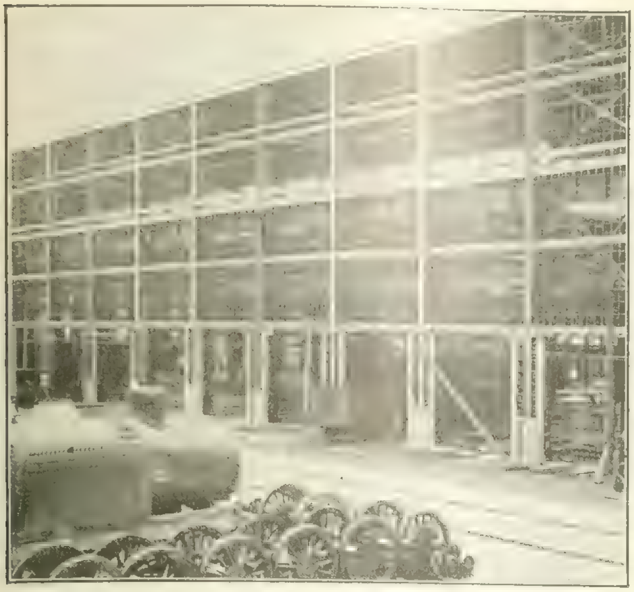


FIG. 8. STEEL SASH OUTSIDE OF STRUCTURAL FRAME

and anchor bolts as described above. Flangeways 1½ in. wide and 1¾ in. deep are formed by flat steel plates set on edge in the concrete, as shown in Fig. 7. The entire floor, except at the pit walls, is covered with 1¼-in. mastic, the surface of which is ½ in. below the top of the rails.

Miscellaneous Features—Hot-air heating is employed, motor-driven fans forcing a current of air over a set of steam coils and then through galvanized ducts. These ducts are laid along the roof trusses and have branches leading down the columns and discharging at a height of 7 ft. above the floor. For electric lighting, the erecting bay has the direct system and the remainder of the shop has incandescent lamps. Sockets for portable lamps are provided in the repair pits.

A framing of 18-in. I-beams and 15-in. channels supports the 4¾-in. slabs of the balcony and mezzanine floors. For these slabs a ½-in. cement finish is used in the wash room and school room, but elsewhere there is a 3-in. treated wood block floor on the concrete slab. On the mezzanine floor are the file room, store room and office toilets, the shop office and general fireman's office being directly below on the main floor.

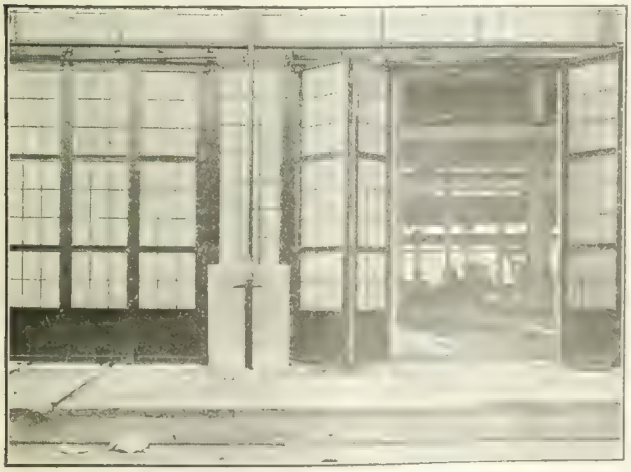


FIG. 9. FOLDING DOORS FOR TRACK ENTRANCES
At left; door closed. At middle; one leaf half open. At right; one leaf full open.

Along the balcony are arranged a tool room, brass shop, electric shop, fan room, school room for apprentices, wash room with 183 faucets over waste sinks and locker room with 864 lockers. There is also a row of 120 lockers in the 6½-ft. corridor which extends the full length of the shop side of the balcony. Partitions and office walls have a steel kick plate 3½ ft. high, surmounted by steel sash and glazing. Stairways and three electric elevators connect the main floor and balcony. The elevator shafts are enclosed with wire mesh, the lower part of which is embedded in a 4-in. wall of concrete to a height of 5 ft. above the floor.

Engineers and Contractors—This large steel shop building and the smaller concrete buildings were all designed by B. P. Phelps, engineer of shop extension, and E. A. Harrison, architect of the Atchison, Topeka & Santa Fe Ry., under the direction of C. F. W. Felt, chief engineer, and John Purcell, superintendent of motive power. The construction was carried out under the supervision of F. M. Bisbee, chief engineer of western lines. Joseph E. Nelson & Sons, Chicago, were contractors for the machine shop, the steel work for which was fabricated by the American Bridge Co. Contracts for the concrete buildings were divided between V. E. Ware, El Paso, Tex., for the power house extension and C. A. Fellows, Los Angeles, Cal., for the miscellaneous buildings. All the steel sash work was furnished by the Truscon Co., Detroit and the special folding doors for the track entrances were made by the Richards-Wilcox Mfg. Co., Aurora, Ill.

These buildings, together with machinery, equipment and the proposed new boiler shop, will represent an expenditure of about $2,500,000.

Engineering Evidence Given in Boundary Dispute

Evidence of engineers was involved in the arguments in the Supreme Court recently in the case involving the boundary between Oklahoma and Texas over the stretch of 600 miles covered by the Red River. The government, appearing as intervener, upheld the contention of Oklahoma that the boundary extends to the extreme flood level of the river to the Texas bluffs, while Texas and various oil interests claiming lands under Texas titles contended that the boundary was at the usual and ordinary level of the river.

The Supreme Court last April fixed the boundary along the south bank of the river and the recent question before the court was what constituted the south bank. Texas contended that if the boundary is fixed as claimed by the government and Oklahoma, that Oklahoma will take from Texas more than half a million of acres of land south of the river with its improvements and a portion containing deposits of oil. It asserted that Oklahoma made no claim to the land south of the low water stage until after oil development began there in 1918.

Surveying and engineering evidence was given by Robert W. Livingston, who, it was said, has been continuously in charge of a surveying party on Red River for two years. The main engineering evidence for the government was given by Major Charles H. Miller, who had 13 years' experience with the Corps of Engineers of the army under the Mississippi River Commission in important work between the mouth of the White River to Vicksburg.

How to Mend the Broken Year in the Coal Industry

Regulation of Output Must Depend on Regulation of Demand—What Consumers Can Do to Deflate the Price of Coal

By George Otis Smith
Director, U. S. Geological Survey

Abstract of address before National Conference of Social Work, Division of Industrial and Economic Problems, Providence, R. I., June 26, 1922.

THE present lack of public anxiety over the coal situation is not at all novel. The average citizen cannot get interested in the coal question in midsummer. Yet disregard of unpleasant facts does not stave off disaster. Nation-wide paralysis of industry and transportation is the natural outcome of a coal shortage if carried to the extreme that cannot be many weeks distant. Serious as the present situation is, however, there are fundamental problems more insistent for solution than even the pending differences between employer and employee. These problems affect the whole coal industry to some degree but especially the bituminous branch. Clear up the economics of the business and a lasting settlement of the labor controversy becomes a possibility; otherwise industrial peace cannot be expected to survive the usual two-year armistice.

What is needed is reform of the business rather than compromise between parties to the controversy. Too long have the mine owners treated the coal business as private privilege and too long have the labor leaders with no less monopolistic attitude obstructed every move for efficiency and economy. The people's coal costs too much because of the mistaken idea that mine owner and mine worker can continue to fight over contracts and rules. Cheaper coal and larger earnings will come when engineering is emphasized more and bargaining less. In terms of engineering, the coal industry has a bad load factor; translated into human relations, poorly functioning mines mean poorly employed miners. A longer working year would seem at first glance, desirable to mine owner, mine worker, and consumer.

Cause of the Trouble—The trouble is not so much the broken year as the broken month, the broken week, and even the broken day. The running time is broken into small pieces, for mine operation is not simply seasonal, it is intermittent. In that theoretical mine of the statistician, the average mine of the country, we find November a longer month than June, by 25 per cent, and June longer than April, by 10 per cent, and yet the working time in a normal November is only 19 to 21 days. And irregularity creeps into the working week and the working day, for Friday and Saturday are normally shorter days than Monday. Granted that the workers in other industries suffer the handicap of seasonal unemployment, our problem, and the national problem just now, is the betterment of the working time of coal mines, and especially bituminous coal mines. The average working time by states and fields shows marked and significant differences. The average year in the southern Appalachian region is a fourth longer than the average year in the Central Competitive district. With 215 days as the average year for the whole country we find a 273 day average year in New Mexico, 247 days in Alabama, and 223 days in West Virginia, as against 202 days in Missouri, 197 days in Illinois, and 192 days in Oklahoma.

Markets, quality of coal, mine costs (including wage scales), and car supply are all factors contributing to these differences in mine employment. Unfortunately, we can gage results better than determine causes; we know the industry to be wasteful, but where are the leaks? The lack of efficiency and the losses due to irregular operation are not universal, for many individual mines work 300 days in the year. Indeed in 1913 when the bituminous mines averaged 232 working days, one-fourth of the half-million men in the industry were employed in mines that worked 280 days or more and nearly 50,000 of them in mines that worked 300 days or more. Our problem, then, is simply to bring the average mine up to the best.

First among methods of mending the broken year is that of stabilizing the coal market. My first practical suggestion for bettering conditions of employment at the coal mine will be addressed to the coal consumer. A more regular market is the first essential, and here is the consumer's opportunity to co-operate. You and I need to buy coal at times when we need it least. Off-season delivery of coal, even to the small consumer, will help materially to make the mine worker's June more like his November. Also, each of us should buy of one dealer, not "shop" for coal. If you or I speculate in our 10-ton purchases of coal, how can we deplore the speculative tendency of our coal dealer and the chain of business hazards thus initiated? Is it not plain that the retail dealer who can depend on his regular trade can himself be a better customer of the wholesaler or the selling agent of the mine? The large consumer can do even more to smooth out the irregularities of mine operation by making long-term contracts, and providing for delivery to suit the mine as well as himself. Such contracts could be made at lowest prices, for with long-term contracts in hand the mine operator could reduce his costs to a minimum. With such a steady market, full year operation and steady employment would become possible—the mine worker would earn a year's wage, and the public would not pay for idleness. That reform, however, must begin at home, not at the distant mine.

The Effect of Regular Demand—With market demands more regular, fewer mines and fewer miners can and should furnish the needed coal. Mr. Peabody as a representative operator admits than one-third of the operating mines represent a burden on the industry, and he suggests their elimination through bankruptcy. Ellis Searles, the editor of the *United Mine Workers' Journal*, admits that 150,000 miners, like one-third of the mines, should be eliminated, and he suggests that they leave the mine for the farm. Mr. Peabody estimates that the idle days of our bituminous mines involve an annual loss to the capital and labor employed of not less than $400,000,000, and I suspect that most of this loss is paid by the consumer.

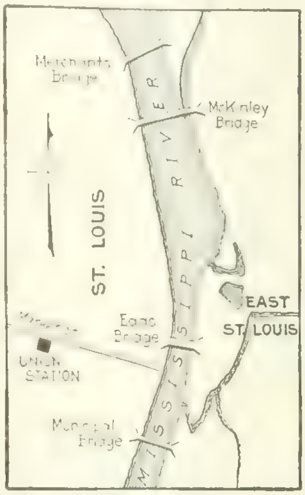
A longer working year for a reduced force is the only possible method of bringing about the lower wage scale and the larger annual earnings, both of which are generally needed. It is largely by reason of the high unit rate of wages that coal costs too much, and on broad economic grounds it may well be questioned whether the producer should be paid a wage out of all proportion with the wage of the consumer. Can a $5-a-day workman afford to buy coal mined by a $10-a-day mine worker?

To hasten this needed deflation, even though it be accomplished through the working of the law of supply and demand, there must be a better informed and more aroused public opinion. Whenever public interest is aroused in the coal question, the defensive note of the coal men is likely to be that appeal for "less government in business," an appeal with which I sympathize so far as governmental regulation might drag politics into business. The political danger that really confronts the coal business is that the leaders in the industry will too long be blind to the trend of the times. Old ways of doing business are not to be the new ways. Our reverence for the privileges and rights of private business is giving way to a new attitude: We are asking what is private business and what is public business. Forced to extremes by private disregard of public interest, this tendency in popular thought may even become dangerous, and Secretary Hoover's recent statement to the operators that "if our coal industry does not govern itself it will surely be governed by the public" was a warning of that danger. So I suggest that if "less government in business" is desired, the best means to that end is *more business in business.* Our best mines are so planned and equipped and operated as to demonstrate how efficient coal mining can be, and a similar statement can doubtless be made of certain units in the merchandising of coal; yet the average coal mine and the average coal yard are far from being gratifying exhibits of that engineering ability or business thrift which we like to regard as typically American.

Recommend Improvements for St. Louis Terminal

Engineers Plan Revision and Unit Operation for Complicated Railway System on Both Sides of Mississippi

UNIT operation of railway terminals and complete rerouting of traffic over the four Mississippi River bridges at St. Louis, Mo., are the high points of a recent comprehensive report by a committee of engineers appointed in 1920 to report to the terminal committee of the St. Louis Chamber of Commerce. This report covers also the terminals of East St. Louis, Ill., which form an integral part of the St. Louis terminal system and industrial district of about 625 square miles. It is pointed out that the improvements are so extensive as to be extended necessarily over a considerable term of years, but it is recommended that a committee representing the railways and the public should be created to provide for the carrying out of these improvements in logical order, with such changes as time may prove desirable.



ST. LOUIS TERMINAL DISTRICT AND ITS BRIDGES

This committee is constituted as follows: F. G. Jonah (chairman, chief engineer of St. Louis-San Francisco Ry.; Harland Bartholomew, engineer of St. Louis plan commission; P. W. Coyle, traffic commissioner, St. Louis Chamber of Commerce; E. A. Hadley, chief engineer, Missouri Pacific Ry.; J. B. Hunley, engineer of bridges and structures, C., C., C. & St. L. Ry.; R. D. Sangster, industrial commissioner, St. Louis Chamber of Commerce; C. E. Smith, consulting engineer for City of St. Louis; F. J. Stimson, chief engineer, maintenance of way, Pennsylvania Lines (Southwest region); D. O. Thomas, consulting engineer for East St. Louis Chamber of Commerce; Charles H. Diehl, secretary. The conclusions and recommendations are summarized below.

Unification — The principle of unification has been retained as far as economically practicable. Passenger traffic is already unified. There should be complete unification of the classification and interchange of cars, which constitutes approximately 85 per cent of the freight traffic. The committee recommends that each railroad should continue to serve the territory local to its own terminals within this district.

Mississippi River Bridges—All passenger trains, except those of the Wabash Ry. which use the Delmar station, should be removed from the Merchants Bridge and from the congested terminals in North St. Louis. The Eads Bridge should be abandoned for railway traffic. The Municipal Bridge should be provided with new approaches and connections to accommodate passenger trains transferred from the Merchants and Eads bridges. The Municipal Bridge should be used also for such freight as can be handled more expeditiously than by other crossings. The McKinley Bridge (electric railway) has capacity for much more freight than it now handles, and should be provided with additional approaches and connections.

The upper decks of the Municipal and Eads bridges should be for highway traffic free of toll, and the highway on the McKinley bridge also should be free. The lower decks of the Eads bridge and its connecting tunnel in St. Louis should be abandoned for steam railway service and utilized for street railway and interurban traffic.

Union Station and Mill Creek Valley — The railroads should acquire additional property in Mill Creek valley south from the Missouri Pacific Ry. to Gratiot St., which will enable the tracks of the Union Station to be lengthened and the approach curves flattened. Engine terminal facilities, coach yards and a yard for making up and breaking up passenger trains should be located west of the station. The station facilities should be improved and the present arched trainshed replaced by a low-roof type of trainshed. In front of the station, Market St. should be widened to form a plaza (as provided by a recent city ordinance) and 20th St. along the side of the station should be shifted south so as to line up with the same street west of Market St., thus eliminating a jog in the street line and giving the Union Station 140 ft. additional frontage on Market St.

Carload Freight—The present system by which each road classifies its own inbound freight for direct delivery to each railroad with which it connects should be abandoned, the interchange of freight between railroads being completely unified. Eight outer group yards should be established at which inbound trains (except local cars) would be stopped and classified and outbound trains made up. Each railroad should continue to serve its own local freighthouses, team tracks and industries. Additional team tracks for joint use of all railways should be provided.

L. C. L. Freight — Freight stations in St. Louis for the east-side railroads are not recommended, but the present system of universal off-track freight stations operated by transfer companies should be extended.

Merchants Bridge Elevated Ry.—This elevated line along the river front should be extended north and south.

East St. Louis—On the east side, passenger trains should follow elevated routes through the congested freight terminals, and a new east-side union station should be built. Freight terminals should also be rearranged to reduce the number of grade crossings.

River Front Development—The river should be straightened north of the Merchants Bridge and the harbor lines south of the Municipal Bridge should be shifted east. The municipal dock at North Market St. should be completed according to the original plans as fast as river traffic requires it.

Electrification — Complete elimination of steam locomotives for smoke-abatement purposes is not necessary under present conditions and the electrification of the terminal system of St. Louis and East St. Louis is financially impracticable.

Man-Made Malaria in Road Construction

The importance of guarding against "man-made malaria" in highway construction, particularly in the South, is urged in a circular just issued by the United States Public Health Service. The circular states that the specifications for roads in the South "require that the culverts be so placed that they will completely drain all wet areas above the culvert entrance and that all borrow pits or excavations made along the roadways shall be filled or properly drained." Many southern states have enacted laws to this effect. The circular points out that if the matter is given attention in time "adequate drainage can be had with very little, if any, additional cost; whereas, if through carelessness or wilfulness the culverts are placed too high or the borrow pits are not properly drained the expense for later rectification may be very great." Finally, the circular states: "No road, however necessary for travel, can be called good if it interferes with proper drainage."

New River-and-Rail Terminals on the Mississippi

Truck Conveyor Bridge and Car Incline with Cradle Provide for Varying River Level—Two Concrete Docks with Cranes

LACK of terminal and interchange facilities on inland waterway routes is recognized as one of the principal reasons for the failure to develop extensive freight traffic on the large river systems of the United States, ranking next to the difficulties of extending joint rate territory and of an equitable division between rail and water carriers. It is of particular interest, therefore, to record the work of establishing river-and-rail terminals for the government's experimental barge service on the Mississippi and Warrior Rivers.

This waterway service was established during the war in order to supplement the carrying capacity of the railroads. It was soon evident that little commercial business could be handled or developed without facilities for interchange with the railways, but there were few river terminals properly constructed and equipped for such transfer between river craft and railway cars. To develop the Mississippi-Warior River service, therefore, funds were authorized by Congress in 1919 and 1920 for the construction of adequate terminals at St. Louis, Cairo, Memphis, Vicksburg and Mobile.

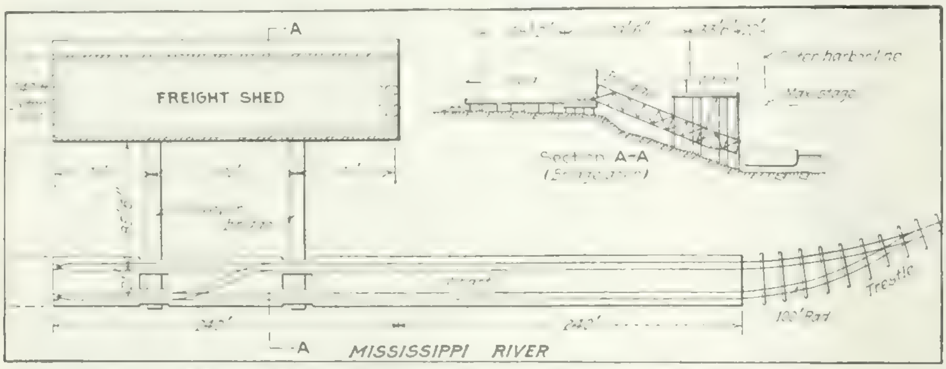


FIG. 1. CONVEYOR BRIDGE AND WHARF AT SOUTH ST. LOUIS, MO.

In 1920 the business of promotion and development of waterways was assigned to the War Department, which established the Inland and Coastwise Waterway Service to provide the necessary facilities and to supervise the organization and operation of the traffic. The design of the terminals was entrusted originally to the Board of Engineers for Rivers and Harbors, U. S. War Department. Plans for terminals at St. Louis, Memphis, Vicksburg and Mobile were then prepared under the direction of Capt. F. T. Chambers, civil engineer corps, U. S. Navy, as engineer of port facilities for this board. More recently, the Waterway Service has loaned money to the local authorities at Memphis, Vicksburg and New Orleans. The plans for terminals at these points have been changed, therefore, to meet the views of the local authorities and of the federal management of the Mississippi-Warrior service.

Package freight constitutes perhaps 25 per cent of the traffic at St. Louis, Mo., which is the northern and inland terminal of the Mississippi-Warrior River steamer and barge line service. The city has established a municipal dock, which is used to a large extent by this service. The dock is of reinforced concrete, 890 ft. long and 36 ft. wide, with its deck at El. 42 on the St. Louis gage or 4 ft. above the 1903 flood stage. A pile fender extends 1,300 ft. north of the dock, at which barges may be moored to await loading or unloading. There are two frame warehouses, 200 x 160 ft. and 125 x 140 ft., with a shed 240 x 25 ft. between warehouse and dock. Three trestles, two north and one south of the dock, provide connections with the St. Louis Terminal R. R. and the Chicago, Burlington & Quincy R. R. Barges lie directly alongside the dock and not at a wharf boat.

The dock was built in the water with its face midway between the inner and outer harbor lines, a fill being then made on the land side by a city dump, thus reclaiming about 30 acres of land now valued at $2,000,000. Freight handling equipment includes two gantry cranes with 5,000-lb. hoisting trolleys, a 30-ton and four 15-ton cranes, a motor-driven conveyor and a gravity conveyor. From Feb. 1, 1919, to Sept. 30, 1921, there were handled 169,750 tons of freight, 90,630 tons inbound and 79,120 tons outbound.

East St. Louis—In addition to this municipal dock the barge line has been using a leased railway terminal at East St. Louis, Ill. This latter consists of an incline running diagonally down the levee at a grade of about 2½ per cent, upon which travels a cradle with a horizontal deck carrying a railway track connecting with the incline track. The cradle is shifted up and down the incline by a locomotive, according to variations in the river level, so as to keep a depth of 9 ft. of water at the outer end of the cradle.

At the end of the cradle is moored a concrete car float or pontoon having track capacity for 17 cars. To the far side of the float is lashed a floating transit shed or wharf boat. Barges are moored to the wharf boat for loading and unloading freight. This unit is to be doubled.

South St. Louis—The Inland and Coastwise Waterway Service has built a terminal of a different kind for the extension of its business at South St. Louis, as shown in Fig. 1. A wharf of creosoted timber is connected to the railroad system on shore by a track on a creosoted timber trestle. In front of the wharf is moored a wharf boat. Two inclined bridges supported by the wharf and by the substructure of the transit shed at the top of the bank, carry endless traveling chains equipped with flights for the automatic transfer of 2-ton hand trucks between the wharf boat and the transit shed.

Each bridge has a wheeled platform at the inner or hinged end, and a counterweight supported at the outer end, the outer end traveling in a vertical plane just inside the face of the wharf for the accommodation of the bridge to the wharf boat at any stage of the river. The extreme variation between high and low water at St. Louis is about 44 ft.

For unloading a river barge moored at the wharf boat, empty trucks will be pushed upon the descending chain belt on one of the bridges and thus lowered to the wharf boat, whence they will be pulled by hand aboard the river barge and there loaded. The loaded trucks will then be pulled by hand to the ascending conveyor and automatically raised to the upper level. There the

trucks will be pulled by hand to the unloading point of the floor of the shed, for classification, or into the railroad cars at the rear of the shed for shipment. The contract for this was let in June, 1921, on an estimated cost of about $205,000.

Cairo, Ill.—A car transfer incline with traveling cradle was built by the Inland and Coastwise Waterway Service, and was provided with a car float and wharf boat, as at East St. Louis. The float consists of four concrete barges 266 x 36 ft. lashed together to form a floating unit 532 x 72 ft., on which three tracks are laid. The wharf boat or warehouse is 56 ft. wide over the guards. For loading grain into barges, arrangements have been made with an elevator company which has a belt conveyor extending to the water front.

Memphis, Tenn.—The only suitable site is on a berm below the steep bank of the river bluff and adjacent to the two railway bridges, as shown in Fig. 2. The city already has an extensive holding upstream from these bridges, the present property consisting of a one-story warehouse connected with the water front by means of an inclined tunnel and trestle housing two lines of endless chain belts, somewhat similar in operation to those at South St. Louis. A railroad track leads into the city warehouse at the top of the bluffs.

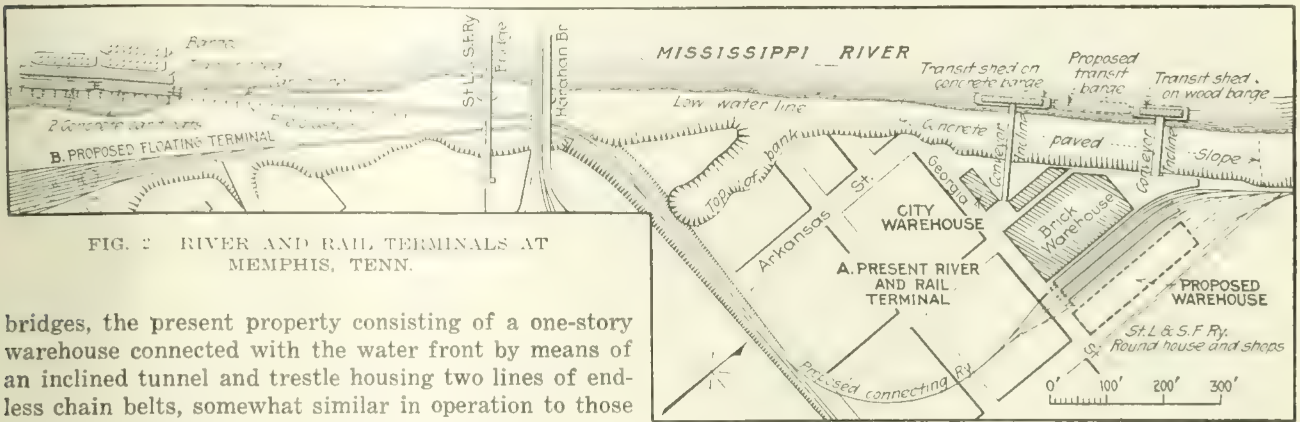


FIG. 2 RIVER AND RAIL TERMINALS AT MEMPHIS, TENN.

The city proposes to buy an extensive tract of land near this terminal, at the top of the bluff, and also to acquire the berm at the foot of the bluff, where it is proposed to locate the government terminal. Every effort has been made by the Inland and Coastwise Waterway Service to co-operate with the city, so that instead of two isolated terminals there will be in effect one terminal, the parts of which will be connected by rail and roadway and will thus promote efficient operation. The city is acquiring the necessary land for the government terminal, but the barge line must continue to use the city terminal until the former is completed. The interchange terminal will be of the incline type, similar to that at Cairo, having rail connection with the city terminal. A belt line railroad connecting with all incoming traffic will also be built by the city.

Vicksburg, Miss.—Here the city has acquired a site and a contract has been let for a terminal similar to that at Cairo, except that the barge will be of steel, having three tracks and its own freight-handling equipment.

Since Mobile is the seaport terminus of the Warrior River transportation system, which taps the coal fields and iron and steel region of northern Alabama, there has been established on Blakely Island, opposite the city, a coal terminal for the government's experimental barge line. Fig. 3 shows the general character of the facilities as designed by the Port Facilities Section of the Board of Engineers for Rivers and Harbors. A creosoted timber wharf 500 ft. long flanks the deep water of the river and supports the front leg of a gantry crane carrying a 4-ton coal bucket. This plant has a capacity of 400 tons of coal per hour.

The gantry crane has a double function: (1) To take the coal from barges and transport it to the storage pile in the rear, and (2) to reclaim coal from this storage pile and deliver it into a hopper in the inshore leg of the bridge, from whence it passes over a weighing belt and then to a longitudinal conveyor belt running the entire length of the plant. This conveyor, by means of a tripper, discharges its load upon the belt of a ship-loading tower, which may be run freely underneath the bridge in order to reach any part of the water front. The plant is thus capable of storing and delivering several kinds of coal to any part of the water front.

Iron ore coming from Cuba and South America in ships will be transferred to a similar stock pile, or to river barges for transshipment to inland steel works. The plant as a whole is intended principally for an export coal terminal, but ship bunkering can be taken care of also. The cost of this terminal was a little over $400,000.

Since the present river service, with its barges and terminals, is experimental, the chief of the Inland and Coastwise Waterway Service has been willing to try several kinds of both floating and terminal equipment. Economical handling of water traffic on the Great Lakes has been mainly with bulk material in enormous quantities, such as iron ore, coal and grain. The Mississippi-Warrior service also handles both bulk and package freight. The manager of the Waterway Service makes the point that if the waterway is to compete with the railway, it is absolutely essential that the shipper of package freight should not suffer on account of barge transportation. In other words, he is entitled to a transfer of freight under covered storage in order that packages may arrive at their destination in as good condition as they would by railway freight car.

Ocean terminal layouts cannot be followed in the design of river terminals. For one thing, a large proportion of the package freight is packed less securely for domestic shipment than that going abroad, a large part of it being in paper cartons. This circumstance has an influence upon the river traffic problem, and it is partly on this account that it has been decided to try the endless chain conveyors for trucks at South St. Louis and the cradle inclines at East St. Louis. For packages of moderate size the conveyor is considered to have the advantage of continuous conveyance, which produces the greatest results. At the same time, it is not adapted

to the transportation of such material as lumber, steel rails, structural material in general, or bulk materials.

The height between extreme low water and flood conditions at all of these Mississippi cities is so great that under ordinary conditions the direct lift is not economical. However, it is necessary to provide direct lift for certain materials, as at the St. Louis municipal dock. The incline and cradle arrangement as used at East St. Louis and Cairo is considered to have the disadvantages of providing little space for classification and storage, and of requiring a considerable interval several times each day for making new set-ups of cars upon the car floats.

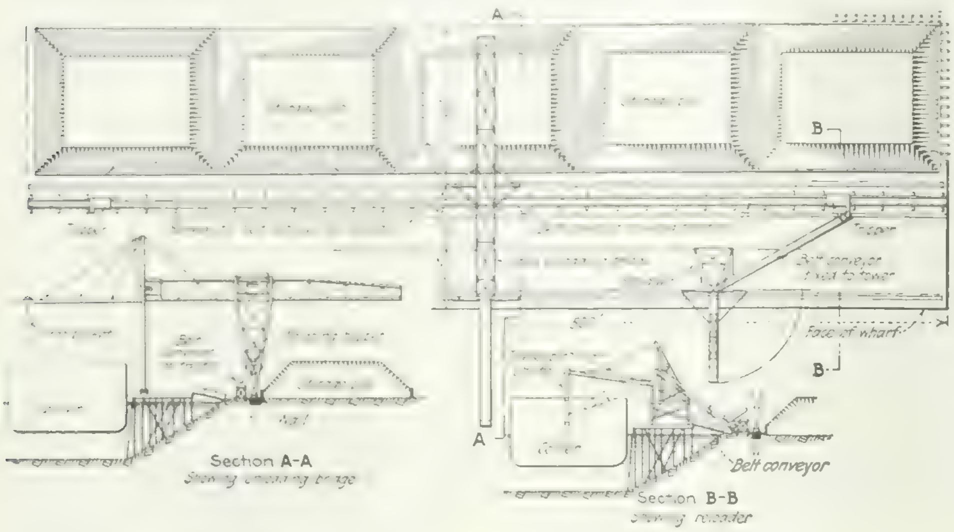


FIG. 3. COAL HANDLING AND STORAGE DOCK AT MOBILE, ALA.

Raising Loch Raven Dam, Baltimore

Work is in progress on increasing the height of the Loch Raven dam for the Baltimore water supply to Elev. 240 above mean tide, or 103 ft. above bedrock. Relief openings were closed in April and it is expected that the work will be completed in June. An attempt will be made to hold the water to Elev. 210 until next autumn. It is hoped that by next spring the reservoir will be filled to Elev. 240, giving a storage capacity of some 23 billions. Provision is made for carrying the dam still higher, providing a water surface at Elev. 270 and a storage capacity of about 50 billion gallons.

The original Loch Raven dam on the Gunpowder River was completed in 1881. It was of stone and only some 25 ft. in height above the bed of the stream. By 1900 the original storage capacity of 510 m.g. had been reduced by silting to 78 m.g., although the silt had been removed from time to time by dredging from 1896 to 1900. In the latter year the city bought a suction dredge which was kept in operation until the fall of 1911, increasing the capacity from 78 to 178 m.g. It was calculated that the annual deposit of silt from 1891 to 1909 was 226,000 cubic yards.

From 1900 on the construction of a higher dam at Loch Raven was advocated by successive water engineers for the city. In 1910 a report on the whole problem of increased water supply was made by John R. Freeman and the late F. P. Stearns, with supplementary reports on the quality of the water and upon treatment by George C. Whipple and Allen Hazen respectively. The report advocated a new dam, a filtration plant at Montebello and other improvements. A dam with a crest elevation of 233½ ft. with provision for increasing the water level to 237½ ft. by the use of flashboards, so as to store about 21 billion gallons, was proposed.

The proposed dam was put under construction in 1912, at a point about a half-mile north of the old dam, but due to legal complications over riparian rights above the new dam, the structure was carried to Elev. 188 only, at which crest level it was completed in 1914, giving a total storage capacity of 1½ billion gallons, of which only some half could be drawn. The downstream face of the dam was stepped and bonding stones and grooves provided for carrying the dam to a higher elevation.

The present contract for increasing the height of the dam was let in April, 1921. At Elev. 240 the overall length of the dam will be 640 ft. and the spillway openings have a total length of 280 ft. In the present work, steel bars are being inserted in the downstream face, bent over just to meet the surface of the concrete, so that the dam may be broadened and raised as mentioned in the opening paragraph.

The work done in 1913-14 cost about $500,000, including cofferdams, etc., and some 45,000 cu.yd. of concrete. The work now under contract includes about the same amount of concrete and will cost about $525,000, bringing the cost up to $1,025,000 for the dam completed to crest Elev. 240.

William A. Megraw has been water engineer of Baltimore since October, 1919, and we are indebted to him for information regarding the present enlargement of the dam. It is expected that the work will be completed in June, 1922. It may be added that the Monebello filters are also to have their capacity increased from 128 to 203 m.g.d., and that new coagulating and settling basins and filtered water reservoirs will be built.

(See *Engineering News*, April 21, 1910, p. 470, for an article on the proposed enlargement of the Baltimore water-works, including figures from the Freeman and Stearns report, and Aug. 13, 1914, p. 231, for an article on the new dam. These articles were written by A. M. Quick and by Ezra B. Whitman, respectively, formerly water engineers of Baltimore.)

Vicksburg Waterworks Changes Correction

New boilers being erected for the water-works at Vicksburg, Miss., will be set for a flood stage of 57 ft. 4 in., instead of 40 ft., as mentioned in the article in *Engineering News-Record* of May 25, p. 870. This new elevation will be 2 ft. 4 in. above the crest elevation of the 1922 flood, according to J. A. Steele, Jr., manager of city water-works.

Tests on Molding of Concrete Under Pressure

Effect of Varying Pressures and of Curing in Different Periods of Air, Steam and Water Exposure

By Hugh M. Nelson
Engineer, Erie Concrete & Steel Co., Erie, Pa.

SOME years ago the writer had charge of a series of tests for the Hydrostone Co., of Chicago, to determine the effect of pressure in molding and various curing methods upon the characteristics of concrete, particularly as regards strength, density, absorption, and ease of manufacturing. The results, not hitherto published, are abstracted herewith.

The aggregates were sand and gravel dredged from the old bed of White River near Indianapolis and the proportions determined on were 17 per cent cement, 26 per cent sand, and 57 per cent gravel, the water used being 47 per cent of the weight of cement. These proportions were kept constant by actual weight throughout. The test pieces were 6 in. in diameter and about 12 in. long, the mold in which they were made consisting of two halves of a hollow steel cylinder 14 in. high, the outside surface being tapered slightly to allow driving of tight fitting steel rings. A cast-iron plunger about $\frac{1}{16}$ in. smaller than the inside of the cylinder was used to transfer the pressure from the 100-ton press to the concrete in the mold. This mold allowed the easy removal of the test specimen immediately after molding.

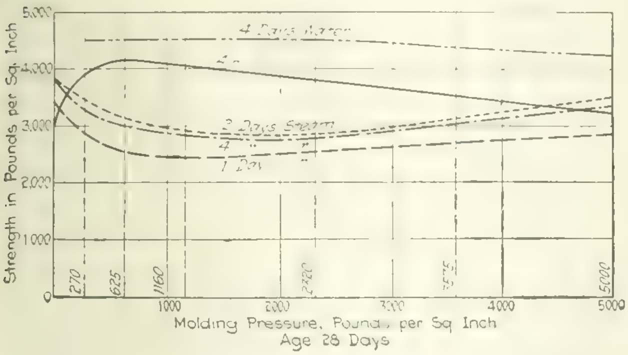


FIG. 1. EFFECT OF VARIOUS CURING CONDITIONS AND PRESSURES

The test blocks were made up in the mold and the pressure was secured by means of a 100-ton press, the pressure being read by a calibrated gage reading directly in pounds per square inch. With a few exceptions, 60 test pieces were made at each of the following pressures: 0, 270, 625, 1,160, 2,320, 3,575, and 5,000 lb. per square inch. Twelve of each kind were cured in moist air; twelve were cured one day in steam; twelve were cured two days in steam; twelve were cured four days in steam; and twelve were cured four days in water. Of each set of twelve four were tested at seven-day age; four at fourteen-day age; and four at twenty-eight day age.

The air cured blocks were placed on a damp floor, covered with cloth, and kept damp by sprinkling. The steam cured blocks were placed on wood racks in galvanized iron tanks, in the bottom of which was kept 3 in. of water at a temperature to insure a saturation of steam at all times. The water cured blocks were allowed to set for about twelve hours and then placed for four days in a tank of water kept at an even temperature. Twenty-four hours before testing, each cylinder was capped with plaster of paris and the following day pressure was gradually applied until failure occurred.

Effect on Strength—At the seven-day age the water-cured blocks were strongest for all molding pressures, air-cured next in strength, four-day steam-cured next, two-day steam-cured next, and one-day steam-cured the weakest. In all blocks cured by the different methods there is a tendency to gain strength with increase of molding pressure above a point near 270 lb. per square inch, the maximum strength being that of water-cured concrete molded at the 5,000-lb. pressure, the strength being 3,500 lb. per square inch.

At the fourteen-day age the order of strengths was the same as that given above for the seven-day age. At this age the water and moist-air cured blocks show the greatest strength at relatively low molding pressures and have a tendency to decrease in strength with increase of molding pressure, while the steam-cured blocks decrease in strength at the lower molding pressures and increase in strength from there as the molding pressure is increased.

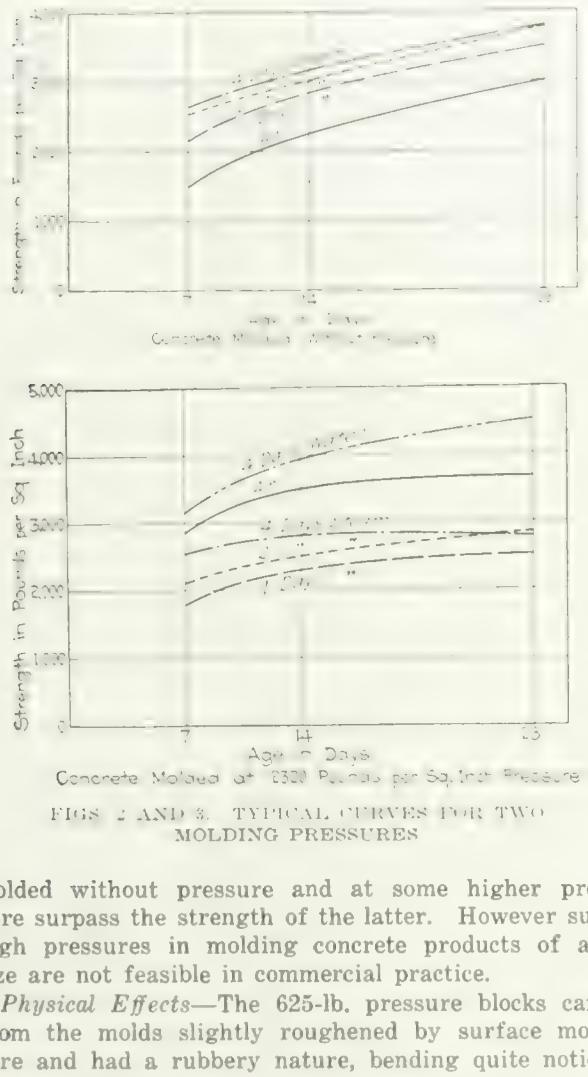
At the twenty-eight day age the tendencies were similar to those at fourteen days except that the two- and four-day steam-cured blocks passed the air-cured in strength at the highest molding pressure, 5,000-lb. per square inch. The twenty-eight day tests are the ones by which the results may best be judged and are shown by means of curves in Fig. 1. As an indication of the tendencies the curves for the no pressure and 2,320-lb. molding pressures, respectively, are given in Figs. 2 and 3.

The tests show that the best curing method in all cases is that of submerging the concrete in water as soon as possible after molding and concrete cured by this method shows a steady increase in strength with age for each molding pressure. For the water-cured concrete there is practically no gain in strength with an increase of pressure from 270 to 2,320 lb. per square inch. and from the latter point of the maximum there is a slow decrease in strength with an increase of molding pressure. From the standpoint of strength alone there is no advantage in going above a few hundred pounds per square inch molding pressure when using the water-curing method.

The air-cured concrete, while second in strength for all pressures except the highest, shows a tendency to decrease in strength with increase of molding pressure above 600 to 700 lb. per square inch. Concrete cured in air is strongest when molded at about 600 lb. per square inch pressure.

The steam-cured concrete for all ages decreased rather sharply in strength for the lighter molding pressures and then increased in strength steadily with increase of pressure for all ages, concrete at 5,000 lb. per square inch molding pressure and cured by the two- and four-day steam methods passing the air-cured concrete in strength at the twenty-eight day age. The twenty-eight day tests on concrete cured by the steam method do not show a strength at any pressure equal to that of the no-pressure concrete cured by the same method. Also the steam-cured no-pressure con-

crete shows a steady increase of strength with age, while the steam-cured pressure concrete strength curve shows a marked tendency to flatten above the fourteen-day age and indicates only a very gradual increase of strength with increase of age. A study of the twenty-eight day tests shows however that in all probability the steam-cured concrete molded at some pressure above 5,000 lb. will attain a strength equal to those



FIGS. 2 AND 3. TYPICAL CURVES FOR TWO MOLDING PRESSURES

molded without pressure and at some higher pressure surpass the strength of the latter. However such high pressures in molding concrete products of any size are not feasible in commercial practice.

Physical Effects—The 625-lb. pressure blocks came from the molds slightly roughened by surface moisture and had a rubbery nature, bending quite noticeably without cracking. With increase of molding pressure the concrete became drier, smoother and more brittle, a couple made at a pressure of 7,150 lb. being so hard and brittle that they could not be removed from the mold without breaking. The concrete blocks molded at pressures from 1,500 to 1,800-lb. pressure had better surfaces, were more easily removed from the molds, and were better from the standpoint of handling immediately after molding than those made at higher or lower pressures.

Study of the effect of molding pressure on weight indicated that the weight per cubic foot increased from about 152 lb. at zero molding pressure to about 159 lb. per cubic foot at 270-lb. molding pressure, and that the weight remains practically constant for increased molding pressures.

Study of the effect of molding pressure on absorption showed that for concrete of the mix used and molded without pressure the absorption is from 6 to 6½ per cent and it drops sharply with pressure to from 3½ to 4½ per cent at a pressure of about 1,000 lb. per square inch, where it remains practically stationary with increased molding pressure for air, water, and one-day steam curing methods. The moist air blocks on the average show the least absorption. For the two- and four-day steam-curing methods there is a small increase in absorption for pressures beyond 1,000 lb.

In the testing of the blocks the air- and water-cured concrete was hard and firm, and destruction occurred suddenly with considerable noise and flying of fragments, while the steam-cured concrete was less hard and firm, failure taking place more gradually. The former also showed an actual shearing of the coarse aggregate in failure while the latter rarely showed that condition, the large aggregate breaking loose rather than shearing.

Conclusions—From the results of the tests it is apparent that the strength, uniformity, absorption, density, and physical characteristics of concrete may be improved by molding under pressure, and it is obvious that the water content largely controls the strength, there being sufficient water retained at low pressures and not sufficient water retained at high pressures for proper hydration.

Concrete molded at relatively low pressures and cured by the moist air or water method is superior in strength and physical characteristics to concrete molded at high pressures.

For steam-cured concrete made under pressure there is actually a loss in strength with molding pressures up to about 1,000 lb. per square inch and from there on a slight increase in strength with increase of molding pressure with an indication that at pressures so high as to be impracticable the strength may equal that of no-pressure concrete. At such high pressures however it is doubtful if there would be sufficient water for proper hydration and the strength attained would be due more to the great pressure used in molding than to cementation. It is doubtful if such strength would be permanent or the physical characteristics of the concrete desirable.

French Railways Try Gasoline-Driven Cars

Corresponding to the experiments now being conducted on American railroads, *The Engineer*, London, tells us that the French State Rys. have also been carrying on experiments to ascertain the possibility of using gasoline-driven motors on lines with limited traffic. The trials are reported to be satisfactory so far. The French appear to be using their motor-driven vehicles as locomotives, for it is reported that a 60-hp. motor weighing 14 tons and drawing a car weighing 10 tons easily reached a speed of more than 30 miles an hour, this being but slightly reduced when a second car was added. It is estimated that on local lines of standard gage motor traction would enable a saving of from 5 francs to 10 francs per kilometer, the present figure for steam traction being more than 14 francs. The Minister of Public Works, who has been following the experiments, has sent a circular to all prefects of departments asking them to study the possibility of applying gasoline traction to the departmental railways. On many of the smaller local lines it is estimated that operating costs may be halved by this means.

Mechanical Equipment as a Factor in Building Design

Structural Engineer Must Provide Adequately for Varied Service Plant with Complicated Piping and Cable Systems

HOW structural design of large buildings of the office, hotel and apartment class is influenced by considerations of the various mechanical equipment required for such buildings was the subject of a recent paper read before the Western Society of Engineers by H. L. Clute, chief engineer of the Arcade Steam Heating Co., Chicago. An abstract of this is given below:

Mechanical equipment of a building is that part which furnishes such utilities as water, gas, electricity, steam, conveyance, ventilation and refrigeration. In preparing the preliminary and structural design of the building it is necessary to have a general conception of the equipment to be provided, or when too late it may be found difficult to make suitable provision and arrangement.

Three classes of equipment are practically common to all buildings: plumbing, electric wiring and steam. Plumbing includes drainage, water supply, gas and often vacuum cleaning. Wiring is for light, power, telephones, signal system, clock system, telautograph and special purposes. Six semi-common classes are elevators, ventilation, electric generation, refrigeration, pneumatic tubes and sprinkler system. Special installations are required to serve hotel kitchens and laundries, theater stages and similar cases. Each installation may be divided into three classes: Apparatus, conductors and accessories.

To illustrate the complexity of the equipment, the water installation may include the following: Two mains for cold water (at city pressure and high pressure); two hot-water mains each with supply and circulation return systems; a main and return for drinking water; brine supply and return mains, and high and low level drainage and storm water mains. Steam distribution may include high, medium and low pressure service, each with supply, return and drip mains. In a typical example there may be thirty systems of horizontal pipe mains each with five to ten risers or vertical lines through the building, and each riser with four to forty branches. These mains are at different levels, with risers extending either upward or downward. Interspersed with these pipes will be from five to twenty duct lines, with branches, pneumatic tubes and electric feeders.

Structural provisions for such equipment include ample floor area for machinery and apparatus, continuous horizontal and vertical spaces for mains and risers, space for offsets for branches, and facilities for convenient operation and maintenance. In the ideal condition all the mains would have the shortest possible leads from producing apparatus to utilizing apparatus, but paralleling the main axes of the building. But in the actual condition the equipment is twisted and distorted to keep it out of the way and out of sight. This arrangement of the equipment to meet actual conditions with efficiency and economy is sometimes one of the principal problems of the mechanical engineer.

Pipe Mains and Basement Girders—Piping is grouped usually at basement ceilings more than at any other place, and here trouble is caused by deep beams and girders. In general the profile of the main must be a straight line with only a slight inclination from the horizontal. For this reason the entire main must be below the bottom of the deepest girder, except when some special provision is made. One building has most of the girders 26 in. deep and some 32-in. deep. As the mains must be below the latter, this brings them far below the ceiling and makes an unsightly arrangement.

This problem is one for the structural engineer. Of course the economical section of a girder is a deep one. To provide the necessary strength by increasing the width of girder instead of the depth in order to maintain a uniform depth would involve extra expense. But in certain cases this construction expense would be warranted by the saving in expense for mechanical installations and by the greater convenience and reliability in the operation of the mechanical plant. Pipes are sometimes laid through holes in the center of steel girders, but with reinforced concrete there would be the liability of interference with the reinforcing bars, especially where the girders are of varying depths.

Pipes and Floor Framing—In the upper part of the building, pipe mains are laid usually above suspended ceilings, but here also the depth of beams and girders is a factor. In some cases a certain depth of furring has been assumed below the ceiling panel and is found to be insufficient for the piping. Then some method of increasing the depth must be found. Sometimes the pipes are carried down and around in cornices and false beams across the panels. This may be necessary but is objectionable in requiring an excessive number of turns or bends in the piping. Where a floor filling of not less than 5 in. depth is available certain mains may be laid in this fill.

A double floor at some point in the height of the building is very desirable, especially in hotel buildings where there are a certain number of special floors in the lower portion and typical or uniform floors above. I believe that in time every hotel building will be designed with a double floor construction above the special floor and below the typical floors, because all of the pipes and risers coming down the upper part of the interior of the building must be disposed of. They must be offset individually and carried down columns and in partitions and special places with various crooks and turns, or they must be collected together at mains in a floor space below the typical floors. To permit free access this space should be at least 3 ft. high.

One of these floors is the main load-bearing floor and the other is an auxiliary floor of short spans, either suspended from the main or carried above it on struts. The tendency is to place the auxiliary floor below the main floor, with the idea that all the deep beams and girders and trusses may be carried in this space and leave a flat ceiling below, whereas if the main floor were below and the auxiliary floor above those deep beams and girders would be exposed on the ceiling. This is a mistake. As stated in connection with basement mains, those beams and girders will not permit the passage of pipes, so the depth of the pipe space should be the required amount below these beams, except that under the beams it may be reduced and workmen may crawl under beams and find a working space in the panels. In general it is best to place the working floor below and the auxiliary floor above, as the space between the girders will then be available to add to the height of ceilings in the rooms below.

Pipe and Cable Shafts—A pipe shaft of ample size for riser trunks should be provided. A width of 3½ ft. is generally sufficient if the length is great enough to accommodate all the pipes in one layer. This is usually placed alongside of the smokestack, and a good arrangement is to use a beam or girder at the side of the smokestack for a walkway in the shaft, building the shaft of sufficient additional width to place the pipes.

Electric cables and feeders are carried up through the building at the centers of approximately equal areas, so that the distances from the cable shafts to the sides of these areas will be not over about 80 ft. If the entire area of the building is divided into as many units roughly of that size as required, and a cable shaft provided in each one it is a very adequate provision. It is seldom the case that the cable shaft is carried up continuously from the basement or lowest floor through the building, but it should be built in this way.

Steam risers are usually near the outside walls and plumbing risers at the interior of the building. The former may be furred in with the columns or carried up in chases. With skeleton construction it is usually difficult to provide chases, but some structural engineers are using a construction in which the spandrel beam is 4 in. thinner than the thickness of the wall, the inside face of the beam being set

back 4 in. from the inside face of the wall. This permits of carrying up a chase through the skeleton framing and gives an excellent opportunity to conceal the steam risers. Many buildings of the better class are now having these pipes concealed.

Interior risers are placed usually in shafts large enough to give working space for a man in maintenance and repair work. A width of 28 in. is about the minimum for a plumbing shaft. Sometimes these shafts are made continuous, or without the floor fill at each floor, and are then used as the exhaust shafts for the toilet rooms. If the floor is open, steel doors are required at each opening for access. That is fireproof construction. If they are closed at each floor ordinary wood panels may be provided. If they are left open the entire area has to be framed, whereas with the closed shaft the pipes may be carried up in sleeves between the reinforcing rods. It is always a question as to which type is best.

If the pipes or risers are furnished in special non-accessible shafts they are either at the columns or in such special locations as may be found here and there. If they are at the columns there is always the question of space required; in addition to the amount required by the pipes there is always a beam carried out from the center of the column, leaving the only available space at one side of this beam. It would be an advantage if there could be some way of designing twin beams where there are a number of shafts of this kind, especially in office buildings. That is, beams side by side, so that the extra space inclosed with the columns would be entirely utilized for pipes. This plan would add very little to the size of the column. Where the pipes are placed in various shafts wherever it may be convenient, no structural provisions are necessary.

Elevators — With electric elevators the machines are located usually over the shafts. Beam framing at the floors carries the guides and must be designed for vertical loads imposed by the emergency brakes gripping the guides. Pits require a depth of 3½ to 4 ft. for spring buffers or 6 to 8 ft. for oil buffers and 9 ft. for compensating cables. In fact elevator manufacturers are always asking for deeper pits. This involves drainage systems, as the pits are rarely watertight.

Boiler-Room Space — Space provided for the boilers is found frequently to be inadequate for proper boiler capacity. Two boilers are preferable to one of equal capacity in order to provide for cleaning and reserve. Three boilers are preferable to two for plants of over 15,000 sq.ft. of radiation. Headroom is often insufficient owing to a desire to limit the depth of excavation, but there should be ample space over the boiler to give free access for inspection of safety valves, automatic checks, main valves and other accessories. For cast-iron, return tubular and water-tube boilers the minimum headroom may be taken as 9, 15 and 28 ft. respectively, although some water-tube boilers require 32 ft. and some may be as low as 22 ft. Thus the type and size of boiler are factors in the building design.

Space must be provided for access to all sides of the boiler and for a firing floor in front. This latter may be from 5 to 10 ft., the latter being sufficient for withdrawing a mechanical stoker. For protection of the floor above the boiler room, an insulated ceiling is preferable to air circulation in the space over the boilers. Where coal is fed by gravity from a bunker to the mechanical stokers the minimum height from boiler-room floor to bottom of bunker will be about 12 ft. Allowing a 40 deg. slope for the bunker bottom, this gravity feed system will require a basement or sub-basement height of about 30 ft. When this is not practicable, the main bunker may be on the boiler room floor with a conveyor carrying the coal to an auxiliary bunker which feeds the stokers.

Smokestack—The area provided for this will depend upon the boiler capacity together with the thickness of insulation and the 4-in. clearance space required by the city ordinance. Since its height varies with expansion and contraction it must be supported at one point, either on a special foundation or on a girder framing in the superstructure. The latter case requires the special attention of the structural engineer.

Engines—Where engines and generators are installed a height of 15 ft. will usually be sufficient to provide space for the large amount of piping that must be placed along the ceiling. Engine foundations must not be in contact with column foundations or floors, a joint filled with elastic packing being used in the floor.

House Tanks—Every building of the class noted requires house tanks sufficient for 20 to 60-minute supply in emergencies. The Morrison Hotel has two 10,000-gal. gravity tanks in the roof pent house for domestic supply. Other buildings have two 4,000-gal. tanks. With two tanks one can be cleaned while the other is in use. To provide support of such tanks may involve special structural design.

Air Conditioners—These are often required in connection with the supply system of ventilating equipment and should be placed as nearly as possible in the direct line of travel from the intake to the ventilated room. The apparatus includes a fan, motor, air-washer and heaters, requiring usually a length of 26 ft. For upper floors, the conditioners may be placed in an interior room which is made available by leading to it an intake duct over the ceiling. A good location in a large building is behind the elevators, the rear wall of the elevator shaft being set back far enough to accommodate the conditioner units, with direct intake through the wall to the unit.

Asphalt Used to Resurface Worn Brick Pavement

Strengthening of Binder Course Shown to Be Desirable in Oil City, Pa.—Special Methods Along Car Tracks

By D. A. Grant

President, The D. A. Grant Co., Inc., Contractor, Oil City, Pa.

Many of the smaller cities of western Pennsylvania are confronted with the problem of restoring worn-out brick pavements varying in age up to 30 years. Economy demands a means of repaving at minimum cost and a pavement of some degree of permanence. The expense of this work must be borne entirely by the cities, since the original paving was done by property assessment.

To remove the old pavement and lay a new foundation to withstand present traffic, utilizing the existing curbing, would involve the cost of excavation and hauling of the old brick and the excavation of sufficient gravel and subsoil to permit the placing of the new foundation. This is a necessary first cost before the expense of a new pavement is considered. By the removal of the brick and the underlying gravel or stone a consolidation that can only be duplicated by years of traffic is destroyed. These bricks have been slowly bedded during a period of many years of traffic, always increasing in weight and volume, so that they are now on a permanent base of thoroughly consolidated sand and gravel, equal, if not superior in some cases, to the usual concrete base on a freshly prepared sub-grade. To waste this foundation would be an economic loss.

Resurface with Asphalt—Resurfacing with sheet asphalt or other asphalt wearing surface is a solution that has been practised by a number of cities for many years. The usual practice is to sweep the brick, remove all loose dirt and then sprinkle or splash asphaltic cement over the surface, employing an old broom or brush for the purpose. The binder course is then laid at a uniform thickness over the old brick, when the pavement is sheet asphalt, but if bituminous concrete,

FIG. 1. WIDE STRIP OF BITUMINOUS BASE

Used where car tracks were on almost same level as adjacent pavement.

the wearing surface is laid directly on the brick. Often this work has been done without any special effort being made to first fill the existing depressions and bring the foundation to a fairly uniform cross-section before laying the pavement in a uniform course.

Inasmuch as the surface of these old brick pavements is usually made up of a series of small waves, it is necessary in laying a somewhat flexible wearing surface, to guard against any movement of this surface that might naturally take place from the crest to the trough of each wave.

In the resurfacing of old waterbound macadam roads with bituminous pavements it has long been the practice to bring the old macadam to a true cross-section by scarification of the lumps followed by the addition of new material. This should also be the practice in case of resurfacing brick pavements. Although it is not practical to remove the high areas, it is quite a simple matter to fill the low areas with asphaltic concrete, which may be thoroughly compressed. A dense asphaltic concrete is much to be preferred for this purpose to the ordinary binder mixture as it forms a stable patch, thus reinforcing the foundation.

Binder Strengthened—It is highly desirable to strengthen the binder course so that it will possess material slab strength to bridge over new service openings and any weak areas that might exist in the base. This may be accomplished at a low cost by the addition of a small percentage of limestone screenings to the binder mixture and increasing the asphaltic content but slightly.

Most of the binder stone used is a one-size quarry product, so that filling the larger voids by means of the coarser particles of the screenings makes the mixture dense. A more important advantage is gained from

FIG. 2. RESURFACED PAVEMENT, OIL CITY

the use of screenings in the quarry dust contained, which acts as a filler. While many engineers have been favorably impressed with the idea of using a filler in the binder mixture, it has rarely ever been so employed. Certainly the vast improvement in stiffening and toughening the binder that can be so easily and cheaply accomplished justifies the incorporation of this additional element in the mixture. Screenings can usually be obtained more cheaply than sand and stone, so that there is no cost added in their use.

An asphaltic concrete binder mixture that has proved satisfactory is as follows:

	Passing	Ret. On	Percentage	
Stone	1½ in.	⅝ in.	60 to 70	
Screenings	⅝ in.	To dust	15 to 25	25 to 35
Sand	10 Mesh	..	10 to 15	
Asphaltic cement	..	..	4 to 6	

To strengthen further the binder course it is excellent practice to increase the thickness of the course to 2 in. and reduce the wearing surface to 1 in. This makes practically no change in the cost of the finished pavement over the old accepted 1½-1½-in. standards and

FIG. 3. BITUMINOUS CONCRETE SUPPORTS TRACK LINERS

certainly is a superior pavement. The feasibility of the employment of a sheet-asphalt pavement composed of 1 in. of wearing surface and 1½ in. of binder, has been too thoroughly demonstrated to question. The Pennsylvania State Highway Department has laid over 625,000 sq.yd. of that standard. The only difficulty in such standards of thickness is that in very cold weather the thinner course of wearing surface chills rapidly and a rough surface may result. This occurs at temperatures, however, at which asphalt pavement should not be laid, regardless of standard of thickness.

If a bituminous concrete binder mixture of the type described is provided for, it may be used to good advantage in increased thicknesses in places where it is necessary entirely to renew the base, such as over service openings and at intersections where it is necessary to remove the brick in lowering the grade.

During the summer of 1921 a contract was let for the repaving of a number of old brick streets in Oil City, Pa., with sheet asphalt. Specifications called for 1½-in. wearing surface and 1-in. binder, A. S. M. I. specifications. All but one of the old brick pavements were laid on a gravel base; the exception was a concrete base of rather poor quality. In all cases the surface was distorted, irregular, and contained numerous potholes. Provision was made in the specifications for extra binder and asphaltic concrete for building up low

areas and for providing a base where the brick were removed at intersections.

Asphaltic concrete was prepared from a mixture of gravel and slag, screenings, sand and Texaco asphaltic cement. Slag and gravel were found to give equally good results as coarse aggregate, although the former required an abnormal amount of asphaltic cement. Local bank sand and gravel were used.

Along Car Tracks—In order to meet the grade of the car tracks with the asphalt surface it was necessary to remove several courses of brick adjacent to the track liners. The channel thus formed was filled with asphaltic concrete laid at a height of 1½ in. below the top of the liners, allowing the wearing surface course to be kept slightly above the brick. No binder was laid on this strip of bituminous concrete.

Where the car tracks were high only a strip of bituminous concrete of sufficient width to permit the laying and locking in place of the brick liners was used, as shown in Fig. 3. On East First St., as shown in Fig. 1, the car tracks were on almost the same level as the adjacent pavement. It was therefore necessary to remove brick and lay a strip of about 4 ft. of bituminous concrete, and crown the pavement slightly toward the car tracks.

A bituminous concrete of great density, composed of gravel, screenings, sand and asphaltic cement, weighing about 4,000 lb. per cubic yard compressed, was used for this purpose. This formed a base so rigid that there can be no question as to its serviceability. A mixture of this type was also used to fill depressions in the old pavement and true up the cross-sections before laying the binder course. These patches were thoroughly compressed and allowed to cool prior to the laying of the binder course. Small irregularities in the old brick surface, too shallow to be filled with bituminous concrete, made it necessary that the binder course be considerably in excess of the specified 1 in. thickness.

In the first work of this character, done under the supervision of the writer, there was considerable movement noted in the binder course during the passing of the roller. This was true even after the material had been thoroughly cooled, and was due to the irregular and vitrified surface of the brick pavement. As a result of this condition, when the wearing surface was being rolled the unstable binder caused cracks to develop in the wearing surface course which were very hard to restore.

As a remedy for this condition the addition of filler to the binder mixture was resorted to. This was accomplished by the incorporation of about 20 per cent of screenings, ⅜ in. to dust, in the mixture, and reducing the sand content to 15 per cent. The result was quite gratifying. The binder so prepared could be rolled to any extent and suffered no ill effects when subjected to traffic from 5-ton trucks.

In the laying of sheet asphalt pavements too little stress is laid on the design and preparation of the binder mixture. Many failures that have been attributed to inferior wearing-surface materials or mixture can be traced to the binder course. There seems to be no reason why this portion of the pavement should not be a true asphaltic concrete, so designed as to possess density, rigidity and stability.

In Oil City several rough, irregular pavements, have been transformed to smooth, silent boulevards by the methods above described.

Man-Hour Cost of Heavy Paving, Lockport, Ill.

Side-Hill Streets Graded, Parked, Paved and Drained—Man-Hours Itemized for Each Kind of Work

By Charles E. DeLeuw
Kelker, DeLeuw & Co., Engineers, Chicago

TIME costs were kept last summer on about 47,300 sq.yd. of concrete paving constructed at Lockport, Ill., by the R. F. Conway Co., Chicago, under the direction of the writer's firm as engineers.

Lockport is situated on one side of the Desplaines River Valley. The streets run parallel with, and perpendicular to, the line of the river. Half are side-hill streets, and on them heavy cuts were necessary. For that reason, the excavation is proportionately greater than on the average paving job in the Middle West. The specifications required the grading to be done from sidewalk to sidewalk. The grading of the parkways also appears as a substantial item in the cost. These parkways were 25 ft. in width, were sloped uniformly from sidewalk to curb, and a carefully finished surface was required similar to that of the roadways after fine grading. The widths of the roadways were 20 ft.

There were no other unusual factors which are worthy of note. The weather conditions were average. Labor was plentiful and there was a willingness to work which contrasted favorably with conditions in 1919 and 1920. The rates paid were abnormally high, and for that reason the data have been prepared to show man-hours per unit of quantity. Data in this shape are very useful. By using the existing rates for the various classes of labor, it is possibly to work up an accurate estimate at any time. The greatest variable which affects cost data is eliminated, and the writer is convinced that if engineers and contractors habitually presented their cost records in this shape, the profession would greatly profit.

Excavation—The total grading was 34,000 cu-yd., for 47,300 sq.yd. of pavement. Two Koehring excavators did the heavy work and the grade was shaped up with slip scrapers. The soil was clay and glacial drift. The quantities handled and the man-hours required for each kind of work were as given in Table I.

TABLE I. LABOR HOURS PER CUBIC YARD FOR 34,000 CU YD. OF EXCAVATION GRADING FOR PAVEMENT

Item	Rough-Grading Hours per Cu.Yd.	Fine Grading Hours per Cu.Yd.	Fine Grading Hours per Sq.Yd.	Trimming Parkways Hours per Cu.Yd.	Total Hours per Cu.Yd.
Foreman	0.0073	0.0099	0.0071	0.0109	0.0281
Excavator	0.0374	[illegible]	0.0030	0.0012	0.0428
Operator	0.0447	0.0046	0.0033	0.0014	0.0507
Helper	0.0323	0.0008	0.0006	0.0002	0.0333
Laborer	0.2374	0.1622	0.1164	0.1958	0.5954
Team	0.1216	0.0426	0.0306	0.0324	0.1956
Truck	0.0004				0.0004
Water boy	0.0012	0.0059	0.0042	0.0032	0.0103
Watchman	0.0321	0.0009	0.0006	0.0003	0.0333

Macadam Base—The 5-in. broken stone base was spread by opening the tail-gates of the truck and was then smoothed by hand. Screenings and water were added and this course rolled until a smooth finish was produced and a wave of mortar appeared in front of the roller. It was then covered with 1 in. of stone and rolled once. Placing the stone required 1,313 laborers' hours or 0.0277 labor-hours per square yard.

The time cost of he 5-in. macadam base was:

Item	Hours Per Sq.Yd.
Foreman	0 0171
Laborers.	0 [illegible]
Teams..	0 0096
Rollerman	0 0224
Roller......	0 0217
Receiver	0 0086
Watchman.	0 0175

Asphaltic Top—A 2-in. asphaltic concrete top, with a dust finish, was required. A railroad crane with a clamshell bucket handled the material to a two-car Cummer plant. Crude oil was used as fuel and the consumption was approximately ½ gal. a square yard for 47,300 sq.yd. The total amount of top was 10,139,000 lb. or 214.4 lb. per square yard. The average haul in five-ton trucks was 3,500 ft. The costs including the labor of erecting the plant were:

Item	Hours Per Sq.Yd. at Plant	Hours Per Sq.Yd. on Street
Foreman...	0 0087	0 0044
Engineers.	0 0308	
Fireman	0.0423	
Laborers.	0.1213	0 0314
Watchman	0 0017	0.0042
Water boy	0.0054	
Rollerman		0 0119
Rollers		0 0119
Rakers		0 0202
Tampers...		0 0106
Smoothers....		0 0108
Trucks ..		0.0150

Drainage Structures—New drains, sewers and inlets and new and altered manholes and catchbasins constituted the drainage structures.

A total of 24,200 lin.ft. of 4-in. *drain pipe* was laid with open joints 30 in. below curb grade. The excavation was carried about 6 in. below the excavation for the curb and cinders were backfilled 6 in. over the pipe; the balance of the backfill was earth. Vitrified "seconds" were used. The labor hours per lineal foot were:

Foreman.	0 0008
Laborers.	0 4020

About 4,540 ft. of 8-in. *sewer* was laid, with mortar joints, in a 30-in. trench. The labor hours per lineal foot were:

Foreman..................................	0.0064
Laborers..................................	0.6410

There were 192 *inlets*. These were 17 x 24 x 5-in. cast-iron boxes, with grates, set in 1:2:4 concrete foundations about 24 x 24 x 18 in., in which 8-in. elbows were embedded. The labor hours per inlet were:

Skilled laborers......	0 735
Common laborers..	9 375

A total of 69 concrete *manholes* and 60 concrete *catchbasins* were adjusted by lowering and retopping with brick. The labor hours per unit were:

Item	Manholes	Catch Basins
Skilled labor...	3 10	[illegible]
Common labor..	9.17	2 400

Two new *catchbasins*, 4 x 7 ft. were built of brick in mortar; the labor hours per catchbasin were:

Skilled labor...	8 0
Common labor.	48.00

Concrete Curb—A total of 38,800 ft. of 6 x 8 x 24-in., 1:2:3 concrete curb was constructed in a 12-in. trench. There was a mortar coat on the top only. The labor hours per lineal foot were:

Foreman.....	[illegible]
Carpenter..	[illegible]
Finisher	[illegible]
Engineer.......	0 0110
Engineer's helper...	0 0048

Concrete laborers....	0 1552
Excavation laborers... ..	0 2952
Backfilling laborers..	0.0402
Teams.....	0 0084
Watchman.	0 0191
Waterboy..	0 0098
Mixer.......	0 0107
Truck Tractors......	0 0214

Wall Construction—There were 63 cu.yd. of 1:2:3½ concrete in a retaining wall 110 ft. long and averaging 5 ft. in height. The labor hours per cubic yard were:

Foreman.....	0.730
Carpenter....	1.015
Finisher......	1.078
Engineer.....	0.222
Mixer........	0.222
Truck tractor.	0 222
Laborers...	5 460

Unloading and Hauling—The materials included stone, sand, cinders and screenings and sewer and drain pipe. The stone and screenings were hauled direct from the quarry and the sand and cinders from a team track. The volume, haul and labor hours per cubic yard for each material were:

	Stone	Cinders	Sand	Screenings
Volume, cu.yd.... .	9,290	350	6,000	1,200
Average haul, mi	8	0.75	0.75	8
Hours per cu.yd.				
Foreman......	0 0009			
Laborers.	0 0138	1 495	2 120	
Trucks	0.4325	0.357	0.547	0 267

The drain tile and sewer pipe were hauled ¾ mile from a team track and placed along the trench. The labor hours per lineal foot for each were:

Item	Sewer Pipe	Drain Pipe
Foreman...	0 0055	0 0008
Laborers.	0 0247	0.0121
Trucks	0 0020	0 0023
Teams	0.0038	0.0013

All hauling from the quarry was by five-ton trucks largely over a concrete road, with a 10 per cent maximum grade.

Heavy Decline in Jersey City Sewer Bids

A REMARKABLE decline in bids for the same sewer construction job in Jersey City has taken place since 1920, a contract for the work having recently been let for $197,898, compared with lowest bids of $644,000 on Aug. 10, 1920, and $335,454 on Oct. 19 of the same year. The engineer's estimate before the first bidding was $237,911. The very high first bid is attributed to an exaggerated allowance for unsettled labor and material markets. The following information as to the nature of the work has been sent to *Engineering News-Record* by C. A. VanKeuren, chief engineer, Department of Streets and Public Improvements, Jersey City. The Fisk St. sewer is 17,865 ft. long, of which 8,800 ft. is 18-in. vitrified pipe; 8,465 ft. is 24- to 81-in. circular brick sewer and 600 ft. is 102-in. steel pipe. The brick sewer is divided by sizes as follows: 24-in., 4,600 ft.; 30-in., 925; 48-in., 1,140; 78-in., 840; 81-in., 960. The average cuts are about 10 ft. for the 18-in. pipe sewer, about 10½ ft. for the brick sewers and about 7 ft. for the steel pipe. There will be rock excavation, 1,000 cu.yd.; rubble masonry, 100 cu.yd.; concrete, about 200 lin.ft.; piles, 8,000; capping, 18,000 ft. B.M.; flooring, 33,000 ft. B.M.; sheathing, 50,000 ft. B.M.; receiving basins, 24, besides two which must be rebuilt. The contract was awarded April 25 to the lowest bidder of April 18, the Public Service Production Co., for $197,898 or 2 per cent under Mr. VanKeuren's revised estimate. The next higher bid was 7 per cent above the revised estimate.

American Society for Testing Materials Meets

Heavy Program and Record Attendance — Research Given Special Attention in Spite of Increased Volume of Specification Work—Interesting Discussions of Fatigue and Impact

STUDY of materials and test methods for the first time in the history of the American Society for Testing Materials took precedence over specification work at this year's meeting, held at Atlantic City last week. The development of standard specifications, while of greater volume than ever before, assumed the position of virtually routine work. This change is the more important as it is a deliberate movement, initiated two years ago by J. A. Capp, then president, and therefore may be considered as a definite alteration of the society's course rather than a sporadic phenomenon.

The most prominent single items of the program so far as the new phase is concerned were two active sessions in which impact testing of materials and fatigue phenomena were discussed. The former followed upon a specially arranged symposium of papers and methods of impact testing, while the latter centered around a paper reporting the results of the Illinois fatigue investigation which has been in progress during the past two years under the direction of Prof. H. F. Moore.

With the new emphasis laid on study of materials, the program of the meeting became enlarged to the point of requiring twelve sessions, in which about 70 papers and reports had to be dealt with. In order to crowd these into the four days of the meeting it was necessary to hold duplicate sessions during two periods. The program as a whole was heavy because of its length and the range and importance of its contents. It is possible that the society will soon go over to the plan of holding two meetings a year, in order to reduce the meeting programs to workable length.

Some Specification Results—While a large part of the committee work was too specialized for mention here, it is possible to indicate briefly some of the results affecting the common structural materials.

Many minor changes in steel specifications were reported and adopted, but certain proposed new tolerances for overweight of large plates were withdrawn. The most important single item in this field was a new specification for steel castings for railroad use, providing for two grades of material, with yield point from 29,250 to 36,000 lb. per square inch and elongation from 22 to 24 per cent. Improvement in the quality of wrought iron and malleable castings was registered by the adoption of higher test figures for these two materials, the tensile strength of malleable castings being raised from 45,000 to 50,000 lb. per square inch. Progress was made toward the adoption of specifications for cast-iron car wheels, following the sharp discussion of the subject a year ago, by the adoption of a tentative specification. A specification for semi-steel (to be called high-test gray iron) was also adopted, as was also an ordering form for foundry pig iron, the latter in the face of decided protest by steel-foundry and malleable men. Brass and bronze was a field of active work by the committee on non-ferrous metals, as usual; among the new specifications are two for brass and copper pipe. The fireproofing committee added a standard fire test for columns to its previous standards, and the committees on lime, gypsum, roads, timber and waterproofing all added to their routine standards. The committee on clay and concrete sewer pipe made some minor changes in the specifications for these materials.

The coal committee reported that it is impossible to prepare standard specifications for steam coal, but that sizes may perhaps be standardized. The rubber committee presented specifications for pump valves, revised its fire-hose specifications as well as others, and reported that it will shortly attempt to standardize weatherstripping, electrical protective matting, and the like. Some specifications for pigment and oils were brought out by the paint committee.

Committee Research Grows Rapidly—Research by specification committees is increasing rapidly, a number of committees now doing more research than actual standardization, particularly those in the paint and oil fields. Two interesting undertakings in this field are an exposure-test study of ship's-bottom (anti-fouling) paint, and tests of brush and spray painting.

A large number of test panels of steel, painted with many different combinations of anti-corrosive and anti-fouling paint, were placed in sea water at Perth Amboy, N. J., and Charleston, S. C., last fall, with the general result of showing that copper compounds are best in the northern water while mercury compounds are best in southern waters. Work with these two classes of materials will continue. As a first test of spray application, four identical houses at Bridgeville, Pa., were painted with the same paint, two by brush work and two by spraying (two different types of machine). Time and cost comparisons were reported by the committee for this test and for another comparative application on interior rough plaster; for the houses, expert brush work was better, while for rough plaster the spray application was both quicker and better.

The committee on drain tile is engaged in elaborate studies of the behavior of various kinds of tile in different soils but is not ready to report. The joint committee on culverts is studying, by means of a full sized test structure at Iowa State College, the pressure of fill on pipe and culvert. Committee C-9, on concrete, has under way a number of tests looking into methods of proportioning concrete.

Corrosion of Iron and Steel—Reporting further results of the inspection of exposure-test panels of iron and steel sheets at Pittsburgh, Fort Sheridan and Annapolis, the committee on corrosion, through J. H. Gibboney (Norfolk & Western Ry.), its chairman, confirmed and strengthened the results of previous inspections to the effect that copper-bearing steel is more resistant than steel containing no copper or extremely small percentages. This conclusion applies only to atmospheric corrosion; in mine-water exposure the results appear to reverse.

Interesting discussion of the relation of self-formed protective films to corrosion developed in connection with a paper "Preliminary Notes on Corrosion," by Prof. W. D. Bancroft (Cornell Univ.). The author referred immunity from corrosion essentially to stop-

page of chemical action between iron and the medium through the formation of a surface film of products of the chemical action. He declared electromotive-force measurements valueless, since they concern only the initial chemical action. Much divergent opinion came to light in the discussion, but Prof. W. H. Walker (Mass. Inst. of Tech.) and others advocated intensive small-area researches into the author's several suggestions for study of corrosion.

Water-pipe corrosion, according to F. N. Speller (National Tube Co.), appears to have some relation to film formation; protective films are formed by reaction between the initial corrosion product and the lime and silica of the water. It has been proved possible to reduce corrosion by extracting oxygen from soft domestic waters. Along the length of a pipe through which water flows, the amount of contained oxygen decreases from the point where the water enters, and this decrease can be used as a measure of the amount of corrosion going on. James Aston (M. L. Byers Co.) distinguished several types of protective-film action, including alloy protection, as in brass, and barrier protection, as in wrought iron (due to the slag layers). H. S. Rawdon (Bureau of Standards) said that the protective value of even small admixtures of tin in brass is well known, but that in general the problem of corrosion cannot be covered simply by the film theory; pitting, electrochemical effect, and other anomalous actions are of influence.

Joint Committee Activities—Co-operative and joint committee work with other societies also has shown some increase during the past year, and is now an important element of the society's standardization efforts. Through co-operation with the American Electric Railway Association a beginning was made toward wiping out differences in copper wire specifications. Joint action with several other societies led to drawing up a proposed standard specification for steel castings for locomotive use. Work on reinforced-concrete specifications by the well-known Joint Committee is still in progress, the tentative report of the committee coming up for discussion at the meeting as noted hereinafter. A similar inter-society committee is at work on specifications for reinforced-concrete culvert pipe. Several other co-operative undertakings are in progress.

Sulphur in Rivet Steel.—The first fruits of the work of the joint committee on sulphur and phosphorus in steel were presented in a report on tests of rivet steel with varying sulphur (0.03 to 0.18 per cent). Only the test data were given, without interpretation or conclusions. There were decided variations of carbon and manganese in the range of steels, and many of the test variations seemed to correspond to these rather than to sulphur variation, a fact emphasized in discussion by J. C. Unger (Carnegie Steel Co.). The most decided changes in mechanical properties appeared in the results of notched-bar impact tests, but according to special micrographic studies reported in discussion by H. S. Rawdon (Bureau of Standards), some of these may be chargeable to peculiarities of the heat treatment, especially the low impact strength found in the annealed rivet bars.

Symposium on Impact Testing—In recognition of the growing interest in testing for brittleness, a symposium on impact testing had been arranged by the society. It brought out nine important papers. Practically throughout they dealt only with the various impact-testing machines and forms of specimen, and did not discuss the meaning of brittleness or its manifestations in service or in the laboratory.

General reviews of the subject were presented by H. L. Whittemore (Bureau of Standards), who compiled a bibliography of the subject, and T. D. Lynch (Westinghouse Elec. & Mfg. Co.), who reviewed the work in impact testing done by the British Engineering Standards Association. C. L. Warwick, secretary, summarized the results of an inquiry directed to a large number of American laboratories as to their practice in notched-bar impact tests, which indicated that both the Charpy and the Izod machines are extensively used. Variation in detail, however, suggested a need for trying to standardize impact testing in this country, a recommendation in which a number of the other speakers agreed.

D. J. McAdam, Jr. (Naval Experiment Station), dealing with "Impact Tests of Metals," described the several machines, and discussed the various studies made of the relation between impact resilience and static-test resilience, with the conclusion that there is "no good reason to assume that static-resilience tests on notched bars are inferior to impact-resilience tests as a means of detecting brittleness." He further discussed desirable elements of the impact-test specimen, and analyzed the relation of form of specimen to the display of plasticity in the tests in a very interesting manner, with the conclusion that a properly notched specimen is sensitive in the third degree to variations in plasticity. T. R. C. Wilson (Forest Products Laboratory) outlined the practice of the Forest Service in impact tests of wood, chiefly the use of the Hatt repeated-blow impact machine. The relation of the height of drop at fracture in this machine to the energy of rupture obtained in a single-blow test has been found to be constant but not linear. The author concludes that static bending, single-drop impact bending and repeated-drop impact bending (all without notching the specimen) gives measures of toughness, though their results are not directly proportional. He brought out the importance, in testing wood for toughness, of allowing the deformation to spread over as much of the test specimen as it will, since it is by such study that the toughness of hickory, for example, manifests itself. The Izod test and other notched-bar tests are therefore valueless for wood.

A very different field of testing was covered by E. B. Smith (Bureau of Public Roads) under the title "Impact Tests of Road Materials." The Page impact machine for toughness of rock, the new Jackson gravel test, and impact tests for the toughness of bituminous materials were described, in addition to the slab impact tests carried on at the Arlington farm of the Bureau. The paper emphasized the absence of accepted standards in this field.

Two papers dealing with impact pressure were presented by C. E. Margerum (U. S. Navy) and A. Elmendorf (Haskelite Mfg. Corp.) under the titles "The Measurement of Pressures Caused by Impact," and "Measuring Forces in Impact." The first paper proceeded on the view that energy of rupture has no meaning and that the pressures exerted in impact should be determined; and the author, believing that it is impracticable to compute such pressures from the space-time curve of the impact, proposes the use of a crusher piece

to measure the pressure. Instead of using a crushing cylinder as in large guns, a small steel ball which bears against a piece of steel is suggested, and its application to a Charpy pendulum is shown. Mr. Elmendorf, however, showed how the double differentiation of the space-time curve to obtain impact pressure is possible, by the use of a differentiating instrument which he has devised. In this machine the tangent to the original curve is determined by the setting of an arm carrying a mirror, which mirror must be so set that the curve and its image will not form a cusp.

A distinctly new idea in tensile impact testing was brought forward by Prof. H. F. Moore (Univ. of Illinois), who described a machine in which the test specimen is hung from a steel calibration bar whose stretch is measured by a sensitive autographic extensometer; this machine has been used in some special testing of metal for toughness.

Noteworthy comments on the relation or rather lack of relation between impact and static-test results were presented under the title of "Significance of the Impact Test" by F. C. Langenberg and N. Richardson (Watertown Arsenal). Numerous test results on ordnance forgings show that when the static-test values are low the Charpy values will also be low, but good static results do not assure a good Charpy result. In the belief of the authors the impact test can be used only for comparative purposes, to determine whether a piece of material is as tough as a known standard piece. Thus, in certain work a Charpy value of 6 ft.-lb. has been known by experience to correspond to satisfactory durability of the piece; accordingly no other piece of the same kind is accepted unless it gives a Charpy test of 6 ft.-lb. or over.

In discussion, Prof. W. K. Hatt (National Research Council) described the development of his tensile-impact machine in 1898. Some anomalies in drop tests of railway axles were reported by L. H. Fry (Standard Steel Works). Mr. McAdam raised the question of whether the relation between the static and impact elastic limit had been determined, but no answer was forthcoming. A. T. Goldbeck (Bureau of Public Roads) described a pressure-measuring device of Swedish origin, in which the mark made by a ball on a blackened plane surface is measured.

Fatigue of Material—Though presented much less ambitiously—in a single paper instead of a symposium—the subject of fatigue brought out more active discussion than did impact. Profs. H. F. Moore and T. M. Jasper (University of Illinois) and J. B. Kommers (Univ. of Wisconsin) set forth in their paper the main results of fatigue investigations to date—all the final results being due to the National Research Council investigation carried on at Illinois. Various testing machines designed for the work were described, but all useful work hitherto has been done on a rotating-beam machine. Three facts of outstanding importance have been discovered: (1) Steels have an "endurance limit," a stress below which they can bear repeated stressing and reversal indefinitely—i.e., well over a hundred million reversals—and above which they fail after a limited number of reversals; the curve of stress against number of reversals, plotted on double logarithmic paper, consists of two straight lines, an inclined part and a horizontal part, the latter marking the endurance limit. (2) The endurance limit is very closely the same as the stress intensity of cyclic bending which shows a rapid increase in heat generation in the specimen, measurable after one minute or less of testing. (3) The endurance limits of different steels are fairly well proportional to their ultimate tensile strengths. While the same facts have not yet been demonstrated for reversals of direct stress (axial tension and compression), they place the subject of fatigue on a solid foundation.

D. J. McAdam in discussion reported tests made at the Naval Experiment Station on cyclic bending with specimens having uniform stress on 1½ in. length, using various steels variously tempered, including nickel steel. No abrupt break in the curve was found, but the failure stress continued to decrease slightly with increase of number of cycles. The slope of the curve increased with the hardness of the steel. L. B. Tuckerman (Bureau of Standards) showed that the Illinois results when plotted with log-log abscissas so as to emphasize the transition between the two parts of the curve exhibited a sharp break at the endurance limit quite unmistakably. He also pointed out that they are the first extensive tests carried as high as 100,000,000 repetitions, and attempted to draw a parallel with certain observations of Dalby on hysteresis loops, while decreased and finally disappeared upon continued repetition of stress, unless the range of stress was made too great, when they did not decrease.

Beautiful photographic demonstrations of stress lines in celluloid bars, shown by polarized light, were exhibited by A. L. Kimball (General Electric Co.), though unfortunately the results have not yet been correlated with the fatigue experiments. Prof. A. Marston (Iowa State College) reviewed the origin and early development of the polarized-light method, referring it back to 1870; he worked on stresses in bridge rollers by this method in 1892, and was able to develop an exact theory of the stresses in rollers.

Fatigue tests on aluminum alloys by R. L. Templin (Aluminum Co. of America) indicated a continued down-slope of the failure-stress curve; after an arrest producing a short horizontal segment there was a renewed down-slope. Some thermal tests on very hard steels were reported by H. Styri (S. K. F. Laboratories), who varied the method by carrying the repetition of stress to constant temperature: the plot of temperature rise on stress showed no sharp break as in the Illinois tests but curved continuously, going up very sharply toward the end. Thos. H. Wiggin stated that fatigue tests on chain iron gave the contradictory result that worthless material, high in phosphorus, gave good fatigue results, standing 15 million reversals at 40,000 lb. stress without failure, while good chain iron broke at 500,000 reversals of the same stress.

At another session H. F. Clemmer (Illinois Highway Department) presented a paper on some fatigue tests of concrete he has been carrying on. The test specimens were devised to simulate the conditions at the edge of a concrete road, where service observations show failure to be common. The test pieces were disposed as the radii of a circle, the circumference of which was a track over which traveled two rubber tired automobile wheels with the axle centered on the center of the circle. The radial specimens were fixed at the center and extended into the path of travel so that they were subjected to a recurring cantilever load every time the wheel passed over them. The tentative conclusions

of the test are that concrete will fail under a repetitive test that imposes a rupture modulus only 60 per cent of the static modulus, that a repetitive load producing stress below rupture will slightly increase the static strength, that the richer the concrete the better able it is to withstand repetitive loading. In the tests reported the repetitions of loads in the failure tests were comparatively low in number.

Concrete—The field of concrete was somewhat less active than usual, with no new standards and only four papers. Three committees, on Concrete, on Cement and on Reinforced Concrete, reported and in two other committees, on Lime and on Brick, matters relating to concrete were discussed. Finally the society's representatives on the Joint Committee on Concrete and Reinforced Concrete reported progress and the tentative report of that committee was discussed by the other committees interested in it.

The cement committee reported that although the standard specification for portland cement had accepted as "American Standard Specification No. 1" by the American Engineering Standards Committee it is planned to continue research work into the quality of cement and the method of testing it. The committee feels, however, that the present knowledge is not great enough to warrant standardizing the tentative compressive test for cement mortar adopted in 1916.

The completed work for the year of the committee on reinforced concrete consisted in the presentation of some proposed tentative rules for the inspection of concrete and reinforced concrete. These had been widely circulated among those qualified to discuss them prior to their printing but there was little comment upon them from the floor. In answer to some criticism that the rules seemed to be unduly rigid, Richard L. Humphrey, chairman of the committee, stated that they were intended to require a better grade of inspector that is now common in the hope of thereby raising the quality of concrete commonly placed. The rules were adopted as tentative and ordered printed in the proceedings.

The committee on concrete and concrete aggregates proposed a new tentative method of decantation tests for fine aggregate and recommended that the tentative standards on tests for voids, for organic impurities and for sieve analysis be advanced to standard. All were adopted by the meeting. Some undigested tests on concrete proportioning were presented in tabular form and the committee's criticisms of the Joint Committee's specification submitted. These latter are outlined in the succeeding paragraph.

Joint Committee on Concrete—According to the procedure of the society criticisms of the Joint Committee's tentative concrete specification, prepared a year ago, were made the duty of the respective committees of the society which are interested in the subject. Four of these committees made such criticisms, which have been submitted in detail to the Joint Committee and were outlined only at the meeting. There was no general discussion of the Joint Committee report. The chairman of the committee, Richard L. Humphrey, stated that in the fall the committee will begin its final draft of the specification, and that meanwhile it is hoped to initiate a series of field tests which will be of material assistance in formulating some of the disputed provisions of the specification.

Of the criticisms the most important is that of both Committees C-2 and C-9 which recommends that in the much discussed strength specification (Section 28 of the specifications) a tolerance be allowed according to the following provision—"At least 75 per cent of the test specimens shall show a strength greater than 80 per cent of the specified requirements in any given class." In this connection Committee C-9 says that it "favors the principle of giving the contractor an opportunity to furnish concrete of required strength according to his own methods, but the section as written allows him no latitude. Realizing the variable results which must be anticipated from tests of concrete made in the field, the committee has endeavored to recognize the rights of the contractor and to specify definitely what will be expected of him under this second method of proportioning." This committee also recommends the permission to use slag aggregate and that the mixing time be cut from 1½ to 1 min.

Committee C-7 on Lime argued for the inclusion of integral admixtures, which are prohibited in the proposed specification; Committee D-4 on Roads proposed that the words "portland cement" be inserted in front of the word "concrete" wherever it appears in the specifications and Committee C-1 on Cement argued against this suggestion. The road committee even went so far as to propose that the term "reinforced concrete" should be "reinforced portland cement concrete." Committee C-2 on Concrete stated that it considered it inadvisable to have more than one specification for reinforcing bars, but was willing to await the action of the bar committee which is now organizing.

Lime—The committee on lime submitted eight new tentative standards, mostly relating to chemical uses and laboratory practice and slightly revised the tentative standards for quicklime and hydrated lime. All were adopted without comment. As appendices to its report the committee submitted the results of several laboratory investigations into the effect of hydrated lime on concrete and a study of the tests on that subject made in the last two years by Prof. Duff A. Abrams. Tests made by W. E. Emley (Bureau of Standards) show that the addition of lime to a water-constant concrete decreases flow and increases strength while the addition of water to a lime-constant concrete does just the opposite. When both lime and water are added it is therefore difficult to evaluate results. Practically the same deductions were made by H. C. Berry (University of Pennsylvania) from some tests which have not yet been completely digested. H. F. Clemmer (Illinois Highway Department) found that with fine-sand concrete up to 7½ per cent, hydrated lime showed a slightly smaller strength but with coarse sand there was a slight increase. There are no definite results as yet from the tests on the stabilizing effect of lime on moisture content of concrete.

T. B. Shertzer (Lime Association) presented in abstract an elaborate study of the Abrams' tests on hydrated lime in concrete. In general he stated that lime can absorb an optimum amount of water; any additional amount merely goes to dilute the concrete. He claimed that in the Abrams tests relatively too much water was used in the lime-admixed concrete and that the loss of strength shown was due to this and not to the lime. He criticized the method of determining the water content by multiplying the base amount rather than by adding to that amount and said that if the

mixtures are adjusted so as to study those of proper water content the average compressive strength of concrete with hydrated lime was 9 lb. per square inch greater than that without lime. There was no comment on Mr. Shertzer's discussion.

Concrete Brick—In the reprinted report of the committee on brick there were a summary of tests on concrete brick made at Columbia University and a Proposed Tentative Specification for Concrete Building Brick. When the report of the committee was submitted it was stated that by a vote of 12 to 10 the committee had decided to withdraw the concrete brick specification because of inadequate data. The reported tests showed that "the limit of 1,500 lb. per square inch specified for the strength of individual concrete bricks is equivalent to approximately 3,800 lb. per square inch for individual clay bricks and both give when laid in 1:3 portland cement mortar, masonry of about 1,000 lb. per square inch compressive strength." Most of the producers in the committee are from the clay brick field. The standard sizes of paving brick adopted at the recent conference at Washington were approved by the committee and the sizes included in the standard specification of the society, subject to letter ballot.

New Test Methods—Several of the papers presented described new instruments or test methods.

Measuring the thickness of galvanized coatings can be done very much more simply than heretofore possible by a new method described by D. M. Strickland (American Rolling Mill Co.). A sample of known area is placed in a known amount of acid and the temperature rise measured after 30 sec.; the rise multiplied by a constant gives the weight of coating in ounces per square foot. The method is quick and accurate and can be used in the field.

Two methods by which the quality of welded joints can be measured were tried out by the Westinghouse Electric & Manufacturing Co., results being reported by T. Spooner and I. F. Kinnard. They depend on measuring the magnetic and the electric conductivity respectively. Both gave a close check on tensile tests, and, while tending to average local defects, gave positive indication of poor welds. The magnetic method was found the more readily applicable of the two.

Some new devices for the study of paints were brought out. One is a centrifugal plate for forming paint films whose characteristics and defects are to be studied; this was developed at the Bureau of Standards and was described by P. H. Walker and J. G. Thompson. The other is an accelerated-test arrangement for outside paints, which consists of a barrel in which the specimens are exposed to strong ultra-violet light, either with or without water spray. It is claimed to affect the paint as much in one day as sunlight does in one month. Discussion of this paper, however, threw strong doubt on the value of the method as a test of paint durability.

F. H. Jackson (Bureau of Public Roads) proposed an impact test for gravel, comprising a falling steel ball which strikes the test specimen of gravel held on a lower steel ball. The measure of the test is the height of fall required to shatter the gravel. It is offered as a method of testing gravel aggregate for concrete in substitution for abrasion tests, which apparently do not give a true measure of the availability of the concrete for road use. This test should reject soft material when properly applied. It was stated that the New Hampshire Highway Department had tried the test on some local gravels, mainly of metamorphic origin, and that it seemed to detect poor specimens that might have passed the Deval test of wear. It was felt that it could be adapted to discover those specimens which had an outside sufficiently hard to withstand ordinary wear tests but a rotted interior, and if so it would be a useful method. R. W. Crum (Iowa Highway Department) said that the test would fall down on the smaller particles, which often are troublesome.

The committee on methods of testing submitted the preliminary steps in a nortworthy study of the various tests applied to materials. Classification of methods according to type of test has been made with a view to co-ordination of tests of similar nature and the adaptation of the best details from one test to another. The committee also presented some suggested definitions relating to testing, which were stated by H. F. Moore to be frankly an expression of the engineering rather than the physicist viewpoint. Some of the terms, principally "unit stress" instead of "stress intensity" were severely criticized by L. B. Tuckerman (Bureau of Standards)

Other Papers of Engineering Interest.—H. S. Rawdon and S. Epstein (Bureau of Standards) in a paper on the nick-and-bend test for wrought iron showed that fracture appearance (fibrous or crystalline) is chargeable to the manner of breaking the bar rather than to the quality of the iron. Some observations by Robert Job confirmed this. Tests of steel castings reported by L. H. Fry (Standard Steel Works) indicated that castings may not have a definite elastic limit but often give convex or irregular stress-strain curves, so that the elastic limit should not be specified. Other tests disagreed with both the facts and the conclusions reported.

An elaborate series of measurements of Brinell ball impressions in various metals was reported by Profs. F. E. Foss and R. C. Brumfield (Cooper Union), whose main result was to show that calculations of hardness number from depth of impression are likely to be seriously in error inthe case of very hard steels.

Important papers on subgrade materials in roads by J. R. Boyd (U. S. Bureau of Roads), on pit-run gravel in concrete by L. W. Crum (Iowa Highway Department) and on concrete proportioning by F. E. Richart and E. E. Bauer (University of Illinois) will be abstracted in later issues.

New Officers—Dr. George K. Burgess, of the Bureau of Standards, was elected president, succeeding Charles D. Young of the Pennsylvania R.R. Prof. Wm. H. Walker, of Masachusetts Institute of Technology, was elected vice president, and D. M. Buck, W. M. Corse, W. K. Hatt and J. R. Onderdonk were elected members of the executive committee.

The presidential address of Mr. Young commemorated the fact that the meeting was the 25th since the society's foundation in 1898 by a scholarly review of the work undertaken and accomplished in that period. Some brief inaugural remarks by the new president proposed that the society now undertake to make its standards more generally applicable, and suggested that such agencies as the Federal Specification Board would be glad to have their work taken over by the society.

The attendance was the greatest in the history of the society, being 743 men and 172 ladies. The previous record was 866 total in 1919.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Rivet-Hole Deductions in Tension Members

Sir—Several formulas and rules for calculating net sections of riveted tension members have been proposed, as mentioned in your issue of June 1, p. 911, in connection with a brief abstract of Prof. C. R. Young's paper in Bulletin No. 2 of the University of Toronto.

The exact theory may be applied by the use of diagrams, but since the deduction increases with increasing size of rivet several diagrams must be employed to cover all sizes of rivets, or else a single diagram for 1-in. holes may be used by entering the diagram with s/h and g/h instead of s and g. It is not always convenient to use such diagrams, and on this account approximate rules have been proposed in lieu of the exact theory. Prof. Young suggests the formula:

$$x = 1.50 - 1.25\ s/g,$$

and D. B. Steinman, in *Proceedings* of the American Society of Civil Engineers for April, proposes the formula:

$$x = 1.30 - s/g.$$

These straight-line formulas are sufficiently accurate for practical use, but in exceptional cases they do not give good results. The writer suggests the following formula as being accurate enough in all cases and at the same time practically as convenient as the straight-line formulas if the slide-rule is used:

$$x = 1 - \frac{3}{h}\left(\frac{s}{g+3}\right)^2$$

where x = the fraction of a rivet hole to be deducted.
g = gage, or transverse spacing,
s = stagger, or longitudinal spacing, and
h = diameter of rivet hole.

Ordinarily h is taken as ⅛ in. greater than the nominal diameter of the rivet, hence the coefficient $3/h = 4$ for ⅝-in. rivets, 3 for ⅞-in. rivets and 2.4 for 1⅛-in. rivets.

In using this formula with the slide-rule, $g + 3$ on the C-scale is set opposite s on the D-scale, and the value of the negative term of the right-hand member of the equation is read on the A-scale opposite $3/h$ on the B-scale. This result is subtracted mentally from unity, giving the value of x. The computation is made in a very brief time.

The accompanying table has been prepared to show the comparative values of x as given by the proposed formula and by the exact theory. It will be seen that the agreement is fairly close throughout a wide range of values of s, g and h.

VICTOR H. COCHRANE,
Consulting Engineer.
Tulsa, Okla., June 19.

COMPARATIVE VALUES OF RIVET-HOLE DEDUCTIONS
E, computed by theoretical formula
A, computed by approximate formula, $x = 1 - \frac{3}{h}\left(\frac{s}{g+3}\right)^2$

Value of Stagger s, in.	⅝-in. Rivets (¾-in. Holes) g=2 in. E	A	g=4 in. E	A	g=6 in. E	A	g=8 in. E	A
½	0.96	0.96	0.99	0.98	0.99	0.99	1.00	0.99
1	0.83	0.84	0.95	0.92	0.98	0.95	0.99	0.97
1½	0.64	0.64	0.86	0.82	0.95	0.89	0.97	0.93
2	0.24	0.36	0.73	0.67	0.89	0.80	0.94	0.87
2½	0	0	0.53	0.49	0.77	0.69	0.88	0.79
3			0.28	0.27	0.65	0.56	0.80	0.70
3½			0	0	0.46	0.40	0.69	0.60
4					0.24	0.21	0.56	0.47
4½					0	0	0.39	0.32
5							0.19	0.17
5½					....	....	0	0
6								
6½								

Value of Stagger s, in.	⅞-in. Rivets (1 in. Holes) g=2 in. E	A	g=4 in. E	A	g=6 in. E	A	g=8 in. E	A
½			0.99	0.98	1.00	0.99	1.00	0.99
1			0.96	0.94	0.98	0.96	0.99	0.98
1½			0.90	0.86	0.96	0.92	0.98	0.94
2	0.40	0.52	0.79	0.76	0.91	0.85	0.95	0.90
2½	0.09	0.25	0.63	0.62	0.82	0.77	0.90	0.85
3	0	0	0.43	0.45	0.72	0.67	0.84	0.78
3½			0.20	0.25	0.58	0.55	0.75	0.70
4			0	0.2	0.40	0.41	0.65	0.60
4½				0	0.21	0.25	0.51	0.50
5					0	0.08	0.35	0.38
5½						0	0.17	0.25
6							0	0.10
6½								0

Value of Stagger s, in.	1⅛-in. Rivets (1¼-in. Holes) g=2 in. E	A	g=4 in. E	A	g=6 in. E	A	g=8 in. E	A
½			0.99	0.99	1.00	0.99	1.00	1.00
1			0.96	0.95	0.99	0.97	0.99	0.98
1½			0.90	0.89	0.97	0.93	0.98	0.95
2			0.81	0.80	0.92	0.88	0.95	0.92
2½	0.25	0.40	0.69	0.69	0.85	0.81	0.91	0.88
3	0	0.14	0.52	0.56	0.76	0.73	0.86	0.82
3½		0	0.34	0.40	0.64	0.64	0.79	0.76
4			0.12	0.22	0.51	0.52	0.70	0.68
4½			0	0.01	0.34	0.40	0.59	0.60
5					0.15	0.24	0.47	0.50
5½					0	0.10	0.32	0.40
6						0	0.16	0.28
6½							0	0.16

Concrete and Brick Wall Tests

SIR—An article in *Engineering News-Record* for May 11, p. 795, entitled "Advocates Four-Inch Brick Walls," a brief abstract of a paper read by Wm. Carver of the Common Brick Manufacturers' Association before the Building Officials' Conference, refers to certain tests on thin walls made in England. The inference which one would draw from this abstract would naturally be to the effect that the tests were confined to brick walls. No particular criticism attaches to Mr. Carver because he failed to report other data from these same tests pertaining to the strength of thin walls of concrete cast in place and of concrete block. If, however, the subject is worth presenting at all to the building industry, it appears that it would be worth while to give the tests complete rather than that pertaining to one building material only.

The tests in question were made by the British Building Materials Research Committee and published in brief in the August, 1920, issue of *Concrete and Constructional Engineering*, under the title "Stability of Thin Walls, and Heat Transmission Through Thin Walls." A glance at the test data will show some interesting comparisons between the strength of brick walls and walls of concrete cast in place or of concrete block. Thus, the very next line of the table which contains the horizontal pull required to break the 42-in. section of brick wall gives the horizontal pull necessary to break the same length of section of concrete wall (1,262 lb. for a 4½-in. concrete wall, and 962 and 1,253 lb. for 4½ in. concrete-block walls; the corresponding figures for brick walls of the same thickness laid in cement mortar ranged from 705 to 895 lb.).

While the conclusions of this committee were to the effect that any of the walls tested have sufficient crushing strength to act as partitions, it is nevertheless interesting to note the comparative strength afforded by walls of the various materials tested. Tests of this sort should be encouraged because they will undoubtedly prove that a great deal more material is ordinarily used for partitions in dwellings and apartment houses than is required. This uneconomical use of material must, of course, be laid at the door of building and code regulations which require excessive thicknesses, not only of partition walls but of exterior walls as well.

Chicago, June 21.
A. C. IRWIN,
Engineer, Structural Bureau,
Portland Cement Association.

Field Check on Earth Pressures

In the article by H. S. Schick, entitled "Field Check on Formulas for Earth Pressure" in *Engineering News-Record*, June 15, 1922, the following appeared on p. 994. "If it were assumed that the rock actually carried no horizontal load whatever it could be made to appear that the reduction amounted to 2.5 per cent, ..." This figure should have been 26.5 per cent.

News of the Week

New York, July 6, 1922

Detroit Council Delays Approval of Pennsylvania R.R. Plan

The City Council of Detroit has refused to grant a hearing on the ordinance that has been prepared to permit the construction of the Detroit end of the new Pennsylvania Toledo-Detroit extension. According to news despatches, this attitude of the council is based upon dissatisfaction with the dispositions of the Père Marquette R.R. and the Wabash R.R. in the matter of grade separation in Detroit. The Pennsylvania under its new plans will share trackage rights and other joint facilities with these railroads.

Reports indicate the probability of the Council's eventually withdrawing its opposition and consenting to hearings on the ordinance.

Coal Strike Conference Meets at President's Call

Called into conference by President Harding, representatives of the bituminous coal operators and miners together with Secretaries Davis and Hoover are seeking a way out of the strike that has been in effect since April 1. At the opening session the President indicated to both parties that the national government must intervene to restore coal production unless they can adjust their differences.

News reports since the beginning of the conference foreshadow a deadlock that will probably bring about such intervention. The operators have rejected the miners' proposals for a central competitive field wage conference, and the miners will have none of the operators' plans for independent district wage conferences. Government participation in a settlement of the strike will probably be directed toward a far-reaching reorganization of the bituminous coal industry.

House Accepts Senate Amendment to Muscle Shoals Appropriation

(*Washington Correspondence*)

By a vote of 145 to 105 the House of Representatives on June 24 agreed to concur in the Senate amendment to the War Department appropriation bill carrying $7,500,000 for the reopening of construction work on the Wilson Dam at Muscle Shoals. The vote carried with it, however, approval of an amendment by Representative James, of Michigan, which provides that no portion of the $7,500,000 is to become available before October 1. The purpose of the amendment was to give additional time for Congress to pass definitely on the Ford offer. The amendment was actively supported by those favoring the Ford offer who saw in the Senate amendment an effort to delay definitely any action on the Ford proposition. The House voted down, however, another amendment proposing a delay until January 1 before use could be made of the appropriation provided by the Senate amendment.

The Newly Elected Secretary of the American Society of Civil Engineers

JOHN H. DUNLAP

New Rules Governing Federal-Aid Road Work to Be Issued

Washington Correspondence

Following the signing of the federal highway act by the President June 20, the U. S. Bureau of Public Roads is preparing the regulations for administering the road statutes. These regulations have been under consideration for many months. They would have been promulgated earlier but it was deemed advisable to wait until after the passage of this year's bill. The regulations now are in the hands of the solicitors of the Department of Agriculture who are determining what changes, if any, are necessary as a result of this latest legislation.

The $50,000,000 which will be available during the current fiscal year means some reduction in the amount of road work which can be done in some states. The principal objection to the new bill is the reduction in the maximum amount per mile of federal aid allowed. As the provision is becoming more clearly understood, more and more complaints are being received, particularly from states having mountainous, desert, or swamp lands, and from sections where heavy bridges are required.

Maps of the 7-per cent system have been received from practically all the states. They show that the systems connect up well at the state boundaries. This is true to an unexpected extent.

Marconi Gets Fritz Medal

The John Fritz medal for 1922 has been awarded Senator Guglielmo Marconi for his invention of wireless telegraphy. The formal award will be made today in the auditorium of the Engineering Societies building, New York City. The committee in charge of arrangements is composed of Benjamin B. Thayer, chairman; George S. Webster, Philadelphia; Walter M. McFarland, New York City, and William McClellan, Philadelphia. At the presentation ceremonies addresses will be delivered by James R. Sheffield, president of the Union League Club, and by Michael Pupin, of Columbia University.

Railroad Shopmen Walk Out in Defiance of Labor Board

Protesting against the wage cut authorized by the Railroad Labor Board, the members of the railroad shopcrafts unions walked out on July 1. Six trades are involved: machinists, boilermakers, blacksmiths, sheetmetal-workers, electrical workers, and carmen, which in lude, together with helpers and apprentices, about 401,000 men.

An effort by the Labor Board to forestall the strike was frustrated by the refusal of B. M. Jewell, president of the railway employees' department of the American Federation of Labor, to attend a conference it had called for July 1. The government has indicated its intention to back the decision of the Labor Board with its full authority and to adopt all necessary measures to keep the trains running.

Decision not to strike has been announced by the maintenance-of-way forces who also were affected by the wage cuts. Other unions have not yet announced their intentions.

Townsend Favors Distribution of Remaining War Materials

Washington Correspondence

A plan for distributing to the states through the Department of Agriculture all the remaining surplus war material which they can utilize in road building and other purposes is put forward in a resolution introduced June 26 by Senator Townsend of Michigan. In the resolution it is stated that the various departments of the government still have on hand war supplies which cost more than $1,000,000,000. Senator Townsend calls attention to the fact that this surplus is being diposed of at public auction at nominal prices and "many times re-sold by the purchasers at unconscionable prices."

The resolution specifies, however, that it is in no way to interfere with the existing law which deals with the distribution of equipment suitable for road building purposes. Under Senator Townsend's plan, requisition would be made by the Governor of each state for such material as could be used by the states.

Dr. Elliott New President of Purdue University

Dr. Edward C. Elliott, whose resignation as chancellor of the University of Montana to accept the presidency of Purdue University was noted in this journal June 1, p. 929, has had an experience of 27 years as an educator and university executive. Born in Chicago

in 1874, he was graduated from the University of Nebraska in 1895 and spent the next two years at that institution as teaching fellow in chemistry prior to receiving his degree of Master of Arts in 1897. After serving four years as superintendent of schools in Leadville, Colo., he undertook graduate work in education at Columbia University, New York City, where he received his Ph.D. in 1905. Eleven years as a faculty member of the University of Wisconsin were followed by a call to become the first chancellor of the University of Montana, a position which he accepted Feb. 1, 1916. From this post he resigned May 16, 1922 to become president of Purdue University, Lafayette, Ind., where he will assume his new duties Sept. 1.

Dr. Elliott has served as educational adviser to many states and municipalities in different sections of the country and is now a member of the School Finance Inquiry Commission, which is making a nation-wide study of educational expenditures. He is the author of three books dealing with problems of public education: "Fiscal Aspects of Public Education in American Cities" (1905); "City School Supervision" (1913); "State and County School Administration" (1915, with Prof. Cubberley of Stanford University).

At the outbreak of the war Dr. Elliott was appointed a member of the Montana State Council of Defense and served as adviser to the Committee on Education and Special Training of the General Staff during 1918 and also acted as regional director of the Student Army Training Corps for the five northwestern states.

Automatic Train Control Ordered by I.C.C. for 49 Railroads

Declaring that "the art of automatically controlling trains has long since passed the experimental stages," the Interstate Commerce Commission has issued final orders to 49 of the more important railroads to install automatic train-control devices on about 5,000 miles of their lines before Jan. 1, 1925. It is estimated that the cost of equipping with one of the devices that has been tried, the way and rolling stock of a single-track railroad would be about $1,500 a mile.

Although it is contemplated that the roads will offer no further opposition to this step, it is improbable that any immediate action will be taken toward compliance with the order. Indications are that the railroads will carry on experiments on their own account to determine more accurately some of the economic factors involved.

Appoint Commission for Chicago Harbor Project

An interstate commission to investigate the feasibility of the project for a new lake-front port in the Chicago district to be known as Illiana, as the Illinois-Indiana state line, has been appointed under joint acts of the two state legislatures. The chairman is Walter J. Riley, president of the O. F. Jordan Co., East Chicago, Ind. Col. C. McD. Townsend, U. S. A., represents the United States on the commission. Mr. Riley and E. R. Erskine, president of the Studebaker Corp., South Bend, Ind., represent Indiana; and Illinois is represented by C. R. Miller, state director of public works, and W. L. Sackett, state superintendent of waterways, Springfield, Ill. The Illiana harbor project originated largely with Col. W. V. Judson, U. S. A., and was described in Engineering News-Record of Jan. 20, 1921, page 120, and July 28, 1921, pages 120 and 166.

The Engineer in Public Life

H. M. HUNTINGTON

The Board of Equalization and Public Service Commission is one of the departments recently created by the state legislature of Wyoming. This board has to do with tax rates, such rates as are established by large corporations, and many other commercial and economic problems. Wyoming has

selected an engineer on this board, H. M. Huntington, who was appointed when the board was organized. Mr. Huntington began his engineering career with the Chicago, Burlington & Quincy R.R. 32 years ago. He has been in continuous practice ever since, his experience including service with the U. S. Geological Survey and the U. S. General Land Office. He was county engineer of Sheridan County, Wyoming, for three terms, city engineer of Sheridan and chief and consulting engineer for the Sheridan waterworks.

Some years ago Mr. Huntington studied law but discontinued it just before taking his final examinations to be admitted to the bar. He was elected to the Tenth Legislature of Wyoming where he exerted much influence in matters pertaining to irrigation and engineering in general.

Mr. Huntington was born at Niles, Mich., in 1869. He went to Wyoming forty years ago. He resigned his position as city engineer of Sheridan to accept his present position on the State Board of Equalization in 1919 and was reappointed in 1921 for a six-year term.

Ketchum Named Engineering Dean at University of Illinois

Prof. Milo S. Ketchum, head of the department of civil engineering at the University of Pennsylvania since 1919, has been appointed dean of the college of engineering, University of Illinois, where he will assume his new duties Sept. 1. Prof. Ketchum is 50 years old

and has had a wide experience both as an educator and a consulting engineer since his graduation from Illinois in 1895. He served as dean of the college of engineering at the University of Colorado for a number of years and was in charge, during the war, of the construction of important explosive plants at Nitro, W. Va. In 1903-04 he held the position of contract manager with the American Bridge Co., in charge of the Kansas City, Mo., office. His professional work includes a wide variety of engagements on structural and irrigation problems and he is well-known as the author of a number of books dealing with the design of steel mill buildings, highway bridges, grain elevators and mine structures.

An extended biographical sketch of Prof. Ketchum appeared in *Engineering News-Record* of Sept. 25, 1919, p. 632, at the time of his appointment to the University of Pennsylvania.

Urge $74,000,000 Bond Issue for St. Louis Public Works

The General Council on Civic Needs of St. Louis, Mo., made up of 208 representatives of 70 civic organizations, has announced its recommendations as to items to be included in a proposal for a bond issue for municipal improvements to be presented for vote during the coming autumn. A feature of the report is the statement that the support of the council is contingent on the appointment of a representative bond supervisory committee to co-operate with the municipal authorities in the prosecution of the work.

The items enumerated by the council are:

Hospitals, institutions, health	$5,000,000
Complete sewer and sanitation program	20,000,000
Neighborhood playgrounds and recreation	4,000,000
Complete major street plan	17,250,000
Paving existing thoroughfares	2,800,000
Grade crossing elimination and viaducts	1,600,000
Municipal heating, lighting and mechanical plant	1,000,000
Fire Department equipment	400,000
Civic building	4,000,000
City markets	1,250,000
Memorial plaza and sites for memorial and civic buildings	5,000,000
	$62,300,000
Water works	*12,000,000
Total	$74,300,000

* Waterworks projects are financed independently of other municipal institutions.

Harding Signs New York Port Bill

President Harding has signed the bill approving the plans for the development of the port of New York as adopted by the New York Port Authority, a board operating under the joint auspices of the states of New York and New Jersey.

Study Truck Transport

A study of bus and truck transportation on federal-aid highways is being made by the U. S. Bureau of Public Roads. The work is under the immediate direction of Major I. C. Moller, who has established temporary headquarters at Boston so as to gather data as to this situation in New England. Questionnaires are being sent out with the idea of obtaining full information as to the distance covered by these operations.

Paris-Orleans Ry. To Electrify Line from Paris to Vierzon

According to recent dispatches, the Paris-Orleans Ry., one of the six great systems of France, has placed an $8,000,000 contract for 80 freight locomotives and 80 heavy high-speed passenger motor-cars. This equipment will be furnished by a group of French manufacturers headed by the Compagnie Française Thomson-Houston, representatives in France for the International General Electric Co. Although the larger part of the order will be manufactured in France, considerable quantities of material of American manufacture will, it is understood, also be required.

The engines will be used on an extension of the original electricification made a quarter of a century ago. The motor-cars will replace and extend the present suburban steam service out of Paris.

After a study of European and American experience the P-O Ry. has adopted a program for electrification based on the 1,500-volt, d.c. system. The first part of the new 1,500-volt section will cover 125 miles of dense main-line traffic between Paris and Vierzon. The high speed through passenger service from Paris to Vierzon on the way to southern France will be served by 1,500-volt d.c. locomotives weighing 250,000 lb. each and capable of running regular speeds between 80 and 85 m.p.h.. Although these machines are not included in the contracts thus far awarded, the railway company is expected to announce the placing of this business at an early date, and to give consideration to the purchase of large numbers of additional locomotives for use on the 2,000 miles of its system in the central plateau region.

Louisville Seeks Power Permit

The city of Louisville, Ky., has applied to the Federal Power Commission for a preliminary permit covering a power development at the United States dam in the Ohio River at the Falls of Louisville. The dam and the lock at that point have been recommended for reconstruction. Primary power to the extent of 28,000 hp. would be available at that point, it is estimated. The city plans, however, to install equipment capable of generating 50,000 hp.

Record June Rainfall at New York

June rainfall at New York City totalled 7.86 in., compared with 7.70 for June, 1887, the highest previous record for 51 years since the local office of the United States Weather Bureau was established.

Suspension Bridge Proposed for San Francisco Bay District

At a recent hearing before a board of army engineers in San Francisco a proposal was made to cross the bay at Carquinez Straits with a 3,000-ft. suspension bridge with a 1,500-ft. central span. It is understood that the bridge, if constructed, would be used by a local transit company.

N. P. Lewis Working on City Plan Program for Boston

As consultant to the City Planning Board of Boston, Nelson P. Lewis, consulting engineer, New York City, is making a brief study of existing conditions and available data for the purpose of suggesting a program of work to be carried out to reach the results desired. He will also suggest what use could profitably be made of existing agencies and what work could best be carried out under the immediate direction of the board.

Bids Asked for New Aqueduct for District of Columbia

With $2,950,000 made available in the District of Columbia appropriation bill to be applied on the construction of a concrete conduit from Great Falls on the Potomac to Washington, the District engineer has advertised for bids, to be opened July 17, for the construction of that portion of the conduit between Great Falls and the District line. The entire project includes also additional filters, a pumping station, and two reservoirs.

Organize $1,000,000 Firm To Handle Ohio River Traffic

Formation of the Inland Waterways Co., capitalized at $1,000,000 to build an extensive system of docks on the Ohio river at Louisville, Ky., and Jeffersonville, Ind., and the lease to the company of the necessary waterfront lands by the city of Louisville has been announced.

The docks at Louisville and Jeffersonville, on which work will be begun this summer are expected to open up possibilities of freight transportation on the Ohio river which hitherto have been impracticable, lacking an actual connection between the river barges, the railroads and the traction systems. The Interstate Public Service Co. which operates and connects with an extensive system of electric railway lines will construct the docking system on the Indiana side of the river and will conduct operations there. This company has held options for some time on a great deal of the Ohio river front at Jeffersonville. The new docks on the Kentucky and Indiana side will have direct connection with both railroad and traction lines.

The Inland company plans to float much heavy freight down the Ohio river from Pittsburgh, and to extend its operations down the river from Louisville as soon as the government locks are completed. In this way practically all-year operation will be assured.

The directors of the new company are James P. Barnes of the Louisville Ry. Co., D. B. G. Rose, Patrick Calhoun, Jr., Churchill Humphrey, Sevier Bonnie, James C. Willson, and Harry Reid.

A. S. Baldwin

Archibald Stuart Baldwin, for several years chief engineer of the Illinois Central R.R. and later vice-president of that road, died suddenly on June 27 while on a train from New York to Chicago. Mr. Baldwin was born at Winchester, Va., Sept. 28, 1861, and was educated at the Shenandoah Valley Academy, Winchester, and Staunton Military Academy, Staunton, Va.

He began his railway career in 1879 as an axeman on the Richmond & Allegheny R.R. (now part of the Chesapeake & Ohio Ry.) but later went to the Iron & Steel Works Association of Virginia as assistant engineer and then chief engineer. He returned to railway work in 1882 as assistant engineer on the Philadelphia extension of the Baltimore & Ohio R.R. and in 1885-1886 was principal assistant engineer on the Chicago, Milwaukee & St. Paul Ry. bridge over the Missouri at Kansas City. In 1887 he became an assistant engineer on the Louisville & Nashville R.R., where he remained until 1907, when he was appointed principal assistant engineer of of the Illinois Central R.R. In a short time he was made engineer of construction and in 1905 became chief engineer.

This position Mr. Baldwin retained until 1918 when he was promoted to be a vice-president of the Illinois Central R.R. Co., and in 1920 he was appointed vice-president in charge of the Chicago terminal improvement and valuation. In this last position he had supervision over two exceptionally important engineering projects: (1) Revision of the complicated passenger and freight terminal facilities; (2) electrification of suburban service and ultimately of main line and switching service also. He had attended the International Railway Congress at Rome in April and afterwards spent some time investigating European practice in railway electrification.

Mr. Baldwin was notable for his engineering skill, his executive ability and his pleasing and courteous personality. He was a member of the American Society of Civil Engineers and past president of the American Railway Engineering Association (1917) and the Western Society of Engineers (1919). An appreciative biography of Mr. Baldwin by the late Isham Randolph appeared in *Engineering News* of Feb. 17, 1917, p. 271.

Am. Soc. C. E. Directors Established Quarterly Meetings

In the editorial in *Engineering News-Record*, June 29, p. 1063, it is stated that the new constitution of the American Society of Civil Engineers prescribes the quarterly meetings of the society. This is not correct. The new constitution makes no provision as to meetings of the society different from the old constitution. The addition of spring and fall society meetings was approved by the Board of Direction at its meeting last January.

William Cushing Edes

William Cushing Edes, former chairman of the Alaskan Engineering Commission, whose death on May 25 was noted in *Engineering News-Record*, June 8, p. 975, was one of the best known and most successful railroad location engineers in the West, having devoted a long and active lifetime to this branch of engineering. He was born at Bolton, Mass., in 1856; graduated from Massachusetts Institute of Technology with the class of 1876 and after practising his profession in Massachusetts for a few years went to California in the late seventies. Entering the employ of the Southern Pacific R. R. he was identified with the location and construction of many of the main and branch lines built by that company. Among other work he was associated with William Hood, chief engineer of the Southern Pacific, in the location of that company's main line through Arizona, New Mexico and Texas. Later he had charge of location of parts of the Southern Pacific's coast route, relocation of the main line in Nevada and the location of difficult sections of the Central Pacific route over the Sierra Nevada Mountains.

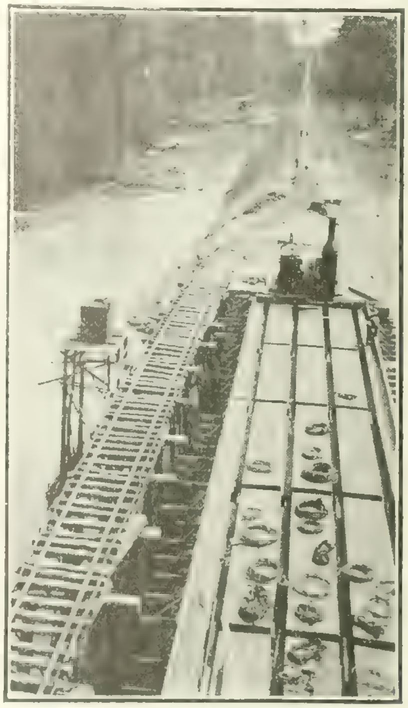
Located Difficult Route

For four years he was associated with W. B. Storey as assistant chief engineer of San Francisco and San Joaquin Valley R. R. between Richmond and Bakersfield, now a divison of the Santa Fe system. When the Southern Pacific and the Santa Fe decided to join in the construction of a single line that would tap the rich timber country along the northern California coast, the combination came about primarily because of the expense of building a suitable line for more than 100 miles in the canyon of the Eel River. This route is said to have been one of the most difficult pieces of railroad building ever undertaken in this country. Mr. Edes was selected to locate the joint route; his location was adopted and construction was carried out under his supervision. Mr. Edes was chief engineer of this system which connects Eureka with San Francisco from 1907 to 1914.

In May of 1914 he was selected by President Wilson as chairman of the Alaskan Engineering Commission. He established headquarters at Anchorage, Alaska, and after considering three routes for the railroad to the interior selected the one that he believed to be the most practical at a preliminary cost of slightly over half the amount appropriated for that work. Subsequent to the location phase of the Alaskan work he divided his time between Alaska and Washington, his presence being required by various Senate committees. When the other two members of the commission resigned, one to become Governor of Alaska and the other to enlist in the World War, Mr. Edes was in full charge of and responsible for all the activities of the Alaskan project. After five years of service on the commission and with the project well along toward completion, he resigned in December, 1919, to take a much needed rest. From that time until his death he made his home in California, devoting his attention from time to time to railroad engineering problems on which he was called into consultation.

Progress on Coastal Plain Bridge

Progress on the construction of the Santee River (South Carolina) bridge which, when completed, will be one of the longest county bridges in the South, is indicated in the accompanying view. The project is part of a recently-inaugurated and long-needed development for bridging the swamp lands of the Coastal Plain. The Santee River bridge is a joint undertaking of Williamsburg, Berkeley and Charleston Counties. The Rollin Construction Corp., New York City, is doing the work at a cost of about $800,000. Design features of the bridge and incidental construction were described in *Engineering News-Record*, Nov. 3, 1921, p. 725.



BRIDGE AND FILL CROSSING SANTEE RIVER

Study Bridge Fire Protection

The U. S. Bureau of Public Roads announces that a committee composed of a representative of the bureau, and representatives of the National Board of Fire Underwriters, lumber and creosote industries, and *Engineering News-Record* is investigating the subject of the destruction of steel bridges by fire and the best means of protection. This is in line with the campaign to prevent fires caused by the careless throwing of cigars or cigarettes when lighted while crossing a bridge with a wooden floor. Many such fires are started in this way the lineman says, but most of them are put out with small damage. Heat from a burning floor sometimes causes the destruction of the whole bridge by softening the metal near it, and the breaking of one weakened part will cause the whole span to drop into the river. On some large bridges a watchman is kept to guard against this danger and in a dry season fires have been known to occur almost daily. Announcement of the formation of the investigating committee was made in *Engineering News-Record* of Dec. 29, p. 1078. The work is nearing completion.

Construction Council Board Meets

In conformity with the resolution passed at the organizing meeting of the American Construction Council in Washington last week, the Board of Governors (which is the new name adopted for the council's executive board) met at the home of the president, Franklin D. Roosevelt, in New York, on June 23. Plans for the council's initial work were discussed, four lines of action determined upon, and an executive committee, composed of one representative from each of the eleven groups in the council, was appointed.

The work to be undertaken immediately concerns the lessening of unemployment in the industry and the lengthening of the construction season; the promotion of the establishment of apprenticeship systems for building mechanics; the formulation of a code of ethics and of standards of procedure covering all branches of the industry, and a study having in view the determination of the best way of collecting statistics gathered by the various associations and societies.

The executive committee, which is to function between the meetings of the Board of Governors, is as follows:

Architects, D. Knickerbacker Boyd, Philadelphia; engineers, Charles F. Loweth, Chicago; general contractors, Noble Foster Hoggson, New York; subcontractors, Oscar A. Reum, Chicago; construction labor, John Donlin, Washington; material and equipment manufacturers, William M. Ritter, Columbus; material and equipment dealers, M. T. Bannigan, Utica; bankers, bond and insurance interests, Willis H. Booth, New York; railroad and public utilities, Francis Blossom, New York; federal state, county and municipal officials, J. M. Gries, Washington; builders exchanges and building trades employers associations, Walter Klie, Cleveland.

Lower Postage for Publications Proposed in Bill

Reduction of second-class postage rates, originally imposed as war taxes, is provided for in a bill introduced in the House of Representatives June 9 by M. Clyde Kelly, of Pennsylvania. The proposed measure retains the zone system and even with the reductions gives the government 175 per cent more than the pre-war rates. The present postage rates on *Engineering News-Record* and other publications are 325 per cent higher than the rates before the war. Hearings on the measure will soon be held.

"The newspapers," said Mr. Kelly, in support of the lower rates, "are information highways just as essential to the business prosperity of this country as the highways and waterways. It is a common-sense policy to give them advantageous rates in the mail."

Get Oil from Tar Sands

The McMurray Asphaltum & Oil Co., Ltd. of Petrolia, Ontario, Canada, has been granted concessions by the Dominion Government and has perfected a process for seperating oil from the tar sands at Fort McMurray, Alberta. Nineteen hundred acres have been leased to the company by the federal government and it is planned to spend $250,000 on initial operations.

Want License Law Administered by Engineers, Not Educators

Emmett D. McFall, an Indianapolis engineer, laid before the Scientech Club at a recent meeting a resolution expressing dissatisfaction with the way the state board for the registration of professional engineers and land surveyors is administering the law. The resolution, which was referred to the club's executive committee, read as follows:

"We believe the general dissatisfaction with the law for registration of professional engineers and land surveyors is due to the way in which the law is administered rather than to any defects in the law itself and we recommend the law be administered by a board composed of practical men in active practice and that no member of the board be connected with any educational institution."

Prof. R. L. McCormick of Rose Polytechnic Institute, is chairman of the board. Organized engineers and the board have been in dispute over the admission of a number of applicants for state license. The engineers, it was said at the club meeting, believe the board has been too theoretical in its application of the law and is barring some from receiving Indiana licenses who should receive them.

Engineer Registration Board in South Carolina Organized

The South Carolina State Board of Engineering Examiners has organized as follows: G. E. Shand, Columbia, chairman; L. S. LeTellier, Charleston, vice-chairman; and T. Keith Legare, Columbia, secretary. The board will soon have made copies of the legislative act providing for the registration of engineers and land surveyors and will have printed necessary application blanks. The other members of the board are: W. S. Tomlinson, city engineer, Columbia; and George Wrigley, Greenville.

New Jersey Engineers License Now Required

Acting under the engineers license law passed at the last session of the Legislature, the New Jersey State Board of Professional Engineers and Land Surveyors, with offices in Jersey City, is now receiving applications from those desirous of practising professional engineering and land surveying in New Jersey. A fee of $25 must accompany an application to engage in either of these professions and for those wishing a license for both a fee of $35 is charged.

Bill Proposes Postal Engineer for New York City

A bill to reorganize and improve the postal service of New York City through engineering advice by consolidating the various separate postoffices and postal districts into one district with five sub-divisions similar to the five boroughs has been introduced in the House by Representative Rossdale, of New York.

The bill proposes that the Postmaster-General appoint a qualified postal engineer and two assistant postal engineers to maintain efficiency and generally improve the service.

Ask Bid for 6-Mile Moffat Tunnel

Rapid progress has been made on the preliminaries for the six-mile Moffat tunnel under James Peak to reduce the grades and summit elevation on the Denver & Salt Lake R.R., as described in *Engineering News-Record* of May 18, pp. 811 and 836. The commission has been appointed by the governor, organization of the Tunnel District has been perfected, preliminary engineering work completed, and plans prepared. It is expected that construction contracts will be let by Sept. 1, which will give time to install the plant and camps and start the headings so as to have the work underground before severe winter conditions set in at the 9,000 ft. elevation of the tunnel.

W. P. Robinson is president of the Moffat Tunnel Commission, which has offices in the state capitol building at Denver. L. D. Blauvelt, chief engineer of the Commission, has been interested in the development of this project for several years.

Committee Studying Design of Dirigible ZR1

Review of the design of the U. S. Navy dirigible airship ZR1 by a special engineering committee has been undertaken at the request of Rear-Admiral W. A. Moffett, chief of naval aviation. The committee consists of Henry Goldmark, consulting engineer, New York, chairman; Prof. Wm. Hovgaard, professor of naval architecture at Massachusetts Institute of Technology, Boston; W. Watters Pagon, consulting engineer, Baltimore; Dr. L. B. Tuckerman, Bureau of Standards; and Dr. M. Munk, National Advisory Committee for Aeronautics.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston. Annual [illegible], New Bedford, Mass., Sept. 12-1[illegible].

The American Ceramic Society will hold its summer excursion meeting Aug. 13-19, inclusive. Cities to be visited include Rochester, Montreal, Ottawa, Kingston, Toronto, Hamilton, Niagara Falls, and Buffalo.

The Engineers' Society of Pennsylvania at its recent annual meeting elected the following offcers: Theodore E. Seelye, of Gannett, Seelye & Fleming, president; first vice-president, Robert W. Moorehead; second vice-president, William Brown; secretary, Howard E. Moses; treasurer, Harry T. Neale; directors, Theodore E. Seelye, Robert W. Moorehead, William Brown, Harry T. Neale, Richard V. McKay, W. Grant [illegible], J. W. [illegible], Frank [illegible], S. R. [illegible], [illegible] M. Masters, [illegible] B. Harry, R. [illegible] Abbott, Her[illegible] [illegible] Thomas, [illegible] [illegible], and [illegible] [illegible].

The Arkansas Chapter of the American Association of Engineers at its recent meeting held in Little Rock listened to addresses on the Salt Lake convention and on the work done along the Mississippi levees in Arkansas by F. J. Herring and L. R. Parmelee, respectively. After the luncheon meeting, an inspection was made of the Broadway bridge across the Arkansas River.

Personal Notes

L. D. BLAUVELT, Denver, Col., has resigned as state highway engineer of Colorado in order to give all his time as chief engineer of the Moffat Tunnel Commission, which is preparing to let the contract for the 6-mile tunnel under James Peak on the Denver & Salt Lake R.R. His successor as state highway engineer has not yet been announced.

DR. J. W. TURRENTINE, formerly director of the experimental kelp-potash plant of the U. S. Department of Agriculture at Summerland, Cal., has obtained furlough from the Department for a period of six months to act as consulting chemist for the U. S. Kelp Products Corp., the newly organized concern which has purchased the government's Summerland plant and is now proceeding with the manufacture of kelp products.

FREDERICK E. BANKWITS, formerly managing engineer of the Fletcher-Thompson Co., Inc., industrial engineers of Bridgeport, Conn., has been chosen vice-president of the Seward Wire Co., of Parkersburg, W. Va., a new concern which will manufacture rubber covered insulated wire.

A. F. SCHRAMM, civil engineer of Roswell, N. M., has accepted the position of sales engineer with the Western Metal Mfg. Co., El Paso, Texas.

LYMAN P. HAPGOOD, superintendent of the Jamestown, N. Y., Water and Light Board for the past ten years, has resigned. He will be retained by the local municipal board as chief consulting engineer. MELVIN O. SWANSON, who has been a department engineer for the past two years will succeed Mr. Hapgood.

R. E. SPEAR, city engineer and assistant city manager of Ambridge, Pa., has resigned.

A. GOVETTE has been appointed superintendent of roads for the city of Longuille, Que.

C. J. COROCAN has been named superintendent of the St. Helena, Cal., municipal water works, recently purchased by the city for $60,000. Improvements costing $10,000 are planned.

E. J. PLATO has been named purchasing agent for the city of Sacramento, Cal., succeeding J. J. HALEY, who resigned to accept a position with the state department of engineering.

EDGAR S. CLOSSON, general supervisor of bridges and structures, New Jersey State Highway Department, has become associated with the Lynch Construction Co., Inc., New York City, as assistant to the president and will be in charge of construction work of the company. He was form-

erly chief engineer of the Lock Joint Pipe Co., Ampere, N. J., and in 1918-19 served as resident representative, United States Shipping Board, Emergency Fleet Corp., stationed at Mobile, Ala., in charge of all operations at the Mobile concrete ship yard.

W. C. Ely, Terre Haute, Ind., who has been a member of the board of managers of Rose Polytechnic Institute for many years, has been chosen president of the board to succeed William C. Ball, who died recently.

Creighton D. Bickley has been appointed highway construction engineer of Essex County, N. J.

Wynkoop Kiersted, consulting hydraulic engineer, Kansas City, Mo., has associated with him Henry A. Stringfellow, under the firm name of Kiersted & Stringfellow, with offices in Kansas City. The firm will make a specialty of waterworks engineering.

Marshall G. Findley, lately with Villadsen Bros., Inc., Salt Lake City, has now located with Gunvald Aus Co., consulting engineers, New York City.

Lieut.-Col. John P. Hogan has been transferred from staff specialists R. C. to the engineer O. R. C., and assigned to the staff of G. H. Q. Engineer headquarters.

James O. Wanzer, formerly an engineer with the California State Highway Commission, has been elected to fill the recently-created position of city manager of Marysville, Cal.

Warren C. Earle on June 1 became head of the consolidated offices of city engineer and street department, city of Pasadena. E. P. Dewey, formerly city engineer and John Beyer, formerly superintendent of streets, remain with the city, the former in charge of sewage investigations and the latter as assistant street superintendent in charge of construction. Mr. Earle has held the position of consulting engineer for the city of San Diego since 1916, giving particular attention to water rights and the city's interests in utility developments generally.

Ralph H. Stearns has severed his professional connection with Roger M. Freeman to accept a position in the hydraulic division of Sanderson & Porter, consulting engineers, New York City.

Charles J. Bennett, state highway commissioner of Connecticut, received the honorary degree of Master of Arts at the recent commencement exercises at Yale University.

A. B. Neumann, former chief engineer of the United States Steel Corp. and recently chief consulting engineer for the Steel and Tube Company of America, has opened offices as consulting engineer in the Peoples Gas Building, Chicago. Mr. Neumann designed and built the east works of the American Rolling Mills Co., made the layout for the original plant of the Mark Manufacturing Co. in Indiana Harbor, Ind., and designed and constructed the Pittsburgh Steel Products Co.s plant at Allenport, Pa.

Obituary

Walter L. Hull, city engineer of Orange, N. J., died recently after a few days' illness. Mr. Hull was first employed by the Lehigh Valley R.R. about eighteen years ago and since then worked successively with the New York Central, Pennsylvania, and Lackawanna Railroads. He was division engineer of the Lackawanna in the present grade-elevation work being carried on by that railroad in the Oranges previous to his appointment three years ago as city engineer of Orange.

Chales J. Deckman, a pioneer brick manufacturer of Ohio, died recently in Cleveland. Mr. Deckman was one of the early manufacturers of brick and founded several companies in and around Cleveland for brick manufacturing more than twenty years ago. He served for two years as president of the National Paving Brick Manufacturers Association and had taken a great interest in the development of specifications for the proper construction of brick street pavements.

Business Notes

Harry M. Wey has been appointed manager of the Chicago district of the Pittsburgh Testing Laboratory.

Fietz & Daniel announces its organization to design detail structural steel and ornamental iron work, with offices in New York City.

Walter J. Evans has been appointed manager of the Philadelphia sales office of The Webster Mfg. Company, Chicago, Ill.

The Chicago Bascule Bridge Co., Chicago, Ill., has opened an eastern office at 30 Church St., New York, and has appointed J. I. Vincent, who has been connected with bascule bridge work for many years, as its eastern representative.

J. F. Parsons, Robert Ed and Gilbert T. Ed have formed a general contracting partnership, the company to be known as the Parsons-Ed Co. The offices of the new company are at Moncton, New Brunswick.

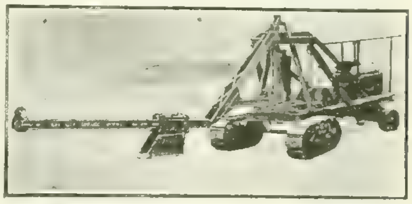
Rapp & Dunkel, structural engineers of Pittsburgh, have dissolved partnership and J. Harold Rapp has organized his own company. The company will furnish designs for complete industrial plants and details, estimates, inspection and supervision of structural steel concrete and timber work.

L. O. Hopkins, chief mechanical engineer of the Strauss Bascule Bridge Co., has accepted the position of chief engineer of the Chicago Bascule Bridge Co. He graduated from the University of Maine in 1905, was with the American Bridge Co. for about five years and went to the Strauss Bascule Bridge Co. in 1912.

Equipment and Materials

Skimmer Scoop Requires No Outriggers

The Bay City Dredge Works of Bay City, Mich., is putting on the market a new Bay City skimmer which does not require the use of outriggers. Outriggers are furnished on all machines as standard equipment and are necessary for clamshell work, but where the skimmer scoop is used the outriggers can be folded back out of the way. An additional point in favor of the machine is that it is equipped with a substantial brake for holding the scoop in any position on the boom. The skimmer can be operated with either



a single or double line. The single line is used for fast work in light or easy digging; the double line for slow speed in heavy work. The machine shown can be converted into a clamshell by removing the skimmer boom and putting on a clamshell boom. It is not necessary to rearrange machinery or use additional drums. The machine can also be used to operate a shovel type dipper, block and hook, electric magnet, and dragline bucket.

Out-of-the-Ordinary Trade Publications

A reference book of rules, tables, charts, and formulas for determining the correct size and capacities of reducing valves and the capacity and flow of steam in pipes of different diameters has been published by the Atlas Valve Co., Newark, N. J.

An excellent descriptive pamphlet which also contains considerable information of technical value on thrust bearings has been issued by the Kingsbury Machine Works, Philadelphia, Pa.

As advance pages of its forthcoming general catalog, the Sullivan Machinery Co., Chicago, has issued Bulletin 69-M dealing with diamond core drills. The illustrated description deals with both machines and methods and offers suggestions on how to select a drilling outfit.

Equipment and methods for the distribution of concrete on construction work by means of towers and chutes form the subject of a ninety-page illustrated booklet just issued by the Insley Manufacturing Co. of Indianapolis. This publication contains much data of use to engineer and contractor in the selection and operation of concrete plants. Such matters as tower height, size of hoist bucket, size of hopper, slope of chutes, and types of chutes are discussed in detail and descriptions, illustrated by photographs and drawings, are presented for a number of typical plant installations.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Contracts for June Second Heaviest Since April, 1920

Increase of $3,888,050 Over May, 1922—$31,866,186 Greater Than Corresponding Period in 1921

With June's contracts awarded figures added to those of the preceding five months a gratifying picture of construction activity is afforded for the first half of 1922. Contracts to the value of $779,766,747 were placed, an average of $130,000,000 per month. The June total is $175,445,000 for the United States, with an additional $6,897,000 for Canada. This record was exceeded only in March, 1922, when contracts to the total amount of $191,782,262 were let. Compare this record with other half-years:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

This is a straight money comparison, which ignores the changing value of the construction dollar. Reducing these figures to actual volume, by applying *Engineering News-Record's* Construction Cost Index Number, gives:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
1922	137 per cent

The figures in the accompanying table are compiled from Construction News, where minimum projects reach $25,000 each on public works, $40,000 on industrial construction and $150,000 in the case of commercial buildings.

Building construction throughout the United States, during June, aggregated $1,972,000 less than in May, 1922, but increased $27,155,000 over June, 1921, and exceeded the totals for June, 1920, by $52,459,958. Industrial construction for June, 1922, gained $9,869,000 the preceding month and $17,575,693 over June, 1921, and was $16,766,500 less than in June, 1920. June values for street-and-road contracts fell $2,031,000 under May, 1922, and $16,519,257 below June, 1921, but were $8,811,846 heavier than in June, 1920.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 1 to 11 are the following projects:

A tunnel project for Moffatt Tunnel District, Denver, Colo., $6,700,000.

A medical school at Cleveland, Ohio, for Western Reserve University, $1,750,000.

A department store for New York City, $2,000,000.

Paving 94,000 sq.yd., various streets, Port Arthur, Tex., $233,000.

Idle Freight Cars Fewer

Freight cars idle because of business conditions totaled 442,252 on June 15, compared with 465,837 on June 8 or a decrease of 23,585 cars, according to reports just received from the railroads of the United States by the Car Service Division of the American Railway Association.

Of the total, 268,863 were surplus freight cars in good repair, which was a reduction of 15,326 within a week. The remaining 173,389 were freight cars in bad order in excess of the normal number unfit for service.

Surplus coal cars totaled 171,832, a decrease since June 8 of 8,999, while surplus box cars amounted to 61,860 or a reduction of 3,301 within the same period. A decrease of 469 cars was reported in the number of surplus coke cars within a week, the total being 4,430, while there also was a decrease in the same period of 178 for stock cars, the total being 12,909.

Of the 2,275,596 freight cars on line, reports showed 332,681, or 14.6 per cent, to be in need of repairs on June 15, compared with 340,822, or 15 per cent, on June 1, a reduction of 8,141 cars. Allowing 7 per cent as representing the normal number in need of repairs would leave 173,389 cars as the number in bad order and idle because of business conditions. Freight loadings increased 85,444 cars for the week.

Engineering News-Record Construction Cost Index Number

July, 1922	169.70
June, 1922	166.62
July, 1921	203.82
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is three points higher than last month, due to continued stiffening in labor rates and to general rises in both cement and lumber. Steel prices are about the same as for the last two months, $1.60@$1.70, Pittsburgh. Average hourly rate for common labor is 44c. Thus, general construction cost is 17 per cent cheaper than one year ago and 38 per cent under the peak; it is 69 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
June, 1922	**187**
May, 1922	179
June, 1921	117
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 187 for the month of June, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 187, for June, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA IN JUNE, 1922

	[illegible] England	[illegible] Atlantic	Southern	Middle W[illegible]	West of Mississippi	Western	Canada	Total
[illegible]	[illegible]	[illegible]	$430,000	$1,120,000	$1,082,000	$295,000	$705,000	$5,124,000
[illegible]		1,009,000	286,000	2,540,000	594,000	336,000	393,000	5,158,000
[illegible]	[illegible]	4,148,000	[illegible]	1,408,000	965,000	920,000	353,000	8,625,000
[illegible]				427,000	366,000	1,812,000	23,000	2,628,000
Streets and roads	1,969,000	7,092,000	7,608,000	11,740,000	7,121,000	4,723,000	1,885,000	42,138,000
Industrial works	3,360,000	6,317,000	894,000	11,212,000	1,545,000	359,000	873,000	24,560,000
[illegible]	3,337,000	25,642,000	6,258,000	36,739,000	8,523,000	3,232,000	2,361,000	86,092,000
[illegible]	[illegible]	720,000	271,000	65,000	40,000	935,000		2,090,000
[illegible]	1,062,000	1,558,000	666,000	1,172,000	272,000	893,000	304,000	5,927,000
Total	$10,757,000	$47,129,000	$17,123,000	$66,423,000	$20,508,000	$13,505,000	$6,897,000	$182,342,000

Organize Building Trades

The Master Builders Association of Binghamton, N. Y., at a meeting May 12 discussed plans for a united organization of all branches of the building industry in that city and engaged Alvin L. Gilmore as executive secretary of the new body. The objects of the association are as follows:

To consider subjects affecting construction and service to the public; to establish principles and standards governing the construction industry; to act as a medium of co-operation among several groups; to promote steadiness of employment among trades; to set standards of skill and honorable reputation; to promote uniformity in building laws; to promote friendly relations among employer, employe and the public; to help enforce building laws and to regulate prices.

In addition the project includes the organization of a trade school of instruction in the building trades.

Large Contracts Are Let During the Week

Among the week's announcements of contracts awarded in Construction News pp. 1 to 11 are the following large projects:

An apartment at Chicago, Ill., to Schmidt Bros. Constr. Co., 22 East Huron St., Chicago, $1,500,000.

An apartment at Chicago, Ill., to Mueller Constr. Co., 179 West Washington St., $2,000,000.

A tunnel, San Francisco, Cal., Hetch Hetchy Project, to Grant-Smith Co., San Francisco, $683,000.

A sewer, Paducah, Ky., to E. R. Harding Co., 400 Robinson Bldg., Racine, Wis., $508,000.

Labor Rates and Conditions Throughout the Country

With increased production in the iron, steel and automotive industries, sustained construction activities and marked decreases in unemployment, the striking coal miners, railroad shop workers and cotton textile operatives appear to be the only deterrents to the rapid recovery of a normal employment basis.

Men are being sought to move crops in the Middle West, laborers are in demand at the steel and other metals producing centers and the building industry is suffering from an acute shortage of skilled labor throughout the entire country. Labor rates, therefore, will continue to advance slowly in many industries.

Wage increases of 5c. per hr. in the lumber industry; 2½c.@15c. per hr. in copper and steel operations; granting bonuses or the maintenance of 1921 wage schedules in the building trades, and wage advances in the automotive, silk and paper industries are contrasted with reductions in the wages of clothing, leather, textile and railroad workers.

Until the coal strike fourteen weeks ago, miners had been operating upon a pre-war wage basis, but railway track workers were receiving 15c. per hr. in 1915, 22c. in 1917, 48½c. in May, 1920, 40c. on July 1, 1921 and have been reduced to 35c. per hr., effective July 1, 1922. This reduction represents a total of nearly $135,000,000 in the wages of about 1,250,000 railway employees as against an annual decrease of about $300,000,000 in freight receipts due to the average 10 per cent reduction.

The percentage increase in employment in various industries, according to the United States Employment Service, runs as follows: automotive, 11.2; railroads, 4.6; iron and steel, 4.5; lumber, 3.0; food, 2.9; metals, 1.5; textiles, 1.1; paper, 0.8; miscellaneous, 0.4, and chemical, 0.2 per cent.

A brief summary of local labor conditions in the building trades, as reported by *News-Record* correspondents, is as follows: **Denver**—Building trades mechanics 100 per cent employed; bricklayers receiving higher than union rates. **Detroit**—Normal in all trades. No unemployment in building trades. Local factories are increasing forces but demand is not drawing men away from construction work. **Philadelphia**—Scarcity of bricklayers and carpenters. Plenty of hoisting engineers and hodcarriers; a limited supply of structural ironworkers; enough piledrivers and common laborers. **New Orleans**—Carpenters accept 85c. per hr., without contract, as against the old rate of 88c. Hodcarriers advanced to 60c. from 40c. per hr. Negotiations, regarding wage increases, pending with structural ironworkers and hoisting engineers. Piledrivers allowed to retain 1921 wage scale. Bricklayers granted 25c. per hr. extra for sewer work. Common labor increased 5c.@10c. per hr. **Cleveland**—Labor rates only nominal, most trades receiving more. **Pittsburgh**—Enough building trades mechanics; wages of common laborers, in many instances, advanced 5c. per hr. **Montreal**—Carpenters and common laborers advanced 5c. per hr.; conditions improved. **New York**—No unemployment in building trades, steady improvement in employment in other industries. Independent Bricklayers' Helpers' Union granted continuation of 1921 wage rates, $6.50@$7 per day, effective until Jan. 1, and affecting about 6,500 cement and concrete laborers and 1,500 plasterers' laborers within the city. **Duluth**—No unemployment; wages tend to advance. Contractors bidding for men to fill crews. Common laborers receiving 40c. as against 30c. per hr. Scarcity of common labor for road and paving projects; wage rates of $3.50 per day and upward being offered.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$0.70	$0.30	......	$0.65	$0.20
Baltimore	1.25	.80	.87	.54	$0.74	1.00	.30
Birmingham	1.00	.75	.50@1.00	.15@.25	......	1.00	.15@.20
Boston	.90	.90	.90	.60	.90	.90	.55
Cincinnati	1.25	.95	.95	.72½	.77¼	.95	.40
Chicago	1.10	1.00	1.10	......	1.10	1.05	.72½
Cleveland	1.25	1.04@1.10	1.04	.60	.91	1.10	+.57½@.75
Dallas	1.00	1.00	1.00	.60	1.00	1.00	.25
Denver	1.25	1.00	1.00	.75@.81¼	1.00	1.03¼	.35@.50
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.07½	1.00	1.00	.80	1.07½	1.07½	.....
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.56¼@.62½
Minneapolis	1.00	.80	.80	.65	...	.80	.35@.50
Montreal	.80	+.65	.50	.35	.50	.55	+.25@.35
New Orleans	1.00	—.85	.90	+.60	.80	1.00	+.35@.40
New York	1.25	1.12½	1.25	87½	1.00	1.12½	.44@.60
Pittsburgh	1.30	1.12½	1.00	.80	1.00	1.00	+.40@.60
St. Louis	1.25	1.12½	1.12½	.85	1.00	1.05	.35@.40
San Francisco	1.12½	1.00	1.00	.75	1.00	1.12½	.47½@.50
Seattle	1.00	.80	.90	.70	1.00	.80@.90	.50@.60
Philadelphia	1.00	.90	.90	.75@90	1.00	.90	.25@.35

Suggests Courses in Bricklaying and Other Building Trades

Lack of the old-time skill and efficiency on the part of building trades mechanics is commented upon, with particular respect to bricklayers, by the Common Brick Manufacturers' Association of America, *Monthly Digest* No. 21, as follows:

"No wonder there has been complaint of a shortage of skilled building tradesmen. Figures just compiled by the Federation of Construction Industries from the last census show that in many of the trades there was a startlingly large decrease in the actual number of journeymen from 1910-1920, in two cases the decrease amounting to 23 per cent and 19 per cent respectively; and even in trades showing an increase, in practically none did this equal the 15 per cent increase in the total population.

"That such a condition exists in the huge construction industry is a matter of the gravest national concern. Everybody knows how badly we are in need of houses and of other buildings, and everybody knows how scarcity of accommodations breeds high rents and scarcity of men discourages building.

"But that is not all. It is a common complaint that workmanship on a building is not what it used to be, and this observation is not confined to any particular trade. The fact is, there never has been much attempt to train an adequate number of men to replace those who normally drop out every year and to take care of the expansion of every trade as the industry grows with the country. A large proportion of the skilled artisans now available received their training in Europe. With immigration shut off the situation will become more serious year by year unless definite steps are taken to train our young men, and to train them so thoroughly that there will be a continuance of the supply of really first-class mechanics. The most logical place in which to begin to interest our youth is in the public schools. A boy's interest in a trade can be aroused in the most vivid way by teaching him some of the simpler processes and letting him actually handle the tools and materials. We owe it to the youth of our land to "sell them the idea" of learning a trade. Too many boys take a "blind-alley" job when leaving school. Turn the boy loose with a pile of brick, a board full of mortar, a trowel and a good instructor. The bricklaying trade is a very attractive one. Many of our successful contractors have worked their way up from the ranks of the bricklayers. It is a healthy, manly, outdoor job and the only limitations on the success of a student or apprentice are the limitations imposed by his own capacity. The wages are good compared with other building trades. From the point of view of the school, to run a bricklaying class costs less than any other branch of manual training. No machinery is required, and the local brick manufacturer is generally willing to supply all the brick required either gratis or at a nominal cost."

Work on New Bridges To Start Soon

Construction of new bridges on the Louisville & Nashville R.R. across the Rigolets and Chef Menteur channels is likely to begin soon, according to a recent statement of the president of the road. The Rigolets bridge, the more important of the two, will be built first; the estimated cost is $3,128,179. It is expected that work on this structure can be taken up before the end of the current year. The bridges are noteworthy because they are directly on the gulf coast and are exposed to occasional tropical hurricanes and wave action.

Employers Are Urged To Call for Government-Trained Veterans

In all the large industrial centers, according to the United States Veterans' Bureau, men are available for positions who have been trained in the rehabilitation division of the bureau. The scope of the training includes every trade, industry, and profession, not excepting agriculture; and instruction is furnished in leading colleges, technical and commercial schools, shops and business houses, and on farms.

Employers who need men of any type are urged by the bureau to communicate with the Rehabilitation Division, Employment Section, U. S. Veterans Bureau, Washington, D. C., stating the type of personnel required, when the position will be available, and the place of employment.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—No. 2 foundry iron up $1 in Birmingham and Chicago. Advances 40c. to 96c. per gross ton, at other principal furnaces. Coal and railroad strikes combined with sustained demand forcing prices of pig iron and other materials upward.

Railway Supplies—Light rails quoted at $30@$35 as against $30@$32 per ton, f.o.b. Pittsburgh; standard spikes $2.25 @$2.35 as compared with $2.25 per 100 lb., one month ago.

Pipe—Wrought steel pipe prices no higher despite continued demand. Higher pig-iron quotations forcing cast-iron pipe prices upward; advances of $1 in New York, $2 in Chicago and $3 per ton in Birmingham. Sewer pipe up 1c. in Philadelphia and 2c. per ft. in New York; slight rise in Minneapolis. Price reductions on sewer pipe and other construction materials, made possible by freight rate revisions, promptly outweighed by higher fuel and production costs, resulting in advances.

Road and Paving Materials—Road oils up ½c.@½c. in New York and ½c. per gal. in Chicago. Asphalt, in packages, down $4 in Chicago and Philadelphia and $6 per ton in Atlanta and Detroit; bulk asphalt reduced 50c. in San Francico, $4 in Chicago and Detroit and $4.50 per ton in Philadelphia. Minneapolis quotes $23.50 as against $21.35 per ton, in bulk.

Sand, Gravel and Crushed Stone—Both sand and gravel down 15c per cu. yd. in Seattle; sand up 3c. per ton and gravel 5c. per cu. yd. in Philadelphia. Crushed stone reduced 10c. per cu. yd. in Montreal. Factors determining price purely local in this group; e.g. demand, labor and transportation conditions rather than supply.

Lime—Hydrated finishing lime quoted at $15.80@$16.17 as against $15.80@ $16.80; hydrated common at $12.29, down from $12.50 per ton and common lump at $2.75@$3.14½ as compared with $2.75@$3.18 per bbl., 280 lb. net, f.o.b., New York. Changes due to freight rate adjustments.

Cement—Mill advances during June were due to higher fuel costs; 10c. at Buffington, Ind., Universal, Pa., and Steelton, Minn. Rise at mills reflected in advances in f.o.b. quotations, in sixteen important cities.

Structural Material—Steel shapes, plates and bars $1.60@$1.70, f.o.b. Pittsburgh; advance of 10c. per 100 lb. at Birmingham mills. New York warehouses quote bars at $2.58 as against $2.48; shapes and plates at $2.68 as compared with $2.58 per 100 lb., last month. Bars rolled from rails 10c. per 100 lb. higher in Chicago. Rivets up 15c. per 100 lb., Pittsburgh. Steel sheets, blue annealed, black and galvanized, advanced 15c.@25c. in Chicago and 15c. per 100 lb., New York.

Brick and Hollow Tile—Common brick quoted in New York at $21 wholesale, $24.60 delivered, as against $20 alongside dock and $23.50 per M delivered, one month ago. Advances of $1 in Pittsburgh, Minneapolis and Atlanta and 50c in Birmingham and Philadelphia. Brick demand heavy and supply light. Hollow tile slightly higher in Minneapolis and Philadelphia, lower in Atlanta.

Lumber—Prices rising because of higher labor cost and increasing demand. Long-leaf yellow pine, base sizes, up $1 in Atlanta and Minneapolis, $2 in Birmingham and Detroit, $3.50 in Dallas and $5 per M ft. b.m. in New Orleans. Similar advances in fir, hemlock and spruce.

Scrap—No. 1 railroad wrought down $1.50 and No. 1 machinery cast $1 per gross ton in New York. Cast borings quoted at $10, chemical industries, and $7, other industries, as against $9@ $9.50 per gross ton last month.

Manilla Rope—Prices down ½c. in Detroit and ½c. per lb. in New Orleans. Heavy stocks on hand.

Explosives—Rise of ½c. in San Francisco in 60 per cent gelatin dynamite; declines of 1c. in 40 per cent and 1½c. per lb. in 60 per cent, in Seattle.

Linseed Oil—Raw quoted at 90c. as against 91c. per gal. in New York and at 96c. as compared with $1.03 per gal. (5 bbl. lots), in Chicago one month ago.

Price [illegible] since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations com[illegible] by The Matthew Addy Co:

	Current	One Year Ag
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	[illegible]†	$25.80
Northern Basic	26 50†	25 50
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	29 16†	25 52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2 25 @ 2.75)	29.16†	32.26
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	18.50†	22.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25 @ 2 75 sil.)	27 32†	26 26
Virginia No. 2 (silicon 2.25 @ 2.75)	28 74†	27.00*
Basic	[illegible]†	25.00†
Grey Forge	[illegible]†	24.40
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	23.50†	22.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	25.17†	28.67
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	25.00†	24.96
Basic	25 00†	23 46
Bessemer	[illegible]†	24 96

*F.o.b. furnace. † Delivered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	$40.00	$45 00		$40 00
Standard openhearth rails	40.00	47 00	$40 00	40 00
Light rails, 8 to 10 lb	28@32	2.20@2.30*	1 60*	1.60@1.70*
Light rails, 12 to 14 lb	30@35	2 15@2 25*	1 60*	1 60@1 70*
Light rails, 25 to 45 lb	30@35	2.10@2.20*	1.60*	1.60@1.70*
Rerolled Rails	28.00	....		

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In x 8 In by 8½ Ft	7 In x 9 In by 8½ Ft.
Chicago, White Oak	$1 35	$1.50
Chicago, Hardwood and Red Oak	1.20	1 30
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco...... Green Douglas Fir	85	1 10
San Francisco, Empty Cell Creosoted, Douglas Fir	1.86	2.30
St. Louis, White Oak*	1 10	1 44
St. Louis, Red Oak*	97	1 17

St. Louis (creosoted)................No. 1, $0 86; No. 2, $0.96; No. 4, $1.28

*Standard specifications 38c. per tie additional. Zinc chloride process 27c. per tie additional.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, $\frac{9}{16}$-in. and larger	$2.25@2 35	$3 25@3 40	$2 [illegible]	$3 00	$4 10	[illegible]
Track bolts	3.25	4.00@4 35	3 [illegible]	4 25	5 10	[illegible]
Standard section angle bars	2.40	2 50	2 40	3 00	4 00	[illegible]

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	71	58½	¾ to 1½	44½	29½

LAP WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	64	51½	2	39½	25½
2½ to 6	68	55½	2½ to 4	42½	29½
7 to 8	65	51½	4½ to 6	42½	29½
9 to 12	64	50½	7 to 12	40½	27½

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	69	57½	¾ to 1½	44½	30½
2 to 3	70	58½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	62	50½	2	40½	27½
2½ to 4	66	54½	2½ to 4	43½	31½
4½ to 6	65	53½	4½ to 6	42½	30½
7 to 8	61	47½	7 to 8	35½	23½
9 to 12	55	41½	9 to 12	30½	18½

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

Black	New York	Chicago	St. Louis
1 to 3 in. butt welded	66%	62½%	59%
2½ to 6 in. lap welded	61%	59½%	56%

Galvanized	New York	Chicago	St. Louis
1 to 3 in. butt welded	53%	48½%	45%
2½ to 6 in. lap welded	47%	45½%	42%

Malleable fittings, Class B and C, from New York stock sell at list less 10%. Cast iron, standard sizes, *32-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York One Current	New York Year Ago	Chicago	St. Louis	San Francisco
4 in.	$42 00	$55 80	$53.30	[illegible]	$43.70	$55.00
6 in. and over	37 50	50 80	48.30	46.60	39.70	51.00

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$40 00	$50 00	..	$50.00	.....	$55.00
4	50.00	60.00	$80.00	60.00	$76.50	65.00
5	80.00	90.00		80.00	97.75	84 00
6	100 00	115.00	140 00	100.00	127.50	110 00
8	150.00	185.00	200 00	150.00	212.50	181.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0 16	$0 087	..		$0.12	$0 12	......
4	.16	087	$0.09	$0.0875	.12	.15	$0.18
5	.22	.1305	.1125		.18	.18	.165
6	.22	.1305	.135	.1225	.18	.21	.25
8	.37	203	.225	.20	28	.30	.35
10	.54	3045	.2925	.28	42	.42	.....
12	70	.3915	.3825	.36	54	.54	.80
15	1 20†	.522	.5625	.52	72	90	.....
18	1 65†	725	765	.68	1 00	1.32	.....
20	2 10†	87		.92	1.20	......	.....
22	2 70†	1 16		.....	1 60	......	.....
24	3 05†	1 305	1.50	1.20	1 80	2 16	2.40
27	4.70†	2.34	....	2 00	3.75†	3 00	.....
30	5 20†	2.59	.	2.45	4 75†	3 60	.....
33	6.70†	3.51	.	3.00	5 50†	...	.....
36	7.70†	4.00	.	3.25	6 00†	...	.....

	3	5	8	12	24	36
Boston	$0.105	$0.1575	$0 245	$0 4725	$1 575	$4 408
Minneapolis	..	..	.40	[illegible]	2 557	5 667†
Denver	.135*	18*	.27	47	1 70	...
Seattle	.13	..	.32½	.65†	2 34	.....
Los Angeles	.11*	165*	.275	495	1 65	.....
New Orleans	..	.106	.27	.459	1 755	.....
Cincinnati	.096	.144	.224	43	1.44	4.382†
Atlanta	.085*	1275*	.21	355	1 37	...
Montreal, *delivered*	.30*	.45*	.70	1.35	4 50	
Detroit	.099	1485	.231	.4455	1.935	5.125†
Baltimore	.1225	2275	.35	6870	2.29	5.23
Kansas City, Mo	.15*	.21*	335	.60	2 41	4.74
Philadelphia	.105	.1575	250	[illegible]	1 58	3.60†

*4-in., 6-in., 9-in., respectively. †Double Strength.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Current	One Year Ago
New York, 45% asphalt.... (at terminal)	$0.05	$0 06½
New York, 65% asphalt......(at terminal)	.045	06
New York, binder..........(at terminal)	.0575	.07
New York, flux............(at terminal)	.055	.06½
New York, liquid asphalt (at terminal)	.06	08
St. Louis, 30-50% asphalt (*f.o.b.*) *Wood River, Ill.*	.05	.02½*
Chicago, 40-50% asphalt	05½	06
Chicago, 60-70% asphalt	.05½	06½
Dallas, 40-50% asphalt	.10	.10
Dallas, 60-70% asphalt	.13	.13
Dallas, 75-90% asphalt	.15	.15
San Francisco, binder, per ton	13.00†	15 00

* Freight $21.75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbl. or 425-lb. drums) and in bulk in carload lots:

	Package	Bulk
New York (Dock D) (Mexican)	$17 [illegible]	$1[illegible]
Boston (Mexican)	18 [illegible]	14 [illegible]
Chicago (Standard)	[illegible]	[illegible]
San Francisco, f.o.b. refinery, Oleum, Cal.	19 50*	[illegible]
Dallas, [illegible]	35 00	27 00
Seattle "D" grade (California)	23 [illegible]	27 [illegible]
Denver (California)	40 00	
Minneapolis f.o.b. Twin Cities (Mexican)	[illegible]	23 50
St. Louis (Mexican)	22 [illegible]	14 [illegible]
Baltimore (Mexican)	[illegible]	[illegible]
Los Angeles, at plant, [illegible]	22 50	15 00
Montreal (Mexican)	28 00	21 00
Atlanta (Mexican)	[illegible]	1[illegible]
Detroit (Texas)	[illegible]	[illegible]
Cincinnati	32.00	28.00
Maurer, N. J. (Trinidad Lake (Refined))	[illegible]	[illegible]
Maurer, N. J. (Mexican)	1[illegible]	1[illegible]
Philadelphia (Mexican)	1[illegible]	1[illegible]
Kansas City, petroleum	28 83	22 83

*Freight to San Francisco, 80c. per ton.

†Petrolastic XX.

NOTE—Barrels or drums are optional in most cities. About 6 bbl. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York [illegible]	5-in. granite 28 to 29 blocks per sq.yd.	$131.75 per M
Chicago	About 4x8x4 dressed	3 20 sq.yd.
	About 4x8x4 common	3 00 sq.yd.
San Francisco	Basalt block 4x7x8	70 00 per M
Boston	5-in. granite	125 00 per M
Atlanta	Granite	2 00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	100.00 per M
Baltimore	Granite	2 00 sq.yd.
Montreal delivered	Granite	100 00 per M
New Orleans	Granite, 4 x 8 x 4	3 25 sq.yd.
Cincinnati	Granite	3 84@4 sq.yd.
St. Louis	4x8x4 dressed	3 35 sq.yd.
	4x8x4 common	3 00 sq.yd.
Kansas City	No. Granite	3 95 sq.yd.
Philadelphia	Granite	125 00 per M.

FLAGGING—

New York	Bronx	$0 25	sq.ft.
	Manhattan, 4 ft.	.26	sq.ft.
	Queens, 5 ft.	26	sq.ft.
	6x20-in. cross-walk	1 [illegible]0	lin.ft.
Chicago	18 in. wide	99	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (delivered)	3	1[illegible]	$2 04
New York (delivered)	3½	1[illegible]	2.17
New York (delivered)	4	16	2.36
Boston	3	16	2 17
Chicago	4	16	3 00@3 25
Chicago	3½	16	2 50
St. Louis	3½	16	2 50
St. Louis	4	16	3 00
Seattle	4	16	Off market
Minneapolis	3½	16	2 09
Atlanta	3½	16	2 30
New Orleans	3	16	1.60
New Orleans	3½	16	1.80
New Orleans	4	16	2 00
Dallas	4	18	3 90
Baltimore	3½	16	3.44
Montreal	4	16	4 50
Detroit	3	16	2 84
Detroit	4	16	3.00
Cincinnati	4	16	2 10
Kansas City	4	16	2 15
Philadelphia	3½	1[illegible]	3.80

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$1 75	$2 50	$1 75	$2 50	$1 00	$1 25
Denver	1 7[illegible]	2 00	[illegible]	1 80	[illegible]	1 60
Chicago	1.80	2.25	1.80	2.25	1.80	2.25
St. Louis, per ton	1 25	1 55	1 30	[illegible]	1 10	1 60*
Seattle	1 10	1 50	1 10	1 50	[illegible]	1 50
Dallas	2 25	3 50	2 25	4 [illegible]	2 25	3 [illegible]
Minneapolis	1 50	2 00	1 50		1 00	1 00
Cincinnati	1 87½	2 25	1 87½	2 30	1 43	1 [illegible]
San Francisco	2 25	2 25	2 25	2 50	1 50	1 50
Boston	2 40	2 65	2 40	2 65	[illegible] 65	2 00
New Orleans	2 08‡	2 85	2 08‡		1 35	1 [illegible]
Los Angeles, per ton	1 50†	1 45†	1 [illegible]†	1 45†	1 35†	1 30†
Atlanta, per ton	1 85	2 35	1 85		1 15	1 40
Detroit	2 00	2 25	2 00	2 25	2 00	2 25
Baltimore, per ton	1 40	1 40	1 60	1 60	2 00	70
Montreal, per ton	1 25	1 50	1 50	1 50	1 25	1 25
Birmingham, per ton (Crushed slag used instead of gravel)					1 28	1 43‡
Philadelphia	1 55		1 60		1 60	
Kansas City	2 00		2 00		1 20	

* Fine white sand: Pacific, $5 per ton, Ottawa, $6.

† Freight from quarry to Los Angeles is 85c. per ton, and is included in above price.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1 65	$1.90@2.00	$1 75	$2 15
Chicago	1.60	2 50	1 60	2.50
St. Louis delivered	1.65	2 60*	1 65	2 60*
Dallas, delivered	2.73	2.80	2 73	2 80
San Francisco	2.25	2 25	2 25	2.50
Boston delivered	3 00*	3 00* (del.)	3 00*	3 00* (del.)
Minneapolis, at plant	2 00	2 00	2 25	2 25
Kansas City at plant	2 10	1.25	2 10	1.40
Denver	3.50		3 50	
Seattle delivered	3 00	3.00 (del.)	3 00	3.00 (del.)
Atlanta	1.90*	2 25*	1 90*	
Cincinnati delivered	1.75	3 24	1 75	3.24
Los Angeles	1 75*	1.50*	1 85*	1 80*
Detroit	1.90*	2.00*	1 90*	2.00*
Baltimore	1.75*	1 75*	1 65*	1.75*
Montreal	1 90*	2.00*	2 00*	2.10*
Birmingham delivered	3.20		3.10	....
Philadelphia	1 70*		1.55*	....
Pittsburgh	2 85	..	2 85	....
Cleveland	3.00*	....	3.00*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1 30	$1.30	$2 00	$1.30
Steubenville District	1 40	1 40	2 00	1.40
Ironton District	1.40	1 40	2 00	1.40
Emporium, Pa.	1.25	1.25		1 25
Easton, Catasauqua, Pa.	1 00	1.00	2 00	0.90
Birmingham, Ala.	0.75	0.75		0.25
Buffalo, N. Y., and Erie, Pa.	1.25	1 25	2 25	1 25
Cleveland, Ohio	1.20	1 20		1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1 20	2 00	1.20
Western Pennsylvania	1.25	1.25	2 00	1.25

LIME—Warehouse prices

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$15 80@$16.17	$12.29	$3.68½*	$2.75@$3.1[illegible]*
Chicago	18.00	....	....	1.40†
St. Louis	23.20	20 00	2.35†	....
Boston	23 00	19.00	3.30†	3.00†
Dallas	25 00		....	2.50†
Cincinnati	15 10	12 50	10.75‡	12.50‡
San Francisco	22 00	18 00	....	1.75†
Minneapolis	29.00	22.00 (white)	1.70†	1.40†
Denver	24 00		....	2.70†
Detroit	18.00	16.00	....	17.00‡
Seattle paper sacks	24.00	....	2.80†	
Los Angeles	30 00	30 00	3.00*	3.00*
Baltimore	15.00	13 00	....	12 00‡
Montreal	21.00	21 00	15.00‡	11.00‡
Atlanta	22.50	13 00	2.00†	1.75†
New Orleans		17 25	1.75†	....
Philadelphia	13.00	12.00	10.50‡	9 50‡

*Per 280-lb. bbl. (net). †Per 180-lb bbl. (net). ‡Per ton—Refund of 10c per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.70, Sheboygan $1.55. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2 80
Kansas City (Ft. Scott)	1 60	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	1.77	1.87
Boston (Rosendale) per bag	.80	2.85
St. Louis (Carney hydrated)	2.10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags.* Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York, del. by truck	$2.40@2.50	$2.40@2.50	$2 80
New York, alongside dock to dealers	2.10	2.10	2.40
Jersey City, del. by truck	2 28	2 32	2.89
Boston	2.50	2 50	2.86
Chicago	2 05	1 97	2.17
Pittsburgh	2 09	2 02	2 17
Cleveland	2.31	2 26	2 43
Detroit	2 33	2 17	2 43
Indianapolis	2 26	2 21	2 43
Toledo	2 33	2 20	2.49
Milwaukee	2 22	2 16	2 39
Duluth	2 02	1 94	2.10
Peoria	2 26	2 08	2 45
Cedar Rapids	2 33	2 21	2 51
Davenport	2 28	2.14	2.47
St. Louis	2 20	2 20	3 00
San Francisco	2.63	2 83	3 09
New Orleans	3 20	3 00	3 36
Minneapolis	2 29	2 24	2 41
Denver	2 90	2 90	3.10
Seattle	2.90	2 94	3.10
Dallas	2.25	2 25	2.60
Atlanta	2.34	2 34	2 60
Cincinnati	2 39	2.35	2 57
Los Angeles	3 30	3.30	3.31
Baltimore, del. by truck	2.50	2 50	3 58
[illegible]	2 10	2 27	3 05
Kansas City	2 40	2 40	3.20
Montreal	2 88	2 48	.
Philadelphia	2 31	2 21	
St. Paul	2 29	2 24	2.41

Note—Bags 10c. each, 40c per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors.

Buffington, Ind.	$1 80	Mason City, Ia.	$1 95
Universal, Pa.	1 85	Hudson, N. Y.	2 00
Steelton, Minn.	1 85	Leeds, Ala.	1 85
Fordwick, Va.	1 95	Hannibal, Mo.	1 85
Mitchell, Ind.	1.95	Lehigh Valley District	1 90
LaSalle, Ill.	1.70	Kingsport, Tenn.	1 95
Iola, Kan.	1.95	Richard City, Tenn.	1.95

TRIANGLE MESH—Price per 100 sq ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	Dallas	San Francisco
032	22	$0 68	$0 95	$0 76	$1 15	$1 15
049	28	87	1 23	98	1 46	1 48
068	35	1 05	1 48	1 18	1 80	1 80
093	45	1 35	1 91	1 52	2 30	2 32
126	57	1 65	2 35	1 87	2 86	2 87
153	68	1 97	2 81	2 23	3 40	.
180	78	2 26	3 22	2 56	3 93	.
245	103	2 99	4 25	3 38	5 15	. . .
287	119	3 45	4 90	3 90	5.96	. . . .
336	138	4 00	5.69	4 52	7 32	6 01
395	160	4 64	6 60	5 20	8 00	. . . . .
PAVING						
036P	17	$0 52	$0 72	$0 58	$0 88	. . . . .
053P	24	.73	1 02	82	1 24	. . . . .
072P	31	91	1 29	1 00	1.57	. . . . .
097P	40	1 18	1 67	1 29	2 02	. . . . .
049R	24	73	1 02	67	1 24	. . . . .
067R	31	91	1 29	1 00	1 57	. . . .
089R	40	1 18	1 67	1 29	2 02	. .

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows.

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27BB	2 3	*$17 50*	$20 39	$21 25	$23 87	$25 50
26BB	2.5	*17 50*	22 00	22 75	26 21	27 56
25BB	3.0	*20 00*		27 10		30 71
24BB	3 4	*21 50*	26 33	29 25	27 90	33.16
22PO	4.33	*24 50*	31 00	31 75		35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Cut: New York	Chicago	St. Louis	Dallas	San Francisco
¾ and larger	$1 60@1 70	$1 85	$2 58	$2 58	$2 47½	$3 50	$2 55
⅝ and larger	1 65@1 75	1 90	2 63	2 63	2 52½	3 55	2 60
½ and larger	1 70@1 80	1 90	2 68	2 68	2 57½	3 60	2 65
⅜ and larger	1 85@1 95	1 95	2 73	2 83	2 72½	3 75	2 80
¼ and larger	2 10@2 20	1 95	2 78	3 08	2 97½	4 00	3.05

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	$1 70	$2 25	$3 25	⅜	$1 95	$2 50	$3 50
⅝ in	1 75	2 30	3 30	¼	2 20	2 75	3 75
½........ ..	1 80	2 35	3 35				

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.) ...	24 60	$23.50	$18 40	*$40 00*†	*$45 00*†
New York (at dock)...	21 00	20.00	15@15 50		
Chicago...........	11 00	11 00	12 00	34 00	42 00
St. Louis, salmon...	14 00	14 00	17 00		28.00
Denver, salmon.....	12 00	12 00	14 00	.	. . .
Dallas..............	11 15	11 15	12 50	no market	
San Francisco ..	15 00	15 00	18 00		.
Los Angeles (del.).....	15 00	15 00	15 50	(not used)	
Boston (del.) .. .	16 00	16 00	20 00	*42 00*†	*47 50*†
Minneapolis (del.).....	17@18	16@17	17 00		43 00
Kansas City..........	14 50	14 50	15 50		. .
Seattle...............	14 00	14 00	14 00	44 00	
Cincinnati............	15 00	15 00	18@20	41 00	36.50
Montreal	16 00	16 00	18 00		68 00
Detroit (del.).........	16.50	16 50	16 25@18	36 50	39 50
Baltimore (del.).......	20 00	20 00	25 00	36 00‡	. .
Atlanta.............	11 00	10 00	15 00		
New Orleans..........	12 50	12 50	14 50		
Birmingham..........	12 00	11 50			
Philadelphia........	17@18	16.50@17.50	16 50@17.50		44 00
Pittsburgh (del.)......	16@18	16.00	......		
Cleveland...........	14 00				

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current on Trucks*	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12. .	$0 11120	$0.12320	$0 0707	$0 10	$0 0635	$0 108	
6x12x12...	.16670	.1642	.0973		.08	.156	. . .
8x12x12...	.20840	.219	.1326	18	.12	244	$0.17890
10x12x12...	....	......	.1621	.	16		21050
12x12x12...	....	......	.1853		185	.	27370

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston........................	$0 94	$0 177	$0.244
Minneapolis (f.o.b. cars) ..	076	12475	220
Minneapolis (delivered).......	085	14025	245
Cincinnati.....................	0670	1263	175
Kansas City...................	085	167	.270
Denver.........................	08	145	.21
Seattle (delivered)............	12	25	.30
Los Angeles factory............	095	176	.22
New Orleans...................	12	23	36
Detroit (delivered)...........	070	135	.225
Montreal.....................	09	145	.30
Baltimore.....................	14	25	.39
Atlanta.......................	072	20	.. ...
Dallas........................	115		....
Birmingham....................	10	17	..
Pittsburgh (del.)....... ...	068	.128	179
Cleveland	.065	.143	

San Francisco, Philadelphia, Atlanta, New York, quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named.

	Pittsburgh, *Mill*	Birmingham *Mill*	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	1.60@1 70	$1 95	$2 68	$4 00	$2 57½	$2 68	$3 10
Channel, 3 to 15 in .	1 60@1 70	1 95	2 68	4 00	2 57½	2 68	3 10
Angles, 3 to 6 in., ¼ in. thick	1 60@1 70	1 95	2 68	4 00	2 57½	2 68	3 10
Tees, 3 in. and larger..	1 60@1 70	1 95	2 68	4 00	2 57½	2 68	3 10
Plates	1 60@1 70	1 95	2 68	4 00	2 57½	2 68	3 10

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse: New York Current	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$2 40	$3 60	$4 65	$3 10	$3 09½	$4 25	$5 50
CONE HEAD BOILER							
¾ in. and larger	2 50	3.70	4 75	3.20	3.19½	4.35	5 65
⅝ and 11/16......	2.65	3.86	4 90	3.35	3.35½	4 50	5 80
½ and 9/16.......	2.90	4 10	5 15	3 60	3 59½	4.75	6.05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.........	$2 40	*$3 10*	$3 90	$5 00	$3.25	$4 95
Cut...........	2 25	*5 50*	5 90	7 75	..	5 00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square, f.o.b., as follows:

	New York: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.
No. 1 grade....	$2 10	$2 55	$3.00	$1 90	$2 35	$2 80
No. 2 grade. ..	1.85	2 15	2 55	1 70	2 00	2 40

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Single shingles, red and green slate finigh, cost $5.50 per package (sufficient to cover 50 sq.ft.) in carloads; $5.75 in smaller quantities, in Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia. l.c.l., $5.60

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft...........	$2 00
Tar pitch (in 400-lb. bbl.), per 100 lb.	1 60
Asphalt roofing (in barrels), per ton, f.o.b. plant*.....................	40.50
Asphalt felt (light), per ton, f.o.b. plant*............................	64.50
Asphalt felt (heavy), per ton, f.o.b. plant*...........................	68.50

* Delivered in Metropolitan Dist., $3,00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10..................	$2 40	$3.62½	$3 63	$4.15	$3 63
No. 12..................	2.45	3.67½	3 68	4.20	3 68
No. 14..................	2.50	3.72½	3 73	4.25	3.73
No. 16.	2 70	3 82½	3 83	4 35	3 83
Black					
*Nos. 18 and 20.........	3.00	3 70	4 30	5.45	4.15
*Nos. 22 and 24.........	3.05	3.85	4 30	5.50	4 20
*No. 26.................	3.10	4.00	4 35	5.55	4.25
*No. 28.................	3.15	4.30	4.45	5.65	4.35
Galvanized					
No. 10 .	3 15	4 30	4 45	....	4.35
No. 12..................	3.25	4 40	4 55	5.60	4.45
No. 14..................	3.25	4.40	4 55	5.60	4.45
Nos. 17 to 21...........	3.55	4.60	4 85	5 90	4.75
Nos. 22 and 24..........	3 70	4.85	5 00	6.05	4.90
*Nos. 25 and 26 .	3 85	5 00	5 15	6 20	5 05
*No. 28.................	4.15	5 30	5 45	6.50	5.35

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Current	One Year Ago	Chicago: Current	One Year Ago
Raw in barrel (5 bbl. lots)	*$0 90*	$0 80	*$0 96*	$0.75

WHITE AND RED LEAD—Base price in cents per pound

	Red, Current, Dry	Red, Current, In Oil	Red, 1 Year Ago, Dry	Red, 1 Year Ago, In Oil	White, Current, Dry or In Oil	White, Yr Ago, Dry or In Oil
100-lb. keg	12 50	14 00	13 00	14 50	12 50	13 00
25 and 50-lb. kegs	12 75	14 25	13 25	14 75	12 75	13 25
12½-lb. keg	13 00	14 50	13 50	15 00	13 00	13 50
5-lb. cans	15 50	17 00	16 00	17 50	15 50	16 00
1-lb. cans	17 50	19 00	18 00	19 50	17 50	18 00

LUMBER

Prices wholesale to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6 8 and 12 Ft	10-16-18 and 20 Ft	22 and 24 Ft	25 to 32 Ft
3x3 and 4	$28 00	$31 00	$31 00	$33 00
3x6 and 8	28 00	31 00	31 00	34 00
4x4-6 and 8	28 00	31 00	32 00	35 00
3x10 and 12	28 00	31 00	32 00	36 00
3x14	32 00	33 00	34 00	36 00
4x10 and 12	28 00	31 00	32 00	35 00
4x14	32 00	33 00	34 00	36 00

	24 Ft and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$30 00	$33 00	$35 00
6x14	32 00	35 00	37 00
8x10	30 00	33 00	35 00
8x14	32 00	35 00	37 00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*, 20 Ft and Under	New York*, 22-24 Ft.	Chicago, 20 Ft and Under	Chicago, 22-24 Ft.
3x 4 to 8x8	$38 00	$39 00	$42 00	$45 00
3x10 to 10x10	41 00	42 00	46 00	48 00
3x12 to 12x12	44 00	45 00	49 00	51 00
3x14 to 14x14	47 50	48 50	52 00	55 00
3x16 to 16x16	52 50	53 50	57 00	59 00
3x18 to 18x18	60 00	61 00	64 00	67 00
4x20 to 20x20	70.00	71 00	74 00	77 00

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M less

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In x 20 Ft and Under, P.	Fir	Hemlock	Spruce	12 x 12-In 20 Ft. and Under, P.	Fir
Boston	$50 00	$52 00	$55.00	$45 00	$54 00	$52 00
Seattle	......	22 50	.	......	..	22 50
New Orleans	30 00	.. ..	......	.....	35 00	
Baltimore	36 45	......	......	......	38 50	.....
Cincinnati	39 00	50 00	......	......	40.00	64 00
Montreal	78.00	45 00	35 00	38 00	78 00	47 00
Los Angeles	.....	44 00	43 00	......	......	44 00
Denver	.....	38 00	38 00	38 00	.	51 00
Minneapolis	45 00	41 00	40 00	.....	48 00	41 00
Atlanta	33 50	.....	.....	.....	39 00	....
Dallas	37 50	.....	.....	.....	39 00	.. ..
Kansas City	33 00	34 00	...	.....	36 00	35 00
Birmingham	23 00	....		.....	28 00	.....
Philadelphia	36 50	39.00	42 50	48 00	46 50	38 50
Detroit	41 25	44 00	.		47 00	46 00
St. Louis	35 00	.....	.....	.....	38 00	

	1-In. Rough, 10 In. x 16 Ft. and Under, P.	Fir	Hemlock	2-In. T. and Gr. 10 In. x 16 Ft., P.	Fir
Boston	$47 00	$48 00	$32 00	$45 00	$48 00
Seattle	..	19 52	..	..	23 00
New Orleans, at mill	70 00		. .	37 00	.
Baltimore	35 00			36 45	.....
Cincinnati	62 50	80 00		33 50	....
Montreal	39 50	48 00	35 00	80 00	45 00
Los Angeles	....	37 00	36 00	.	43 00
Denver	...	35 25	35 25		33 75
Minneapolis	44 50	37.25	36.25	40 75	38 25
Atlanta	21 00	.....	.....	24 00	.. ..
Dallas	37 50	30 00	.....	40 50	.. ..
Kansas City	35.00	34.50	.....	20.00	31 00
Birmingham	22 00	.....	.....	24 00	.. ..
Philadelphia	29 50	37.00	43 00	32 50	37 50
Detroit	42 75	35 00		40 25	38 75
St. Louis	36 00	.....	.....	35 00	.....

Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $2.00 additional per M. ft. to contractor.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractor on large projects.

St. Louis—Wholesale price to contractors, $4 50@$6 per M ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb

Baltimore	$ [illegible]	Detroit	$ [illegible]
Birmingham	[illegible]	Kansas City	[illegible]
Boston	[illegible]	New Orleans	[illegible]
Buffalo	[illegible]	New York	[illegible]
Chicago	[illegible]	Pacific Coast (all rail)	[illegible]
Cincinnati	[illegible]	Philadelphia	[illegible]
Cleveland	[illegible]	St. Louis	[illegible]
Denver	[illegible]*	St. Paul	[illegible]

* Minimum carload, 40,000 lb

†Minimum carload, 50,000 lb., structural steel only, 80,000 lb for other iron and steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2 00	$2 00	$2 55

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	30%
Patent flattened strand, special and cast steel	30%
Patent flattened strand, iron rope	15%
Plow steel round strand rope	45%
Special steel round strand rope	40%
Cast steel round strand rope	32½%
Round strand iron and iron tiller	15%
Galvanized steel rigging and guy rope	17½%
Galvanized iron rigging and guy rope	+2½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅜-in., 8 ft., ¾-in., 6; ⅞-in., 4½; 1-in., 3⅓; 1⅛-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0 20	New Orleans	$0 17½
New York	17	Los Angeles	16½
Chicago	.19	Seattle	.18
Minneapolis	.19½	St. Louis	.21
San Francisco	.17	Montreal	.30
Atlanta	.21	Detroit	.19
Denver	.20	Baltimore	.20
Cincinnati	20	Kansas City	18½
Dallas	.29	Birmingham	.20½
Philadelphia	.18		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0 2950	$0 3250
Boston	.24	.275
Kansas City	.24	.2750
Seattle	.1775	.1975
Chicago	2450	2750
Minneapolis	.2144	.2347
St Louis	2475	2775
Denver	.2250	.2550
Dallas	.29	.375
Los Angeles	23	.26
Atlanta	2575	2875
Baltimore	.2550	.27
Cincinnati	.2350	.255
Montreal	.215	.255
Birmingham, *delivered*	.155	.175
New Orleans	.2725	.3075
San Francisco	195	.235
Philadelphia	.24	.27

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in	30 to 50 ft	$0.13	$0.17½
12 in.—2 ft. from butt	6 in	50 to 59 ft	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in	70 to 79 ft	0.25	0 34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$11 50	$11 50	$12 00
Stove plate	12 50	12 00	13.50
No. 1 machinery cast	*17.00*	16.50	14.50
Machine shop turnings	7.00@7.50	4.00	5.00
Cast borings	7 00@10.00	5 50	6 75
Railroad malleable cast	11.00	12 50	10 25
Re-rolling rails	11 50@12 00	13 00	15 00
Relaying rails	28.50	30 00	15.00

SHIP SPIKES—Current prices per 100 lb.:

	San Francisco Galv.	San Francisco Black	Seattle Black
[illegible]	$6 75	$5 50	$8.55
[illegible]	6.30	5 05	8 25
[illegible]	6.15	4 90	8.30

Pittsburgh base in lots of 200 kegs or more $2.50

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

Volume 89 — NEW YORK, JULY 13, 1922 — Number 2

Mr. Chandler's Retirement

THIS week Mr. Chandler relinquishes the acting secretaryship of the American Society of Civil Engineers. His going should not be without a word of commendation for his regime as the society's executive officer. He came to New York as the avowed selection of the progressive group of the Board of Direction. Quite naturally, therefore, the conservatives were on the alert to detect partisanship in his conduct of society affairs. But there was no partisanship. Mr. Chandler acted as he should have acted—not as the executive of the progressive group but of the whole society. He was tactful, he was human, and he won the admiration of those who looked upon him at first with suspicion. It appeared for a time that he might be the means of finally healing the breach between the two elements in the society's leadership. But that was not to be—due to his loss of the support of most of those who put him into office. For his diplomacy Mr. Chandler has been much praised. But he had more than diplomacy. He had backbone and conviction and to his backbone and conviction is due, at least in part, his elimination from the secretaryship. Just what were the motives of the board in replacing him has not been declared. It is to be hoped that they were due to honest disagreement on society policy between him and his opponents. Moreover it should be remembered that the new secretary was elected over Mr. Chandler only after repeated ballots and by a narrow margin. Brief though his regime, then, Mr. Chandler has reason to be gratified at the prejudice he overcame in New York and to be proud of the fact that his return to the West is due, primarily at least, to his faithfulness to his own views, even to breaking with those who were responsible for his election.

Traffic, Not Safety

PEOPLE have had the Brooklyn Bridge falling down for years. As far back as 1881, two years before it was opened to traffic, there was an editorial in this journal ridiculing an attack on the safety of the bridge. It is a favorite last resort of the Sunday supplement editor to picture the terror of the snapping cables and twisted trusses with miniature trains and pigmy bodies hurtling through space to the river. The alarmists have now another chance, for the city has barred the bridge to motor traffic. Hereafter only horse-drawn vehicles can use the roadway, and the newspapers are asking experts about overloads and crystallization and other high sounding things that may presage early dissolution of the bridge. This is unnecessary agitation. The Brooklyn Bridge is overloaded and has been overloaded for many years but the few motors that are not to be allowed on it now will not reduce that overload very much. The new order is a traffic corrective and is merely an indication of what the growing traffic problem is to do to our accepted ideas of rights of travel. The Brooklyn Bridge roadways are narrow and the approaches to them tortuous. A few weeks ago a new roadway was opened on the nearby Manhattan bridge which could be readily reached and quickly traversed and the opportunity was taken to reroute and classify the traffic—at the same time, but only incidentally, reducing the wear on the Brooklyn Bridge roadway and relieving somewhat its floorbeam loading. The Brooklyn Bridge's future is a serious problem but this particular move is not an indication of any immediate danger; the safety factor under the new order is but little different than under the old.

Discretion, the Need of Emergency

TWICE during the last week the New York subway has been the scene of accidents that have tied up the movement of trains for long periods. On both occasions passengers have been confined to the cars, some of the time in darkness, both literal and figurative. That panics did not occur is due no doubt to the patience and good judgment of the traveling public and to the extraordinary record of safety that has been achieved by the subway during its eighteen years of operation. Yet we cannot forbear to ask ourselves two questions in this connection. Why is it usually so difficult to obtain information as to the cause of delay in almost every department of transportation service? Much of the danger of panic under such conditions can be averted if those affected are generally informed as to the cause of the delay or difficulty. And why is it necessary to hold passengers cooped up in subway cars long after some one in authority must know that a delay is to be of long duration? Despite the conditions under which a rapid transit subway in New York City must be operated, means could be devised for investing someone on the ground with authority to discharge trains stalled between stations for long periods. Rules and regulations are essential in the public interest, but a blind and rigid adherence to rules and regulations in the face of emergency conditions will often prejudice the very public safety they have been designed to insure. If we must deprive the rank and file of every vestige of discretion, we must provide over them an authority that will be sufficiently decentralized and flexible to cope with emergencies.

The Price of Stability in Construction

A SEWER-CONSTRUCTION job was recently put under contract in Jersey City, N. J., at a price little more than 30 per cent of the low bid for the same work received Aug. 10, 1920, and 59 per cent of the low bid taken Oct. 19, the same year. Contrasting these prices with the actual variation in materials and labor prices the 1920 bids contained heavy insurance against any labor or material-price fluctuation, far out of proportion to any sum warranted by actual current prices. Applying *Engineering News-Record's* construction cost index

number, the August, 1920, bid was more than double the actual cost of doing the work, assuming that costs upon which bids were taken could have endured while the work was in progress. In other words the unsettled conditions at the price peak forced the contractor to add to his bid a contingency that represented half the cost of doing the work today. Though the Jersey City job may represent extreme conditions, it is indicative of the tremendous loss in construction work which must be charged to a psychological condition. What can be done? Labor is hard to control. If contracts exist they are not considered inviolable, particularly in troublous times. And price quotations are as changeful as the winds. However, the direct money loss involved forces an acknowledgment that the job is worth tackling.

Contractor's Concrete Specifications

THE resolution of the Associated General Contractors, noted in the news columns, authorizing its committee to "prepare specifications for concrete and reinforced concrete which in their opinion would be reasonable," probably does not indicate so serious a division of opinion between the engineers and the contractors as its first reading would suggest. The Joint Committee is endeavoring to produce a satisfactory concrete specification. Its tentative effort, now out a year, has met with much criticism, which was to be expected, but the committee is now in possession of all of this criticism and is prepared to proceed to a final revision which should be materially changed from the first draft and should, further, come near to expressing the latest expert ideas on the design and production of concrete. It is reassuring to learn that the contractors, through their associated body, are not undertaking to produce a rival specification, but are merely to prepare a specification probably not for publication but as a positive statement of their views which have hitherto been expressed as negative criticism of the Joint Committee report. At all the public discussions of that report the critics, who have frequently voiced the contractors' opinion, have been asked for definite substitutions satisfactory to them. Probably this proposed work of the A. G. C. committee will do just that thing.

Federal Aid Stabilized

WHEN the President last month signed the Post Office appropriation bill authorizing $190,000,000 of government funds for road construction during the next three years—in addition to $13,000,000 for forest roads in 1923 and 1924—assurance of stability was given to the policy of federal aid. Fifty million dollars were made available for the year which began July 1 and $65,000,000 and $75,000,000, respectively, were authorized for the two succeeding fiscal years. It is true that these appropriations fall short of the amount considered necessary by state highway officials if state road systems are to be completed within a reasonable time to meet the demands of traffic. Estimates have commonly been based upon an assumption of $100,000,000 yearly of federal aid. While the states, therefore, do not get all they sought, they can now plan their work in the full knowledge that a continuing policy of governmental assistance is established, in spite of the fact that the new legislation reduces the maximum participation by the government from $20,000 to $16,250 per mile for roads for the current year and to $15,000 per mile thereafter. An important part of the new act is its provision for extending federal aid to structures involved in the elimination of railroad grade crossings. Otherwise the work will be administered as it has been since the establishment, last year, of the 7-per cent system of primary and secondary routes. The U. S. Bureau of Public Roads reports that plans for the interstate and intercountry systems have been received from all but eight states and that the state systems are being co-ordinated to serve the best interests of the country at large. The new appropriations come opportunely, for several states had almost reached the limit of funds available. It is estimated that the $190,000,000 lately authorized will result in the construction of more than 25,000 miles of road which, added to the 46,000 miles estimated to result from previous appropriations totaling $350,000,000, will produce a total of 71,000 or nearly 40 per cent of the 180,000 miles of road in the 7-per cént system of federal-aid routes now outlined. Uncertainty as to the future of federal aid is removed and the states can now lay their plans for at least three years to come.

Another Simplification Proposed

SIMPLIFICATION of styles and sizes is the first step toward the elimination of waste, according to the studies of the committee of the Federated American Engineering Societies appointed to investigate that subject. Unfortunately the greatest economic losses from too many and varied styles lie outside the jurisditcion of engineers in the uncharted and uncontrolled realm of fashion. In those fields where engineers have some influence, however, progress toward simplification is being made. Already the paving brick industry has cut down its standard shapes and sizes from sixty-six to seven and the reinforcing bars rolled to standard have been reduced to ten sizes. Now the lumber people are going to get together with the Forest Service and the Department of Commerce in an effort to standardize lumber grades and sizes which will mean a reduction in the multitude of sizes and grades now prevalent. Lumber is a fertile field for such simplification, not only from the standpoint of the producer, who should save money by direct reduction of costs, but also from that of the consumer, who will be saved time and bother in size and grade selection.

County and State Highway Liaison

IN EVERY state highway department there should be a liaison bureau whose specific purpose it is to carry the doctrine of sound highway management into the counties and co-ordinate the highway thinking of county and state. As a general rule county road management is less advanced than state management. In this conclusion the committee of the Nebraska State legislature, whose findings are published in another column, is in agreement with all previous investigations and with general observation. The Nebraska study, in common with previous ones, announces only the obvious reasons that county highway accounting is insufficient and county highway engineering is inefficient. To leave the question at this point does not get us far. Poor accounting and mediocre engineering are effects instead of causes.

The Nebraska report indicates that there are counties in which highway management is as capable and as keen for efficiency as in any state highway de-

partment. This conclusion also tallies with general observation. The accounting and the engineering in these counties is obviously competent but the fundamental condition is that the people have been educated to require good highway management. In general it can be asserted that wherever a favorable comparison can be made between county and state practice the possibility is due to an usually highly educated public sentiment which demands and supports sufficient and competent county engineering.

The wisdom of these exceptional counties should be carried into all counties and this is a task which state highway departments might well assume. Practically all state highway departments recognize this duty, at least as a theory, but it is performed only incidentally and by indirect influence. In only one or two states is it recognized as a task to be performed by a bureau organized for the specific purpose. This liaison work is not of a kind that can be well done as an incidental task. Local jealousies have to be overcome and the technicalities and economics of proficient highway management have to be taught. These are tasks which require the entire effort of competent heads of a department bureau organized and financed to do the work.

An Engineering Anniversary

ENGINEERING suffers from a lack of interest in its own traditions. We are proud to have it esteemed a forward-looking profession. Our boast is that we are so occupied with the problems of today and tomorrow that we have scant opportunity to contemplate our achievements of yesterday. Sound and creditable as this attitude may be, it is possible to lean over backward, and in our devotion to what we hold modern, practical and progressive, to deny ourselves the inspiration to be derived from reflection upon the worth of those who have preceded us. Such inspiration is real and practical, for it is the prop that has sustained every craftsman and every professional man since mankind first began to take pride in its work.

With this thought our mind turns back to 105 years ago when the first contract was signed for the construction of the Erie Canal across New York State. On Independence Day of that year, 1817, the first earth was turned in the enterprise just west of Rome, N. Y.

It is scarcely possible to exaggerate the importance of this anniversary to American engineers, for out of the labor of that undertaking was born the American profession of civil engineering. It is true that earlier surveys had been made for public works in many parts of the land and that some of them were built. But almost without exception the conduct of those works was in the hands of European engineers. The American engineer had not yet arrived. Indeed, it was largely by chance that the Erie was begun under American auspices, for the state tried hard to secure the services of William Weston, an English canal builder who already had designed and built several works in this country. He, however, finally refused on the grounds of advanced age and ill health.

So it came to pass that Benjamin Wright and James Geddes, surveyors who had been engaged on some of the preliminary surveys for the canal, came before the board, expressed their confidence in their ability to locate and build the canal, and bespoke on the part of the commissioners an equal confidence. It was granted. As might have been expected, sapient legislators and political opponents of the canal at once rose in their places demanding with fine scorn, "Who is Geddes and who is Wright? And what canals have they ever built?" Then, too, hostility took another tack. Some, for example, insisted that the engineer's spirit level never would suffice to run the long canal levels, which when built, would probably be off by the total depth. So Wright went out and ran two independent lines each more than 60 miles long, checking on the closing within 1½ in. And that settled that.

Today we marvel at the courage and the resource of those professional pioneers who were to link the waters of the Atlantic and the Great Lakes through more than 350 miles of what was almost trackless forest. Of experience they had had practically none. Systematically organized engineering science was as yet unknown. Few books were available. Every problem that arose must be solved from its very foundation principles through to its final application. Not only were they to overcome the physical obstacles that beset them, but they were also to devise means of administering public works until then unnecessary and unknown. Out of the Erie Canal the American contractor came into being, for it was decided that the work should be divided into short sections and let to individuals who would undertake their construction. During the course of this work much interesting information and many valuable data were gathered and incorporated into our fund of engineering knowledge. There was developed the use of plows and scrapers for excavation, the consolidation of embankments by teaming over them, ingenious plant for clearing and grubbing, and, most interesting of all perhaps to contractors, the institution of payment on monthly estimates.

Out of that splendid corps came a coterie of tested men who were destined to write their names high in the annals of the profession, which through this undertaking they were founding in the new nation. Aside from the two leaders, there were Canvass White, who first produced American hydraulic cement, and who designed the mechanical structures of the canal; Holmes Hutchinson, who was later called upon to design and build canals and railroads in several states; Nathan S. Roberts, who designed and built the Lockport flight of locks, and later was builder of canals in Pennsylvania, of the Harpers Ferry bridge, and engineer for the federal government on a proposed ship canal around Muscle Shoals, and John B. Jervis, builder of railroads and water-works and eventually president of the Chicago & Rock Island R.R. These are but a few.

In 1825 the canal was completed. It was 363 miles long, 40 ft. wide at the water surface, and 28 ft. wide at the bottom. Its depth was 4 ft. Eighty-three locks, each 90 x 15 ft., overcame a total rise and fall of 675 ft. and eighteen aqueducts, mostly of cut stone, carried the canal over streams and other obstructions. The time between Buffalo and Albany had been halved. The cost was $7,000,000.

Small wonder, then, that Benjamin Wright has been called the "Father of American engineering." Small wonder, too, that the historian of the opening ceremonies was able to inscribe his triumphant enthusiasm in these words: "Europe begins already to admire—America can never forget to acknowledge that they have built the longest canal in the world, in the least time, with the least experience, for the least money, and to the greatest public benefit."

Hydro-Electric Development Involves Unusual Tunnel Job

Reconstruction of Kern River Plant Requires Enlargement of 8,300 Ft. of Rock Tunnel—Location, Topography, and Ground Give Rise to Special Problems

By H. K. Fox
Superintendent, San Joaquin Light & Power Corporation, Fresno, Cal.

ENLARGEMENT of a grade tunnel through blocky and otherwise difficult ground to a pressure tunnel having a cross-section more than four times as large was the outstanding element in the reconstruction of the Kern River plant completed last summer. The special problems to be solved made necessary the application of special equipment and methods and illustrate aptly the engineering function of adapting available means to a desired end in the interest of speed and economy. The location and surroundings raised also problems of subsistence for the working forces that are not frequently met with in engineering construction work. The new plant as installed develops two-thirds of the economic capacity of the site and has been arranged for convenience of future enlargement to full capacity.

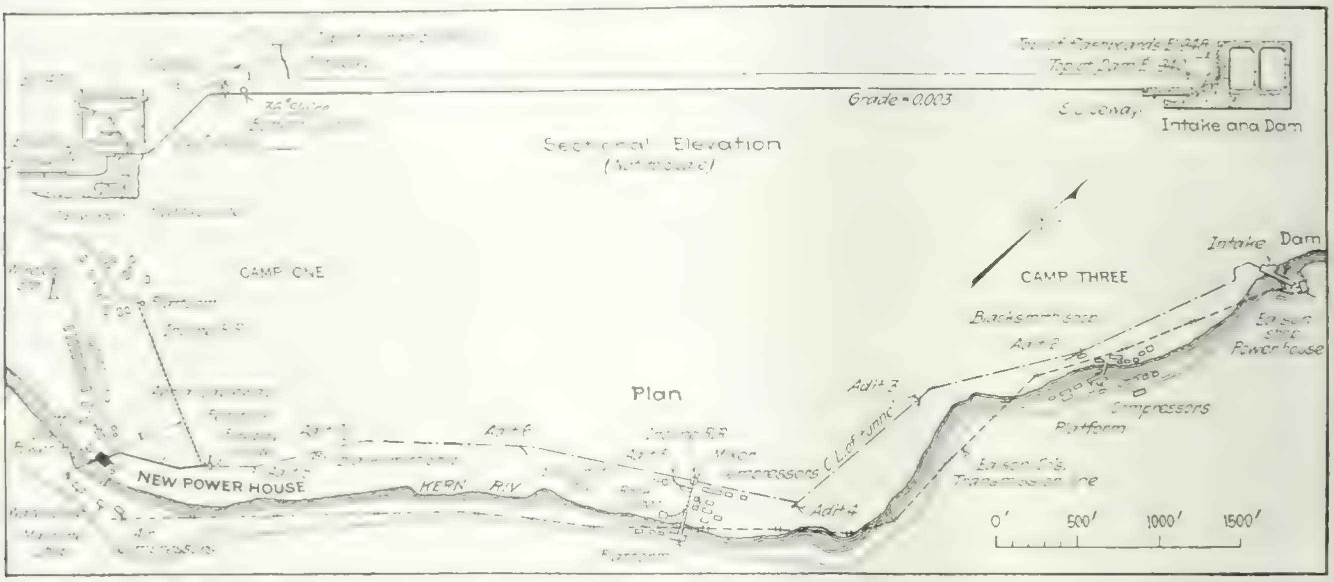


FIG. 1. GENERAL LAYOUT OF KERN RIVER DEVELOPMENT

Here are shown the general scheme of the installation and the location of the three construction camps. Camp One was job headquarters. All the adits were used for access to the work thereby making possible simultaneous progress at many points as well as excellent ventilation and little loss of time waiting for the tunnel to clear after blasts. All the concrete was mixed at Adit Five, which was centrally located. Materials were brought in by the road on the east side of the canyon and then handled to the mixer as is illustrated in Fig. 5 herewith.

The original development of the Kern Canyon project of the San Joaquin Light & Power Corporation, located on the Kern River approximately eighteen miles northeast of Bakersfield, Cal., was completed in 1890, and consisted of a flume, a very crude diversion, steel pressure pipe, and two wheels, with generators of 400 kw. each. Later, because of mountain slides destroying the flume during the rainy season, a tunnel 6 ft. 6 in. x 6 ft. 6 in. was driven and the intake moved upstream to the tailrace of the development above. On account of the inefficiency of the two old units, another unit of 3,000 kw. was installed in 1917.

In the fall of 1920 a study of the stream flow of the Kern River made it evident that the economical development of the Kern Canyon project called for the total installation of 18,000 hp., so authority was given to construct an entirely new plant of 12,000 hp. capacity and to provide tunnel capacity for the ultimate development and foundations for the future unit of 6,000 hp. Fig. 1 shows the general layout of the job of which a better conception will be obtained if it is borne in mind that the river flows through a deep narrow canyon ending abruptly at the power house site. This is strikingly shown in Figs. 2 and 3.

Condition of Old Tunnel and Penstock—The old plant was shut down Jan. 28, 1921, whereupon an inspection offered an opportunity to study the wear after thirty-one years' operation. The tunnel had been driven very close to the surface, and had eight adits in its length of 8,300 ft. The ground being mostly a very poor grade of granite and very blocky, at places nothing but slides of rock and earth were encountered. The sides and floor were lined with concrete and the roof arched where the ground required it. Only one cave-in was found, it being the only wet place in the roof. The walls had been laid up dry and faced with hand-placed plaster and the floor had been poured two inches deep on top of the ties and muck. The latter was about fifty per cent washed out but the walls as a whole were in excellent condition. Some slabs from the floor were turned up on edge and obstructed the flow materially. The redwood timbering was concreted in, and being within two inches of the surface of the concrete, had caused failure in one place. There was no serious

amount of moss clinging to the concrete. Through one adit it was possible to crawl into an underground chamber over the tunnel, about 200 ft. long and 5 ft. high, formed by the arching of the loose rock and earth over the concrete roof of the tunnel. This chamber had been formed during the excavation of the tunnel by the fine dirt sifting down through the lagging.

Intake and Diversion Dam—Storage at the intake was not possible, because of the location of the Southern California Edison power house, Kern River No. 1. On the intake side of the river and directly over the intake site, is a very dangerous mountain slide, from which during the rainy season blocks of rock rolled down to so great an extent that it was necessary to have a watchman constantly on guard to warn the workmen. For the same reason the intake structure was designed to provide a cushion of loose fill over its top. The structure is part of the dam, and has two 6-ft. sluice gates, one in front of the rack bars to remove coarse material, and the other behind the rack bars to clean the sand trap.

The two headgates are built up of timber and steel and are operated by threaded stems. The dam is 140 ft. long, 6 ft. wide, and 15 ft. high, with buttresses and 30-ft. apron. Flashboards, 8 ft. high, are so designed that in case of flood by releasing one timber they go out. They can be removed one at a time by a traveling chain block, supported by a two-span steel bridge over the dam.

As soon as the old plant was shut down, a cofferdam was built around the old intake and the new structure rushed to completion before the spring floods. When the tunnel was completed, in the early part of the following summer, the entire river was diverted through the tunnel and the dam built after the powerhouse was on the line, and while the rest of the job was being salvaged and cleaned up.

Enlargement of Tunnel—The tunnel work was the major part of the job and consisted of enlarging the old tunnel from 6 ft. 6 in. x 6 ft. 6 in. section to 13 ft. 6 in. x 14 ft. section. The new tunnel is a pressure tunnel. There are eight adits in the 8,300 ft. and as none of them is very long, all but two were enlarged, some of this work being done before the old tunnel was unwatered. After a careful study of surveys and costs, it was determined that the best plan would be to follow the line and grade of the old tunnel, thus using it as a pioneer. The ground encountered was a very blocky granite with many seams of quartz or mud but was entirely dry.

From Fig. 1 may be seen how access was had to the adits and from what points the work was carried on. The original flume was located approximately on the same elevation as the tunnel floor, and provided an excellent path from adit to adit and a bench on which to lay the 4-in. air line and 3-in. water line, with branches at each adit.

FIG. 2 LOOKING UPSTREAM FROM POWER HOUSE SITE

From this picture may be obtained a clear idea of the topography of the canyon and of the material through which the tunnel was driven. The lengths of penstock are lying close to the end of the tunnel section. On the right bank, looking at the picture, may be seen the road over which concrete materials were hauled to the mixing plant at Adit Five.

FIG. 3. LOOKING DOWNSTREAM FROM CANYON WALL

This view shows how abruptly the canyon ends at the power house site. On the right, adjacent to the power house, is shown Camp One, with headquarters office and living quarters. On the left bank are the machine shop, air compressors, and storehouses. The incline railway on the right slope provides access to the tunnel entrance.

The old plant was shut down Jan. 28, 1921, and immediately a 3-ft. gage track of 25-lb. rail and 6 x 6-in. ties was laid the entire length of the tunnel. As all equipment was chosen so that it could be passed through the old tunnel, it was distributed at once and work started from all points of attack at the same time.

At first an attempt was made to drill radial holes, using stopers for the roof, but the loose rock fill behind the concrete walls caused the steel to stock so badly that despite the advantage of being able to drill continuously ahead of the shooting and mucking, this method was abandoned. In conjunction with the radial drilling, an attempt was made to trap the muck but as it was necessary to build the traps too low for traffic to pass under it, this likewise proved unsuccessful.

A full heading was finally adopted with twelve to fifteen 15-ft. holes to the round, the muck being shot down on the track. All the mucking was done with Shuveloders, which, to their great advantage, worked on the main track instead of the usual sections.

Because of the pioneer and the very blocky ground, it was impossible to shatter the rock into small pieces. As a result the shuveloders were forced to handle material much heavier than that for which they are designed, but contrary to all expectations, after sev-

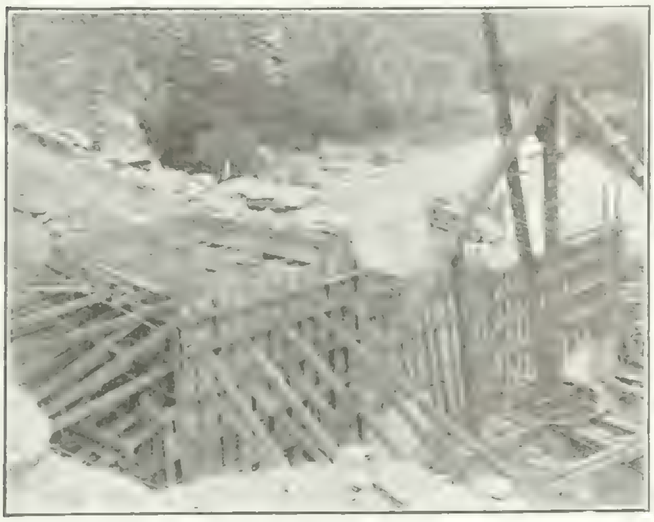


FIG. [illegible]. GENERAL VIEW AT INTAKE
[illegible] walls [illegible] a short distance below this point, these were 1,000 ft. high and [illegible] danger. [illegible] two bunk houses were partially wrecked by 5-ton blocks.

eral improvements and reinforcements were made, they did the work very satisfactorily.

Two, and in some cases three, headings, about 250 ft. apart, were worked on each side of an adit, so that while one heading was being drilled another was being mucked, thus making both operations practically continuous. Because of the excellent ventilation made possible by the numerous adits and the pioneer very little delay was caused by powder smoke. It was possible, therefore, so to plan the drilling and shooting in the several headings that progress depended upon the rate of mucking, which, during the last thirty days, amounted to 120 lin.ft. of tunnel per 24 hours. In order to keep four shuveloders working under such constant and severe service it was found necessary to have two other spare machines ready at the adits to replace a breakdown.

Five-ton electric locomotives, equipped with storage batteries and 2-yd. steel side-dump cars constituted the hauling equipment. No trolley was used; neither were the batteries removed from the locomotives while being charged at the adits, as enough equipment was provided to have at least one unit always on charge. The time of charging was about three hours. The batteries gave no trouble whatever, and in one instance, when a locomotive was lost over a dump 200 ft. high, it was necessary to go down to the river and open the switch, as the wheels were still spinning on the rocks. When hauled back to the tunnel this unit immediately resumed work without repairs.

In timbering three and five segment sets were used. Special spacing of the crown bars was necessary to provide for the concrete delivery pipe that would be used later. As a whole, very little lagging was done, but in one place already mentioned it was necessary to caulk with straw to keep the fine dirt from sifting in.

It was difficult to determine the proper tunnel section for use in the different parts of the tunnel. From an examination of the old tunnel it was evident that some parts would surely need lining, and these were driven to a lined section. Other parts might look as if they should be unlined, but after enlargement would show up dangerous ground. As a result the section was changed many times in order to avoid unnecessary lining and at the same time to avoid driving unlined sections which would need concrete. This resulted finally in three finished sections: one unlined; one lined to a size much over capacity, this being used for short lengths where the unlined section was not considered safe; and third, the lined section.

Concreting Tunnel—It was decided to do all the concreting from one plant, located approximately opposite the middle of the tunnel. Adit 5 was chosen because the muck dumped there was of good quality granite, and this material was used in concreting the tunnel.

The plant (Fig. 5) was built on the 45-deg. slope of the mountain, the inclined railway being built with its lower end at the road, thence across the river and up the slope to the storage above the mixer. A branch from the crushing plant led into this railway through a switch operated by the hoist runner by means of compressed air. The crushing plant was located at the bottom of the muck pile and consisted of two crushers and a revolving screen. Rock was fed into it with a scraper. A self-dumping car carried the material up the incline to the storage bins, made by building a timber wall across a deep ravine. Below this storage was located the mixer, cement bin and sack cleaner. A material platform was built along the road at the lower end of the incline where cement, lumber, and equipment were delivered by truck.

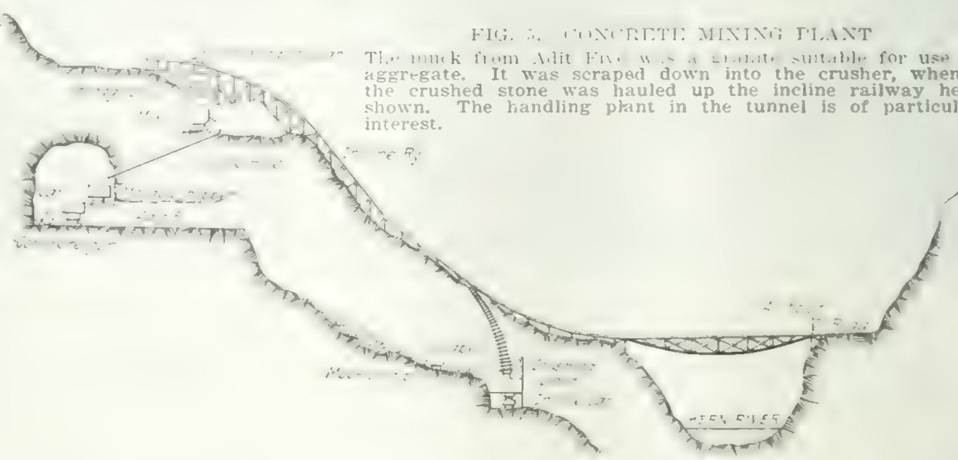


FIG. 5. CONCRETE MIXING PLANT
The muck from Adit Five was a granite suitable for use as aggregate. It was scraped down into the crusher, whence the crushed stone was hauled up the incline railway here shown. The handling plant in the tunnel is of particular interest.

From the mixer the concrete flowed down an inclined shaft through an 18-in. pipe, about 30 ft. long, to a hopper in the tunnel. This hopper traveled on a track so that its six 11-cu.ft. compartments could each in turn be spotted under the pipe. The bottom of this hopper was built on a slope and had the outlet gates of its several compartments so arranged that as a car was spotted one operation discharged the concrete into the six compartments of the cars. The car bodies were exact duplicates of the hopper, except that they had an individual sliding gate for each compartment. [For a detailed description of this plant see *Engineering News-Record*, April 27, 1922, p. 686.]

From the cars the concrete was discharged directly into the pneumatic guns, each compartment holding a gun batch of 11 cu.ft. Two guns were used, each consisting simply of a huge cylinder, with a piston, which forced the concrete into a 6-in. pipe, through which it was forced by compressed air into the forms. They were simple and efficient machines and gave no trouble whatever.

During excavation, space was left for the six-inch pipe to lie on top of the timber segments between crown bars and directly over center line. One of the difficulties encountered was in the removal of the pipe as the forms filled and to facilitate this the pipe was cut into 5-ft. lengths, connected by special quick-acting flange couplings. As a further aid the reinforcing steel in the crown of the arch (see Fig. 6) was specially designed.

As the concrete was discharged from the pipe against either a bulkhead or the concrete of the previous run, it flowed down into the walls and as these filled began to pack into the arch. By deflecting the pipe slightly the entire section was filled, after which the sections of pipe were removed.

Plugging of the pipe was practically eliminated by using aggregate not over one inch, by using bent pipe instead of ells and by keeping the gun close to the forms. The greatest difficulty experienced was the hardening of the concrete in the cars after a long haul. It was found that for a distance of less than 3,000 ft. there was little trouble, but for hauls between 3,000 and 4,800 ft., the maximum length, the concrete would not flow readily from the cars. This difficulty was found to be greater with a concrete having excess water or an aggregate deficient in sand.

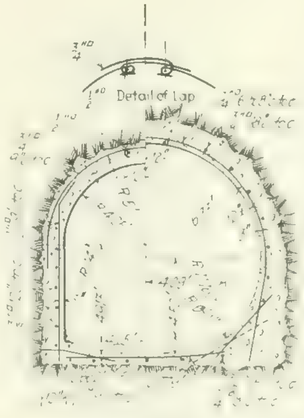


FIG. 6. CROSS-SECTIONS OF LINED TUNNEL

The normal lining is shown in the left-hand or B section. The right-hand or C section was used in short lengths of tunnel which had first been driven to an unlined section and then considered to be unsafe without lining.

Because of the two different cross sections in concrete, two sizes of forms were necessary, these being built of wood and oiled to prevent adhesion of concrete. One hundred and eighty feet of forms were needed for each gun, 60 ft. supporting the previous day's pouring, another 60 ft. receiving the day's pouring and a third being set for the next day. Reinforcement was placed ahead of the forms and supported on the tunnel timber.

The total volume of concrete placed in the tunnel was 13,750 cu.yd., 4,980 ft. of tunnel having been so lined. This was done in eighty 24-hr. days. The record days work was 285 cu.yd., and over a period of several days an average of 120 lin.ft. of walls and arch were completed in during a period of twenty-four hours.

Upon completion of the sides and roof the placing of the invert was started. A 400-ft. section was cleaned at a time, reinforcement placed and the 6-in. pipe strung out on horses. By experimenting, a nozzle was improvised that "shot" the concrete against the floor without much spattering, and there was no difficulty in shooting a 400-ft. section complete in 24 hours.

As a final precaution against leaking, all doubtful looking seams in the unlined section were cleaned and a heavy coat of "gunite" applied, these sections having been well underground and in good rock.

Forebay and Surge—The old forebay was in a large chamber excavated at the lower end of the tunnel, and in part of this the new concrete structure was built. It can best be described as a short piece of tunnel, approximately at right angles to the main tunnel. The regular tunnel forms were used. The tunnel entered at one side

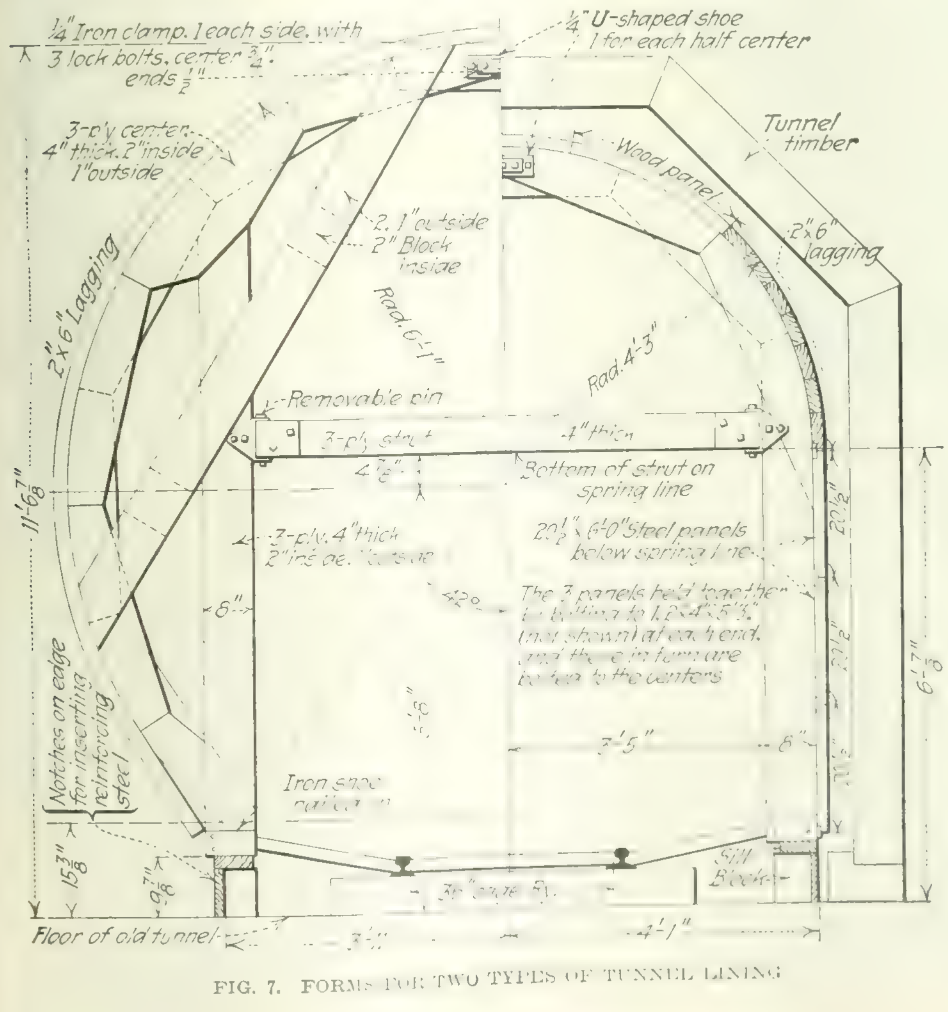


FIG. 7. FORMS FOR TWO TYPES OF TUNNEL LINING

and two penstocks entered on the opposite side. In one end a 36-in. sluice gate was provided. A sand trap and rock bars were installed to guard the machine against debris from the unlined section. In the remaining part of the old chamber were placed the two butterfly valves at the tops of the penstocks, one for the new penstock, 8 ft. in diameter, and one for the future penstock, 6 ft. in diameter, together with the 36-in. sluice gate and the air relief valves on the penstock. Surge was provided for by driving a 25-ft. diameter shaft to the surface about 60 ft. upstream from the forebay.

Penstock—For the present development, only one penstock was built, it being of riveted-steel plate, 8 ft. in diameter at the top, 7 ft. at the wheel, and 568 ft. long. It is supported on concrete piers or saddles and in addition to being backfilled is held by concrete anchors at the bends. This pipe was made up at the shop in 30-ft. lengths. No difficulty was experienced in handling these lengths in the field, although some of them weighed nearly 9 tons.

Power House—The power house site chosen was adjacent to the old plant, and was located on gravel and large boulders with enough clay to make a very tough conglomerate. On the power house side of the river is an easy slope for about 200 ft. from the waters edge, but directly opposite, on the warehouse side, is a vertical wall about 80 ft. high. As there was no room for wasting the muck on the power house side and as it was very inconvenient to get in the machinery and material, it was decided to build a cableway, extending over the lower end of the penstock, and the center line of the unit, thence across the river to the top of a 40-ft. tower on that side, so that trucks could be driven under it.

The cable was 2¾ in. in diameter and the span 636 ft. A special carriage was built on the job so that by using the block and hook belonging to the power house crane a 6-part line and 28-ton capacity was obtained. Because of the heavy and valuable machinery loads to be carried the stresses and sag were carefully computed. Observations taken when the 26-ton rotor was handled proved the computations to be accurate. The first duty of the cableway was to land the steam shovel for the excavation of the power house and part of the penstock, and to carry the muck across the river to the waste dump. As soon as the foundations were in the cableway began erection of the unit. This was carried on together with the erection of the building, so that by the time the concrete girders were ready for the 50-ton crane, the unit was complete and the crane was lowered directly to its rails by the cableway. After the roof was poured the final duty of the cableway was to handle the buckets of hot tar which was used as a roof covering.

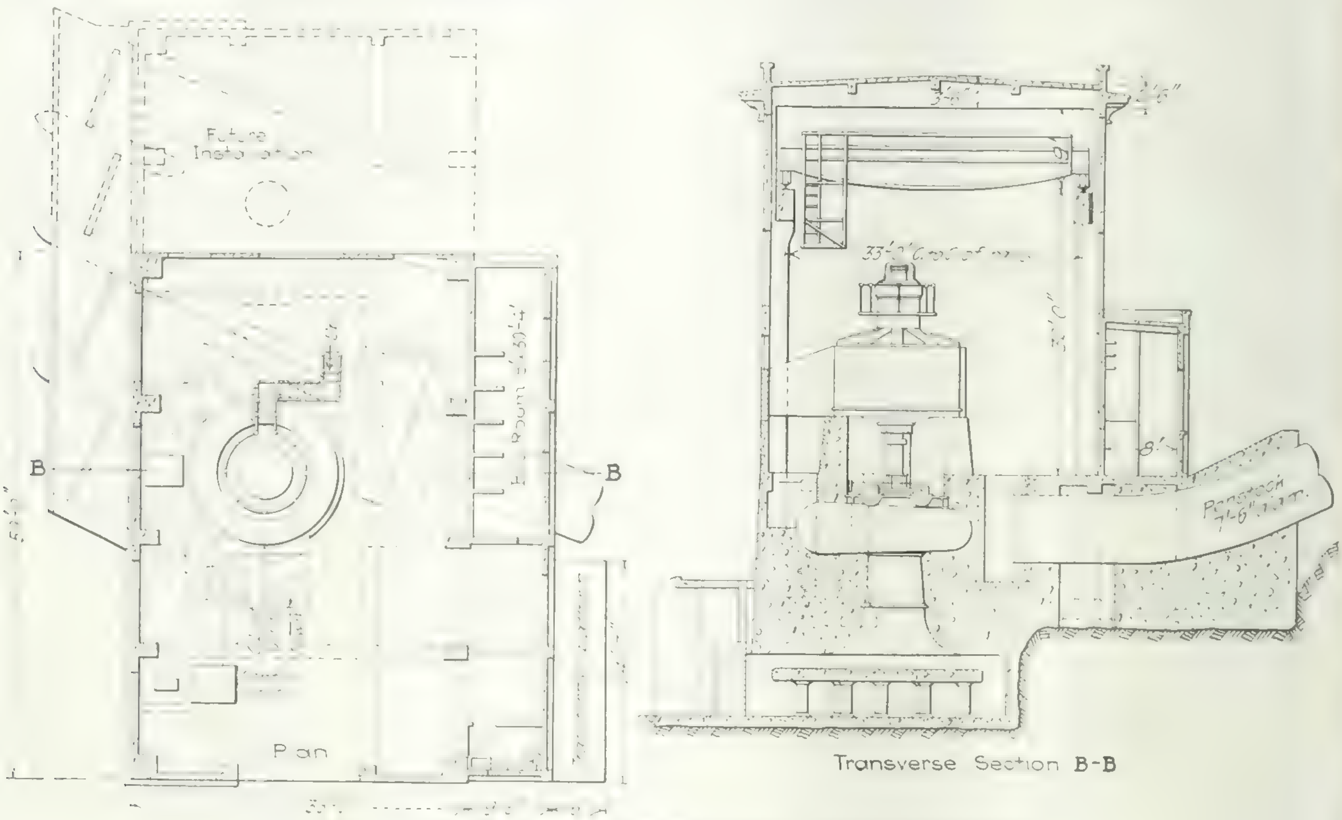


FIG. 7—PLAN AND TRANSVERSE SECTION OF POWER HOUSE.
One 12,000-hp. unit only has been installed, but provision has been made for a future 6,000-hp. unit.

One unit only was installed but foundations are provided for one future unit and one end of the building is of temporary construction. The present unit with its auxiliaries consists of a 12,000-hp. Francis type vertical turbine, operating under a head of 230 ft., with a plate steel casing butterfly valve and pressure regulating valve, directly connected to a 10,600-kva. 11,000-volt, 60-cycle, 257-r.p.m. generator with Kingsbury bearing, on top of which is mounted a direct connected 864-kw., 125-volt, flat-compounded exciter. A White regainer was installed in the draft tube to increase the over-all efficiency of the unit. To insure better regulation in time of trouble, the exciter shunt field may be either separately or self-excited.

In order that power may be delivered from this plant

to the Southern California Edison Co., provision has been made also for generating at 50 cycles.

An unusual feature of this plant is that the water wheel is reached from the main floor, there being no pit. In order to accomplish this the generator is supported on a concrete ring, the top of which is 7 ft. above the floor. One advantage of this is that the governor, control units, switchboard and valve operating mechanism are all on the same floor, so that one operator and an oiler compose the entire crew.

Generator and transformer protection is provided by a bank of differentially connected relays with respective current transformers connected on the neutral of the generator and bushing type on the transformers. These relays open the generator switch, transformer switch and the field, the latter being so connected that it cannot open unless the generator switch opens. Each line is equipped with reverse power relays which are connected so that a short on one line will open that switch only, this selective action being necessary only when both lines are tied to the same station bus. For normal operation these relays are converted into plain overload relays by shunting the potential element contacts through a small knife switch mounted on the panel.

The control and lighting current is furnished by a small 25-kw., 125-volt, d.c. generator, direct connected to a 40-hp. impulse wheel with governor. Eleven thousand to 440-volt transformers provide station service for oil pump, valve operation, motor-generator set and camp requirements.

The low tension bus room is on the main floor into which the cables from the generator lead to the main switch, which is a 1,200-amp., 15,000-volt switch. Disconnects are provided for shunting around the switch in case it needs repairs. All of the low tension current transformers and main field switch are mounted on the generator.

The high tension bus is all of the outdoor type, supported on steel towers. The voltage is stepped up from 11,000 to 66,000 volts by a bank of 3,600-kva., single phase transformers, connected delta on the low side and Y on the high side, with the neutral grounded. The 11,000-volt current is brought from the bus room by 800,000 c.m. lead cables carried in a concrete beam. The switching equipment consists of three 300-amp., 70,000-volt, electrically operated oil circuit breakers, one for the transformers and one for each line. Disconnects provide a means of cutting out these switches for repair. A ring bus makes the whole flexible in order to handle both 50 and 60 cycles.

Camps, Water Supply and Sanitation—The construction of camps was started Dec. 1, 1920, the old operators' quarters being used as a nucleus from which to build the Headquarters Camp, No. 1, at the mouth of the canyon. The machine shop, saw mill, warehouse and material yard were located at the most advantageous point from which to distribute material, as shown in Fig. 1.

Camp No. 3 was built in the river bed, the buildings on platforms about eight feet above water, and the compressor plant on a high rock. No soil or sand was available for cesspools and lavatories, so it was necessary to haul out the kitchen waste in tanks and to build a concrete pit for the lavatory. This was burned out daily with straw and crude oil.

The water supply was pumped from the river by 3-in., 3-stage centrifugal pumps to 10,000-gal. tanks, located high enough to put pressure anywhere on the job. This water was all chlorinated, and excellent tests were obtained through the state laboratories.

Landslides from the walls of the canyon, 1,000 ft. high, were an everpresent source of danger, and many narrow escapes occurred, two bunk houses having been partially wrecked by 5-ton blocks of rock. This occurred at 7 p.m., while the men were in the bunkhouses. Two small rocks, which preceded the heavy slide, gave warning so that the men escaped.

All garbage was hauled to one point, where 120 hogs were kept, the job of hog-tender being combined with that of watching the powder magazine. Cans and other refuse not going to the hogs were thrown into a pit and

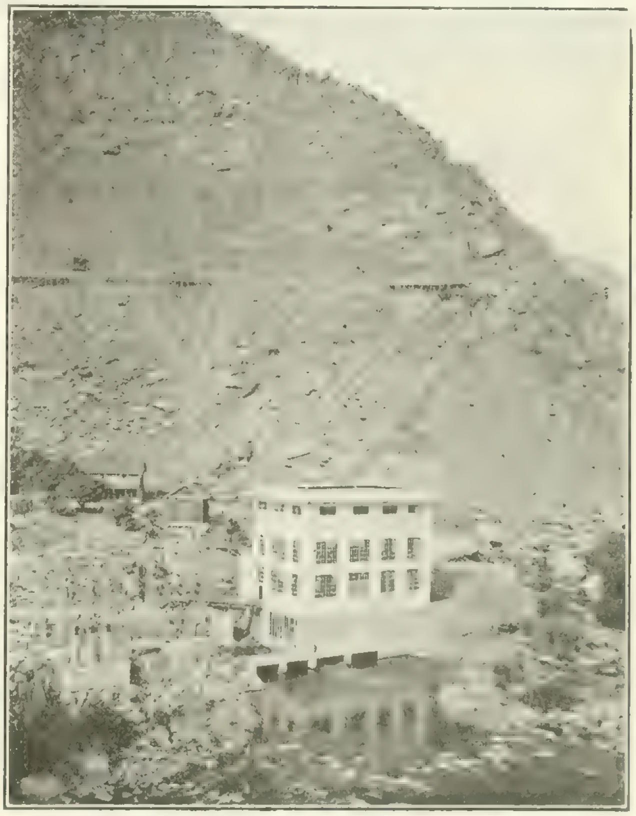


FIG. 8. COMPLETED KERN RIVER POWER HOUSE
Note to the left the high tension bus structure and overhead the cableway used to handle materials and equipment during construction.

burned. In spite of a temperature of 116 deg. in the shade, few trees and the absence of vegetation, there was very little discontent or sickness.

A hospital was located at headquarters camp, and first aid stations placed at several points on the work.

The unit was put on the line Aug. 5, 1921, 248 days after authority was given to start construction.

The construction of this project was carried out under the direction of R. C. Starr, construction engineer of the San Joaquin Light & Power Corporation, whose organization consisted of H. K. Fox, superintendent, B. F. Jakobsen, designing engineer, J. D. McDougald, general foreman, Victor Rynning, general storekeeper, E. L. Fox, tunnel foreman, George Fisher, chief electrician, D. J. Pease, master mechanic, and W. B. McMillan, resident engineer. The concrete guns were furnished by the Universal Concrete Gun Co. and the power unit was manufactured by the Allis-Chalmers Mfg. Co. of Milwaukee.

Improving Improved Roads in Maryland

Macadam Roads Widened at Little Cost by Concrete Borders—Original Structure Conserved and Modern Pavement Produced by Resurfacing

BY MAINTENANCE and resurfacing, guarded by the regulation of traffic, the State of Maryland is conserving the full value of its original investment in waterbound macadam roads. By exactly the same methods it is protecting its investment in concrete and other high-grade roads. In fact the practice has been elevated to a principle of highway improvement on which are based all activities in keeping up a 1,700-mile state system. Principle and practice may be expressed as follows:

1. Limit the use of highways to vehicles having a gross weight of 10 tons.
2. Maintain every road in perfect condition.
3. Resurface every road as soon as it can no longer be made by maintenance to give perfect service.

Maryland's policy, which makes it necessary from time to time to improve her improved roads is fundamentally sound and correct. Under it she has become one of the "best roaded" states of the Union. The improvements which keep her moderate-priced roads continually up to date cost far less than the high type roads which elsewhere are being built to carry traffic no heavier than her roads carry. The Maryland plan starts with a relatively small investment in admittedly low-type road. By a process of gradual improvement, by selective treatment of the weak places, it builds up a better road from year to year, always conserving the bulk of the previous investment. It is a plan which is more like the French plan than is to be found anywhere else in the United States. It differs sharply from the method which attempts by expenditure of vast sums to build at once, forever.—J. N. Mackall, Chairman, Maryland State Roads Commission.

How the first requirement—perhaps the most important of all—was met, was described in *Engineering News-Record*, April 21, 1921, p. 666. A motor vehicle law was *enacted* and then *enforced*. It is in the same positive manner that maintenance and resurfacing are *planned* and then *carried out*. In brief, it is not the maintenance or resurfacing methods or the forms of structure employed, which make it possible for the Maryland roads commission to have conserved the full value of its original investment in roads, but it is the fact that *maintenance and reconstruction are performed.*

Development of Practice—Maryland began building modern highways in 1908 and in the years that followed it built macadam roads at first 12 ft. and finally 14 ft. wide, and following macadam, it built paved roads and some gravel roads until every county seat and every town with a population of 1,000, had an improved road connection with all the others. At the beginning of 1920 these improved roads had cost about $30,000,000. Some of the early ones were very cheap—they cost only $10,000 a mile. They had all been well maintained from the time they were built. Meanwhile a serious traffic problem had developed with the use of motor trucks and unrestricted vehicle loads. Two solutions presented themselves: (1) Let big truck loads continue and perhaps grow larger and let them smash the old roads and when this had happened build new hard-paved roads designed to carry the heavy trucks, which was to say, let the truck owners destroy the original $30,000,000 investment, or (2) reduce the truck loads and hold them down to the capacity of the old roads kept up to full strength by perfect maintenance, and when better service was required than the old roads could give, widen and resurface them, conserving all of the old structure. As has been indicated, the second solution was adopted. Maintenance and resurfacing are the operations.

Maintenance Practice—Perfect maintenance is not held imaginary by the Maryland road commission. No hole of any size is permitted to remain in the surface of any road. Holes are repaired, as soon as they appear, by patrolmen. Patrol maintenance is regarded

as a fundamental requirement of perfect maintenance. Another thing held fundamental is that construction and maintenance shall be under the same engineering direction. The district engineer when he builds a road in his district also maintains that road.

Technically the methods of maintenance do not differ largely from those everywhere in use. The difference is that the maintenance in Maryland is continuous and precise. The practice is no different than the theory. This idea of perfection in maintenance is being emphasized here because it is upon perfect maintenance as much as on exact control of traffic loads that the principle of improvement, which has been described, has its foundation.

With the best of maintenance there comes a time when the old road will no longer serve the traffic. It is wearing thin or having its edges raveled out or is cracking up to a degree where holding it in service any longer merely by maintenance is uneconomical and barely possible. Then, while the road has high structural value and can be built onto, it is set aside for resurfacing. The big contribution of Maryland to highway improvement structurally is the methods it has developed of resurfacing macadam and concrete roads as illustrated by the drawing and views of old and reconstructed roads reproduced herewith.

FIG. 2. A WIDENED MACADAM ROAD

This is a portion of the Frederick Road shown in half-section by Fig. 1. The 14-ft. road is now 20 ft. wide, 14 ft. original macadam, backfilled on the haunches, and two 3-ft. concrete shoulders. The dark streak down the middle shows the original undisturbed macadam.

FIG. 1. TYPICAL SECTIONS OF WIDENED MACADAM ROADS

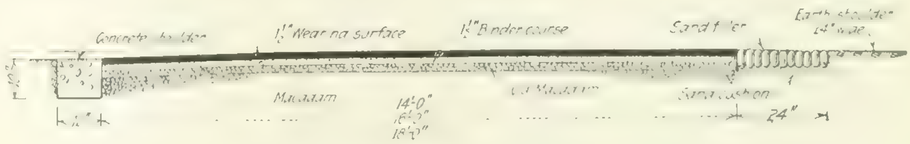


FIG. 3. MACADAM RESURFACED BETWEEN BORDER STRIPS

FIG. 4. MACADAM READY FOR RESURFACING

This is fairly typical of a macadam road considered to be ready for resurfacing, maintenance patches [illegible] excessive and the edges are raveling. The same road widened by 12 x 10-in. concrete curbs and resurfaced with 3-in. of asphalt is shown in the photograph at the top of page 56.

Resurfacing Macadam—Two ways of resurfacing old macadam are practiced: (1) Construct along one edge or both edges of the old macadam a concrete strip as shown by Fig. 1 and the view Fig. 2, and at the same time raise the haunches of the old road crown with new macadam, or (2) widen the old macadam by concrete or cobble strips and resurface the macadam with asphalt between strips, Fig. 3 or over the strips, Fig. 6.

Considering the first method as depicted by Figs. 1 and 2, 12-ft. and 14-ft. roads have been widened to 20 ft. and in the process of widening the sharp crown—¾ in. on 1 ft.—of old style macadam roads has been cut down to conform to modern standards. Referring to Fig. 1, the surface of the concrete strips is about 2-in. lower than the pavement crown and from 2-in. to 5-in. higher than the surface of the old macadam at the edges. To fill in the haunch then, requires the addition next the concrete strip of a wedge of bituminous macadam 2 to 5 in. deep tapering off to a feather-edge.

Eminent satisfaction has been given by the resurfaced macadam construction. No difficulty has been had in holding the macadam in place. The new macadam in the sides thickens the old road where it is weakest. And of course the concrete curb not only widens the road but holds the old road from raveling at the edges.

In the second method of resurfacing macadam there is a true resurfacing process. Fig. 4 shows the appear

ance of a macadam road when it is considered about ready for resurfacing. Sometimes the macadam gets in worse condition, but this is generally due to unusual circumstances. The photograph on p. 56 shows the same road resurfaced with 3 in. of asphalt between 1-ft. concrete curbs. Figs. 3 and 6 indicate other typical asphalt surfacings.

Ordinarily the 1½ in. asphalt binder is put directly on the macadam which is merely swept clean. In case the road has some pot holes, these are cleaned out and additional binder is placed in them and tamped to grade immediately ahead of the regular binder course. Except when additional stone is required, or where the cross-section is distorted or where the surface is corrugated the old road is not scarified. When scarifying

FIG. [illegible] MACADAM [illegible] STRIPS

FIG. 7. CONCRETE ROAD WIDENED AND RESURFACED—CURRENT MARYLAND PRACTICE

is necessary new stone is added and the whole is waterbound and rolled. Scarifying retards resurfacing and costs about $5 per ton of new base in place. With bids for binder and tops running $1.40 to $1.50 a square yard and $9 per ton for extra binder, the scarifying increases disproportionally the cost and low cost is of course the compelling argument for the resurfaced road against new concrete roads. Bids for 10 x 12-in. concrete curbs run about $13 per cubic yard and for 8-in. x 2- or 3-ft. about $11 per cubic yard.

Resurfacing concrete—The general method of resurfacing old concrete roads is the same as for macadam roads. With the ordinary conditions of surface no roughening has been found necessary to hold the asphalt from creeping and it has been laid on grades as steep as 6 per cent. A typical section of resurfaced concrete road is shown by Fig. 7.

Traffic uses the roads during reconstruction. One concrete strip is built, using a portable one-bag mixer, and then the second. Half the road is always open to traffic. Unless the old macadam is scarified none of the operations is heavy and the volumes to be hauled are not large. Large equipment does not, therefore, encumber the operation and block the roadway.

Theory Developed—The practices recorded are the offspring of a matured theory of highway improvement. It is that roads can be improved only to be, later on, improved again—there is no permanent road. First roads of such cost as could then be afforded were constructed. These roads have earned their cost. By perfect maintenance and traffic regulation their original structural integrity still exists. On the original structure there can now be joined new construction which modernizes the old road and enables it at a fraction of the cost to give service for a number of years to come which is as satisfactory as a higher-type new road would give. The requirement of service to traffic is thus met until some future time when a further reconstruction or, perhaps, replacement is required.

Rusted Steel Chimney Repaired by Welding

Repair of a badly corroded steel smokestack at the plant of the Arbuckle Sugar Refinery, Brooklyn, N. Y., was accomplished by an unusual use of electric welding. The stack is 16 ft. in diameter at the top and 245 ft. high, and consists of ⅜-in. plate a steel shell ⅜-in thick (originally) at the top, lined with brick. Corrosion had been so active in its upper part during twenty years of service that the steel in many places was of hardly more than paper thickness, and rollers on a hoisting cage used to lower men and materials along the side of the stack went through the plate repeatedly

It was desired to make repairs without putting the stack out of continuous service. The method finally used, with success, was placing new ⅜-in. sheets directly over the sheets to be replaced, and butt-welding them to the adjoining plates at the vertical edges and welding them to the rivets of the ring seams. No method of riveting new sheets in place could be used, on account of the brick lining. When repairs by welding replacement were first contemplated, it was planned to burn out the old sheets one by one and replace them as they were removed, but it was found that this could not be done because the metal was so thin that the edges would not stand up.

The plates were about 5 x 9 ft. in size, weighing something over 200 lb. each. The principal difficulty in executing the work on this plan was caused by the height above ground, which bothered both the arc and the men. There was always enough air movement at this height to affect the arc or blow it out, and the welders found it hard to work efficiently, on an open platform. Both difficulties were disposed of by building a cage with inclosure on the outside so as to give practically sheltered conditions; the welders were then able to work almost as well as on the ground. The cage was about 7 x 9 ft. in size, and was suspended from falls attached to the top of the stack so that it could be raised and lowered like an elevator cage. The sheet to be attached was loaded into the cage and hoisted with the men. Air holes for pneumatic tools and the electric wires to the welding machines also went up and down with the cage. The work was carried out by the Electric Welding Co. of America, Brooklyn.

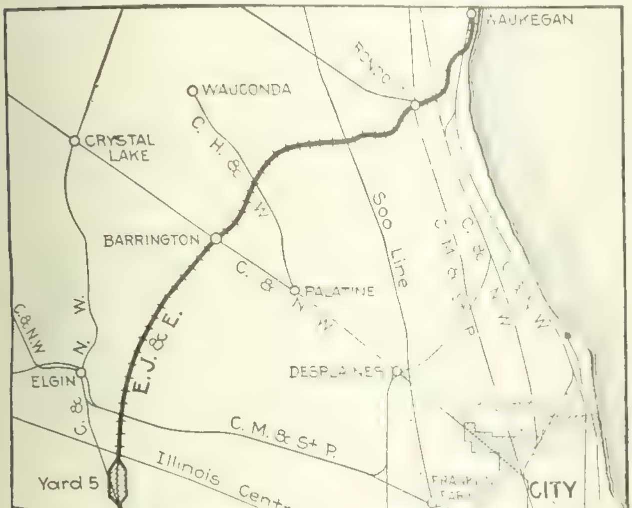
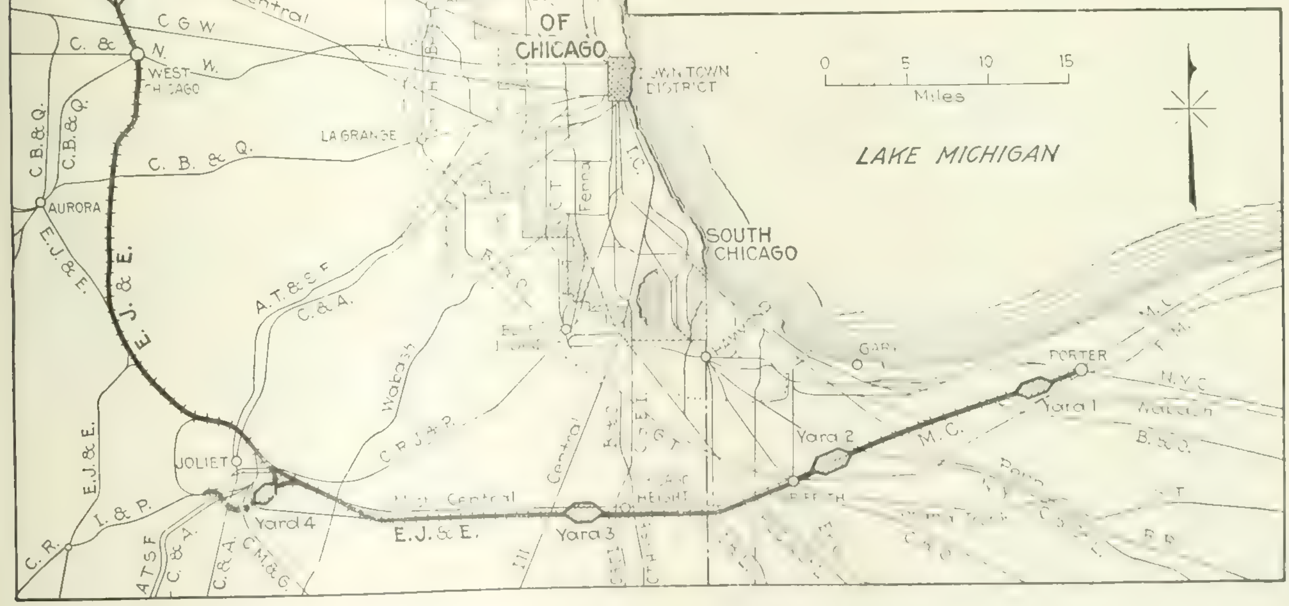
Riveted Pipe Relaid After 31 Years Service

The Los Angeles Water and Power Bureau recently transferred to the engineering department of that city for use on the emergency sewage disposal project, 17,000 ft. of 44-in. riveted iron pipe about ⅛ in. thick, which has been in service thirty-one years. The pipe is reported to be in uniformly good condition.

Another Relief Plan for Chicago Terminal System

Belt Line and Interchange Yards to Keep Through Cars out of Local Facilities—Three City Passenger Terminals

TRANSFER of through freight cars around Chicago and the concentration of all car interchange business at a few large outside yards, together with joint operation of the entire terminal district, are the features of a recent report to the National Association of Owners of Railroad Securities by the Board of Economics and Engineering. Col. F. A. Molitor is chairman of the Board, and the detailed studies for the report have been made by W. L. Darling, one of the members. The general scheme is illustrated by the accompanying map.

PROPOSED CHICAGO BELT RAILWAY WITH INTERCHANGE YARDS

Lines Inside City Limits are Not Shown in Detail.

Under present conditions 23 separate companies operate 29 railroads entering the city. Within the city limits there are 16 independent belt or industrial lines, 80 points (or more) where freight is interchanged, 184 freighthouses (69 in the business district), 120 freight yards and 65 engine terminals. Of a daily traffic of 27,000 freight cars in and out, 14,000 cars, or 54 per cent, are through cars. Transfer from one trunk line to another by one or more belt lines involves a delay of 13 to 18 hours at each transfer point. As a general average, according to the report, there is an aggregate delay of about 58 hours to both through and local business in passing through the city. This time is exclusive of that consumed in train movements.

Belt Line and Interchange Yards—Under the plan proposed, all through cars would be diverted around the city by an outside belt line, thus keeping the local yards and terminal facilities clear of this business and permitting their development for adequate service, besides releasing a considerable area of ground for more productive use. All the present 80 interchange points would be eliminated and there would be retained only the terminals and facilities required for freight of Chicago origin and destination.

For this belt line the Elgin, Joliet & Eastern Ry., an exclusively freight line known as the "Chicago Outer Belt," would be utilized. This road extends from South Chicago, Gary and Porter, southeast of the city, eastward to Joliet, north to West Chicago and Spaulding, and then northeast to Waukegan, on Lake Michigan. It is approximately 20 to 30 miles from the center of the city and intersects every railway entering Chicago. Some double tracking, connecting lines and junctions would be required to complete the belt system as proposed.

Four large interchange yards would be established at Porter, Griffith, Chicago Heights and Joliet. All main line freight trains would terminate at and start from these yards, interchange being made here and over the belt line. Local cars would be handled in full trains between these yards and the city terminals. North of Joliet the present outlying yards can be used conveniently, but later a fifth large yard would be provided at West Chicago.

City Freight Terminals—Consolidation of all city freight business in the district between State St. and the (proposed) straightened river channel south of

Polk St., as recommended in the Wallace plan of the Chicago Railway Terminal Commission (see *Engineering News-Record*, May 19, 1921, p. 845), is suggested for further study.

Removal of all freighthouses and team yards in the congested districts to outside locations has been studied, but the Board has not arrived at a definite conclusion. Trucking by container or other method at 25c. per ton per mile would cost $2.50 with facilities located ten miles distant, which amount, the Board states, would exceed the fixed charges saved. It is proposed to consolidate all city L. C. L. freight into trap cars of 11 tons capacity and possibly to use flat cars with containers. These latter should be loaded for firms and individuals in order to avoid rehandling of freight through the downtown freighthouses. A greater saving would be effected, according to the report, if the containers were operated between the group yards and the city.

Unit Operation—Although unified control and operation would be necessary to the effective use of the proposed plan, the report takes the position that such control does not necessarily involve disturbance of existing ownership. Single administrative control is required and it is considered that this may be secured by lease or operating agreement. The improved operating methods could be put into effect on completion of the group yards, the improvements along the Elgin, Joliet & Eastern Ry. and the necessary connections.

Passenger Terminals—Consolidation of all passenger traffic at three of the six existing stations, as proposed by the Board, would retain the Chicago & Northwestern, the Union and the Illinois Central stations. In selecting the roads to use the respective stations, consideration has been given to the tentative plan of the Interstate Commerce Commission for grouping all the railways of the United States into nineteen systems. An advantage in the proposed arrangement is that the roads would be grouped together at outlying points and further consolidated as they approach the city, thus reducing the number of crossings and developing trunk lines for passenger business only. Furthermore, some of the present circuitous routes within the city limits would be shortened by three to nine miles.

In the final plan of the terminal district as prepared for this report, passenger lines have been separated from the freight lines as far as possible in order to avoid interference of the two classes of service. For example, since the Santa Fe and Chicago & Alton are parallel (but on opposite sides of the drainage canal) between Joliet and Chicago, it is proposed to handle passenger traffic of both roads on the former and freight traffic on the latter.

Cost of Terminal Project—A summary of the estimated cost and savings shows a net cost of only $5,000,000 as follows:

[illegible]	[illegible]
[illegible]	
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

This estimate does not include the value of 24 hours saving in time on all through and local business; the savings due to the use of three or four passenger terminals in place of six; saving in property by abandoning certain facilities and the reduction of future investment by reducing requirements for electrification, track elevation and other terminal expenditures. The report states that one of the most important savings under the new plan is due to the more efficient use of the power employed in the terminal district. Probably not more than half and certainly not more than two-thirds of the capacity of the engines is now utilized because of the frequency of long switching movements with short trains.

Improvement works covered by the Board's estimate of $47,000,000 include the following: Four group yards, $36,000,000; car repair shop, $1,000,000; 33 miles of second track, $1,650,000; new double track connections and connecting lines, $6,300,000.

Earlier Project—In many respects the project described above is similar to one put forward ten years ago by L. C. Fritch, then chief engineer of the Chicago Great Western Ry. (now vice-president of the Rock Island Lines). This earlier project (see *Engineering News*, May 9, 1912, p. 902) was naturally on a smaller scale. At that time the Elgin, Joliet & Chicago Ry. was considered too far out for use in transfer service and a 50-mile belt composed mainly of existing lines was to run from South Chicago to Mayfair, keeping outside of Hammond, Blue Island, La Grange and Franklin Park. Three large interchange yards were to be established on this belt. The number of cars to be handled in and out of Chicago daily was taken at 30,000, of which 33 per cent were interchanged. Facilities capable of handling 3,000,000 interchange cars annually were estimated to cost $15,000,000 and to require $2,000,000 annually for fixed charges.

Metal Flume Experience of the Reclamation Service

Summary of a questionnaire on the design, construction and life of metal flumes at six projects of the U. S. Reclamation Service by Julian Hinds in "Reclamation Record" for April.

METAL sheets galvanized, manufactured, installed, and maintained as were the earlier metal flumes will last under average conditions from 10 to 12 years. No data are available as to the weight of galvanizing on these old sheets, but they probably carried not more than 1.5 oz. per square foot. The later flumes with heavier coatings and with more careful painting and maintenance may be expected to show a materially longer life. There appears to be no appreciable difference in the lasting qualities of the various brands of iron and steel used for flume sheets. Rough interior flumes appear to deteriorate more rapidly than smooth flumes, due to disturbances at joints.

Light silt in suspension does not in all cases seriously erode the flume sheets, but heavier particles may destroy the sheets in a comparatively short time.

Careful consideration should be given in designing flumes to possible future increase in canal capacity and to the size of washers and shoes. The present type of concrete footing is generally satisfactory. The size of footing should be increased for soft soils, and special care should be taken to make footings in seeped locations resistant to alkali. Trestle timbers should be of ample size and should be protected with paint or creosote. Posts are likely to rot at the bottom.

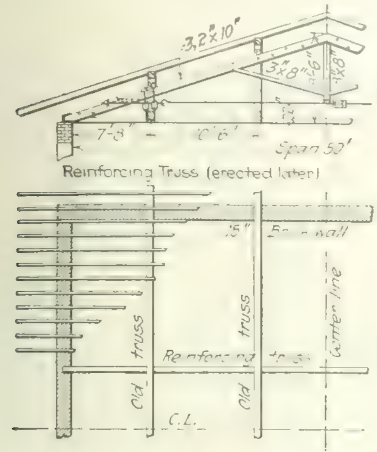
Sheets should be painted before the galvanizing is destroyed, with a coat of water-gas tar followed by one or two coats of coal tar, and a coat of coal tar should thereafter be permanently maintained on the sheets by repainting at intervals of from one to three years.

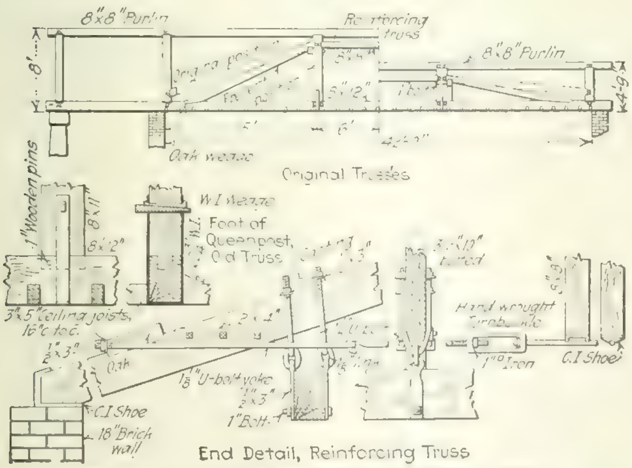
Timber Roof Framing in Arkansas Capitol is 87 Years Old

Originally No Iron in Trusses, Mortising and Pinning Hold Joints—Bottom Chords Are Heavily Stressed

AN INTERESTING example of old wood roof-truss framing, found in the roof over the old senate chamber of the Arkansas State Capitol, was examined recently by Philip B. Hill and N. B. Garver on the part of the Arkansas Chapter of the American Association of Engineers, at Little Rock. Essential features of the truss framing are shown in the drawing herewith, reproduced from blueprints accompanying their report.

The room covered by the trusses is 42 x 50 ft., inside. The original trusses, spanning in the 42-ft. direction or parallel to the ridge line of the peaked roof, are of different depths, respectively 8 ft. and 4 ft. 9 in. out to out; the shallow truss is considerably more heavily stressed than the other. It is concluded by the investigators that originally there was no iron in the trusses, but that the mortising and pinning was relied upon to hold the joints. Not only are the truss connections made thus, but the ceiling rafters, 3 x 5 in., also are





ROOF TRUSSES, ARKANSAS STATE CAPITOL

The original trusses were erected about 1835. Two reinforcing trusses transverse to them were put in later, apparently because the original trusses sagged.

mortised into the bottom chords of the trusses. There are other peculiarities; for example, the end posts do not come directly over the walls but are offset inward, which throws a heavy stress into the bottom chord.

Originally the batter posts appear to have been framed into the end posts, but subsequently they were changed to frame into the bottom chord; the stub is still found in one of the end posts, and the corresponding mortises in other end posts. On account of the weight of the ceiling, the joint at the foot of the queenpost broke after construction, and the post was then attached to the bottom chord by a wrought-iron strap stirrup, connected by wrought-iron wedges, without bolts.

Later still, apparently, two trusses spanning in the other direction were put in to support the old trusses, presumably because they sagged. The old trusses are of hewn cypress timbers, while the reinforcing trusses are of pine. The top chord of the reinforcing trusses consists of three 2 x 10-in. boards. Other details of these trusses (shown by the detail sketch) are equally interesting. Part of the batter posts of the old trusses was cut away when the reinforcing trusses were installed, reducing their section about one-half, but the suspension from the new trusses probably relieved them of most of their stress.

County Road Work Discredited in Nebraska

COUNTY construction of highways is generally discredited in a legislative committee report published by the Nebraska Department of Public Works. So deplorable a lack of records and proper accounts was found in all but a few counties that the committee discredits all costs per mile which have been claimed and recommends that:

1. Complete segregation be made of state and federal-aid roads from the county roads, both as to construction and maintenance, the complete responsibility for the construction and continued maintenance of state and federal highway system being in the Department of Public Works, and a like responsibility for county roads in the County Board. This suggestion will fix the responsibility, eliminate the necessity of co-operation between so many branches of the government, and centralize the authority where it may be exercised.

2. Every county should have a county highway engineer with a longer term than two years of office, probably four years. There should be definite qualifications fixed before an engineer can become eligible to this office. It is very difficult for the county boards to ascertain in advance whether they are securing competent men and experiments are costly.

3. The highway engineer should be given ample authority in matters pertaining to the construction and maintenance of the county roads, and be charged with the responsibility therefor. We believe that he should have absolute authority of the proper construction and maintenance of all county roads. This would contemplate the removal of authority from the township board, but it would result in a more centralized responsibility and opportunity.

4. That each county should lay out a system of highways for itself just as the state laid out the system of state highways, and that all work done by the county should be done so as to fit into this plan of operation. The piecemeal work which has been done in many places is largely wasted.

5. We believe that beyond a doubt some uniform standard of accounting for expenditure should be required of every county in the state. The present law we regard as ideal, but if it is too cumbersome then it should be simplified, but in all events the county should keep such a uniform accounting system. With the expenditure of such large sums of money, this is highly important.

6. We believe that it would be a benefit to the State if the counties were required to submit quarterly reports of their expenditures relating to highway matters to some central agency, not for the purpose of auditing them or burdening them, but in order that there may be centralized and tabulated information available as to the mileage and costs, and the general condition of the roads in every county in the state. It seems to us that this information is necessary to intelligently deal with the highway problems of the future.

Effect of Elevation Upon Run-Off from Catchment Areas

A Study of Data for Northeastern Streams to Aid in Estimating Run-Off from Certain Areas in New Jersey

By Allen Hazen
Civil Engineer, New York City

IN THE semi-arid west, catchment areas that are high in elevation produce the most water. The elevation of the catchment area to be used is one of the first things to be considered in any project. The relation between elevation and run-off is not a simple one. Other matters are involved. For one thing, the side of the mountain towards the ocean usually produces more water than the side away from it.

Rainfall data are more numerous than run-off data; and the studies and literature of the effect of elevation have largely related to rainfall. But rainfall does not tell the whole story, for with high elevation the evaporation is less and the run-off greater from the same rainfall. It also seems to be true that on an average the higher areas are steeper and drain more rapidly and completely than lower and flatter ones, and the run-off is a greater percentage of the rainfall. The effect of elevation may, therefore, be much greater on run-off than it is on rainfall.

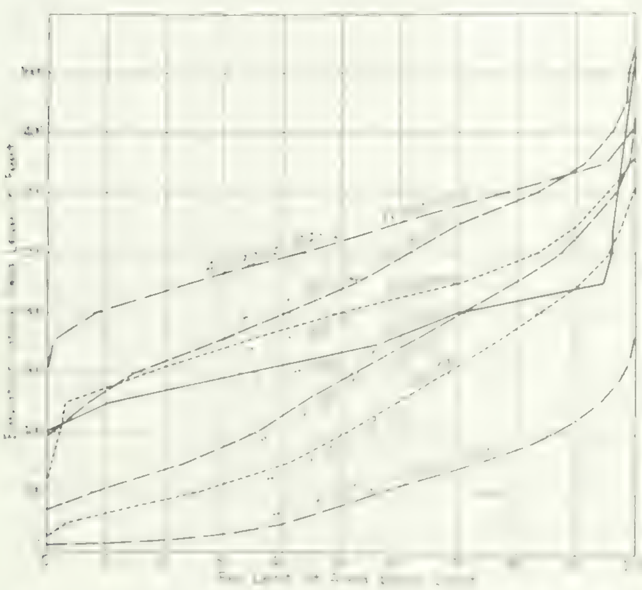


FIG. 1. ELEVATIONS OF NEW JERSEY CATCHMENT AREAS

The effect of elevation upon rainfall and run-off has been less generally recognized in the eastern United States. The differences in elevation, although considerable, are less marked than in the west. The run-off from the lower areas are greater relatively and the differences due to elevation are more easily lost sight of among differences produced by other causes.

The accompanying table gives run-off data for northeastern streams recently collected by the writer as an aid in estimating the probable run-off to be expected from certain New Jersey areas. The average elevations of the areas were ascertained and are shown in the table.

The average elevations of the areas were obtained by measuring the areas above selected contours and making a mass curve of the results. Such a plotting for certain New Jersey areas is shown by Fig. 1. This, in turn, is planimetered and the average elevations are calculated from the results. For these areas the state maps, one mile to the inch, were available and the results may be taken as practically exact. For some of the larger areas in other states corresponding maps were not available, and a small-scale United States Geological Survey map, with 500-ft. contours, was used. These results are roughly approximate only.

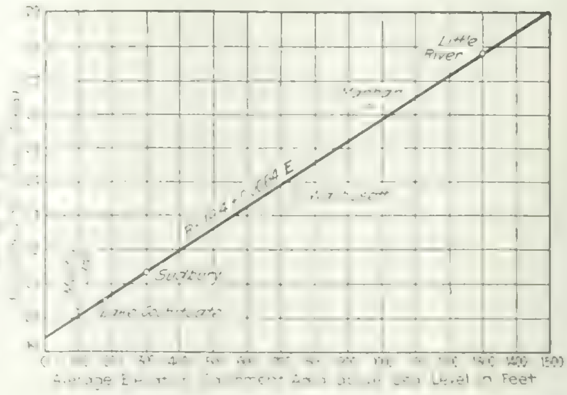


FIG. 2. MASSACHUSETTS ELEVATIONS AND RUN-OFFS

The first step in the procedure was to make a correction for the areas of water surface where they existed. For the Massachusetts supplies the run-off records represent the actual conditions, including reservoir areas. At Hartford, Conn., and at the Ashokan reservoir of the Catskill water supply, New York City, gaging stations on the main tributary streams above the reservoir were provided when the dams were built; and records so obtained are from areas without water surface. In the latter case the records from both stations were consolidated by the writer. Because of additional loss by evaporation from water areas a correction must be applied to bring all to the same basis.

RUN-OFF RECORDS FOR NORTHEASTERN STREAMS

	Year	Ending	Average Per Cent Water Surface	Average Elevation Ground Surface	Actual Run-off Inches	Run-off Corrected For Water Surface	Run-off Corrected For Elevation 0.0064 x El
[illegible]	37	1916	2.5	771c	20.57	21.0	16.1
[illegible]	20	1899	0	1,172c	19.58	19.6	12.1
[illegible]	5	1920	2.0	457b	28.03	28.4	25.5
[illegible]	20	1897	3.6	109b	19.85	20.4	19.7
[illegible]	58	1920	7.2	180a	19.49	20.5	19.3
[illegible]	46	1920	4.8	300a	20.62	21.3	19.4
[illegible]	24	1920	5.3	750a	22.83	23.6	18.8
Manhan	24	1920	0	965b	26.22	26.2	20.0
[illegible]	15	1920	1.4	1,293b	27.52	27.8	19.5
[illegible]	8	1920	0	754b	24.91	24.9	20.1
[illegible]	8	1920	0	1,022b	28.13	28.1	21.6
[illegible]	14	1920	0	1,984b	32.07	32.1	19.4
[illegible]	18	1920	0	2,148b	27.80	27.8	14.0
[illegible]	14	1920	0	1,655b	31.09	31.1	20.5
Catskill	10	1920	0	1,580b	17.45	17.4	7.3
Hudson	29	1916	1.57	1,226c	23.50	23.8	16.0
[illegible]	53	1920	4.2	600a	22.60	23.3	19.5
[illegible]	27	1918	4.0	1,043b	26.99	27.8	21.1
[illegible]	16	1920	0	1,458c	23.12	23.1	13.8
[illegible]	23	1920	1.42	603b	25.75	26.0	22.1
[illegible]	28	1912	0	345b	22.65	22.6	20.4
Perkiomen	28	1912	0	540b	22.58	22.6	19.1
Tohicken	29	1912	0	500b	27.41	27.4	24.2
[illegible]	19	1920	0	1,443c	23.77	23.8	14.6
Susquehanna	26	1916	0	1,295c	21.12	21.1	12.8

[illegible] Water Works Association Committee.
[illegible] U. S. Geological Survey maps, 1 mile per inch, exact.
[illegible] U. S. Geological Survey maps, 37 miles per inch, rough [illegible].
[illegible] and near it.

A rough approximation was sufficient. This was reached by assuming that 3 sq. miles of water area produce as much run-off as 1 sq. mile of land area. A revised run-off figure for land only was reached on this assumption.

A rapid inspection of these figures after this correction indicates that the higher areas produce more water than the lower ones. The differences are so great as to suggest the desirability of bringing the effect of elevation into the calculation in some definite way. Even though the first attempt leads only to a rough approximation, the results may be more accurate than would otherwise be reached. Rainfall data were not used. It was thought to be better to use the run-off data only. Although less numerous, the run-off records go directly to the heart of the matter as rainfall records do not.

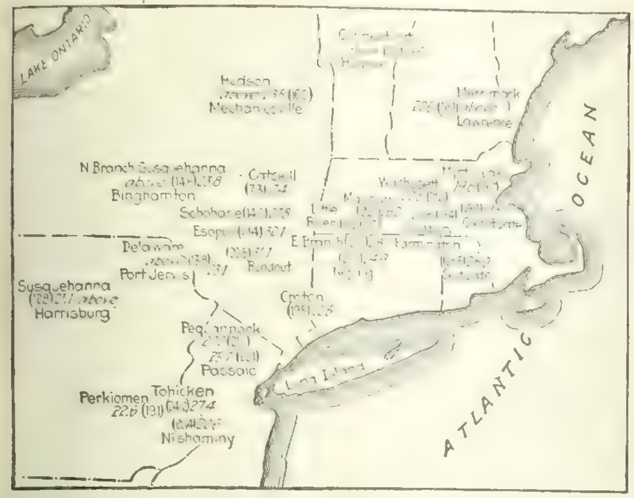


FIG. 3. RUN-OFFS FOR NORTHEASTERN UNITED STATES

Parentheses are at centers of gravity of catchment areas. The figures outside the parentheses are actual run-off; figures within the parentheses have been adjusted for altitude and water area.

This study was particularly important for the New Jersey estimates because the best record of stream flow in the state is that of the Pequannock River of the Newark water supply; and as it happens this area is also the highest in elevation of all the New Jersey areas there would be a danger of over-estimating the yield of the other areas if Pequannock records were used without correction.

To get a first general idea of the effect of elevation upon run-off a number of Massachusetts records were used. These were selected because there were more long-term records in a limited area than elsewhere, and the differences in elevation were enough to be significant. The values for mean run-off were plotted against average elevation in Fig. 2. The points lie almost in a straight line. It is true that the records from the different areas do not cover the same period of years, and strictly the comparisons should be made for the same period. Limiting the data to those contained in a single period throws out the greater part of all those used. Those that remain after this treatment support the general result shown in Fig. 2, and they are not reproduced.

The position of these catchment areas and of all the others shown in the table are shown in Fig. 3, which is reproduced from the New Jersey report. Parentheses on this map are plotted approximately at the centers of gravity of the respective areas.

In considering these Massachusetts areas, the map being before one, there is no apparent reason why the precipitation for Manhan and Little River should be greater than for Wachusett and Sudbury except that the elevations are greater. In fact, if the elevations were all the same one might expect that the areas nearer the ocean would produce somewhat more water than those farther from it.

The effect of elevation found by this diagram is therefore apparently a minimum below which the true value is not to be expected. Whether the true value is greater than indicated cannot be established from this evidence.

The line in Fig. 2 that connects the points showing these data indicates an average relation between elevation and run-off of 0.0064 in. of run-off per annum for each foot of difference in average elevation. This figure was taken provisionally as a basis for adjustment of all of the data used in this study.

The next step in the procedure is to correct the average run-off for each station for elevation by deducting an amount equal to the elevation multiplied by 0.0064.

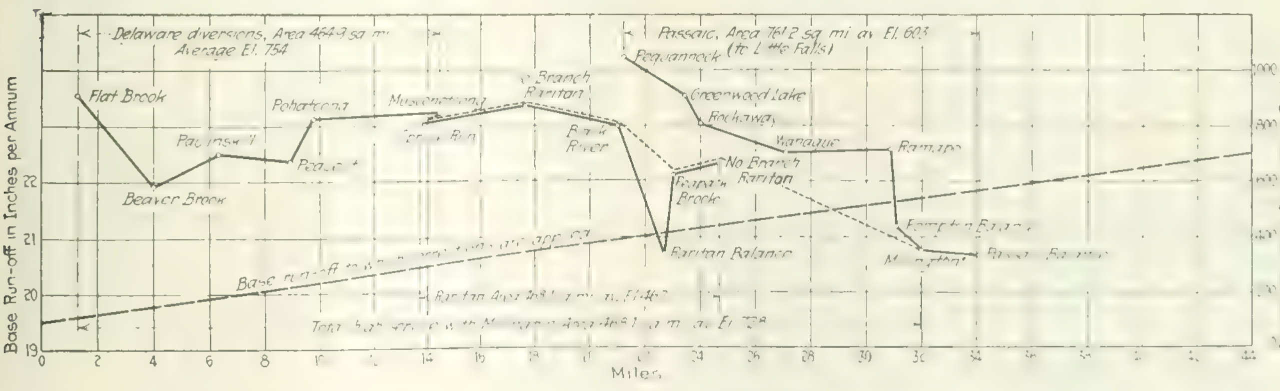


FIG. 4. ASSUMED RUN-OFFS

Used as basis for applying altitudes and water area corrections. Circles represent projections of center of gravity of catchment areas onto vertical plane through north line of State of New Jersey from catchment areas.

The figures so corrected for both water surface and elevation are shown in the last column of the table and in parentheses representing the position of the various catchment areas in Fig. 3.

It was found that the adjusted values show much less variation between stations than the values for total run-off. To illustrate, Esopus Creek, part of the New York City supply, and one of the highest areas, has the highest rate of run-off shown in the table, but the corrections bring it down to the level of the Croton

River with which it may be compared. On the other hand, the record for Catskill Creek shows a marked variation. Although high, its run-off, after correction, is much lower than neighboring areas. Schoharie Creek also shows this in less degree. This is no doubt accounted for by the fact that these streams lie on the far side of the Catskill Mountains, so that a somewhat similar effect is obtained to that observed in the west where the side of a mountain away from the ocean produces less water.

With the map before us showing the adjusted values for all the areas, base values were selected for the areas for which estimates were to be made. In Fig. 4 are shown the base values in diagrammatic form. These base values were then put through the reverse processes of adjustment. To each was first added an amount corresponding to the elevation correction. Where water area exists, or is proposed, a second correction for water area was made. The results so reached were accepted as the most probable mean run-off values for the areas under consideration.

It is not to be expected that any high degree of precision can be reached by this simple procedure. The run-off data are too few, and too many unknown elements are left out of account. It is thought, however, that one important element has been taken into account in a rough way, and that the result reached may be more accurate because this has been done.

The amount of water that may be safely counted on in dry years with various amounts of storage may be computed by the methods described in the Transactions of the American Society of Civil Engineers, Vol. 77, p. 1539. For these estimates the mean flow is always the starting point, and the subsequent calculations thus rest on estimates in which the elevation of the catchment area is an element.

War-Built Turbine Ships Inferior

In testimony before the Congressional committees considering the ship subsidy bill E. E. O'Donnell, of C. H. Sprague & Co., Boston, operating in the coastwise coal trade, testified that turbine engines in ships built during the war are not as good as those constructed in normal times. "In building the turbine engines during the war the materials did not go into the engine that would ordinarily go in normal times, in the way of steel, copper, etc., due to the great demand of the military organization for copper, brass and steel," he said. "These turbine ships will not stand up as well as the average vessel built prior thereto or at the present time. Eighty per cent of the government's fleet was built with these turbine engines. I consider the reciprocating engine and the Scotch boilers as better, although not so considered by engineers. They are the most dependable."

Mr. O'Donnell said the average seaman is prejudiced against the water-tube boiler in merchant ships as the boiler requires a great deal of attention. It requires a tight condenser or there will be trouble with the tubes in the boiler from salt water getting into the boiler causing incrustation and burning out. As to oil-burning ships, he said it was an engineering question, which might be argued both ways, whether there are less boiler repairs on an oil vessel than on a coal burning vessel; the oil vessel has a more constant steam pressure and uniform temperature throughout the boiler.

Alkali Attack on Concrete Roads and Building Brick

Notes on the Study of Disintegration in the Rice Field Country of Glenn County in California

By Irving Furlong
Associate Chemist, Bureau of Standards, Appraisers Building, San Francisco, Cal.

GLENN COUNTY, California, is situated in that part of the upper Sacramento Valley bounded on the west by the Coast Range and on the east by the Sacramento River. The general trend of drainage is to the southeast. In parts of the county, drainage is practically absent. Owing to deposits of alkali in the Coast Range, water with its source in the mountains reaches

FIG. 1. FLOODED CONCRETE HIGHWAY IN RICE FIELDS

the valley bearing dissolved alkali, and those parts of the county lacking natural drainage have long been the reservoirs for alkali-bearing water. All water in this district is alkali bearing. Wherever water has evaporated, alkali crusts are residual.

During the winter months, parts of Glenn County are inundated (Fig. 1). Because of the general alkaline condition of the soil and the excessive water, the alkali district was neglected agriculturally previous to the successful experiments with rice. By diking up the fields in checks in such a way that ponds 6 to 8 in. deep could be formed, the natural conditions prevailing produced ideal rice production territory. The California Highway traverses the rice field section of the Glenn County alkali district, the rice fields bordering the highway right-of-way for many miles. The salient point here is that the level of the water in the rice ponds is in places higher than the crown of the highway. In such places, the highway subgrade is water-saturated and wherever broken concrete permits, surface exposure of alkali water on the highway is in evidence. That part of the highway traversing the rice fields has suffered nearly a complete breakdown and brick buildings located in the heart of the alkali district show evidences of incipient disintegration. The views show some of this damage.

The Bureau of Public Roads has made a detailed study of the Glenn County alkali district. Highway condition was correlated with extent of alkali deposits in contact. The evidence evolved appears conclusive

that where seepage into depressions has been the heaviest, there the alkali deposits are the most abundant and the degree of highway disintegration is a function of the amount of alkali in contact.

In experiments with test specimens representing aggregate identical with that employed in the building of the Glenn County Highway Route, the testing laboratory of the California Highway Commission reproduced the deleterious effects of the Glenn County alkali on such aggregates. In the range studied, the leaner mixes, when subjected to alternate wetting and drying in alkali water, yielded to the alkali attack more rapidly and completely than the richer mixes. Under no conditions of experimentation with unprotected concrete was entire immunity to alkali water established.

The above mentioned evidence leaves practically no doubts that alkali played an important role in the disintegration of several miles of the Glenn County Highway. Heavy truck traffic passing over a concrete slab laid over a water saturated subgrade probably hastened the disintegration, but the same conditions now observed would have ultimately obtained even if there had been no traffic of any sort on the highway. Fig. 4 shows a portion of a concrete bridge in the affected area of Glenn County. Alkali water, unassisted by the wear and weight of truck traffic has rendered the concrete in this bridge friable to such an extent that it is gradually crumbling away. [An article in *Engineer-News-Record*, Feb. 3, 1921, p. 217, shows a concrete road design intended to remove the alkali water from contact with the concrete.]

Composition of Alkali—Regarded as a unit grouping, the alkali concentration varies from a fraction of one per cent up to practically the pure crystals. The principal alkali found throughout the district is sodium sulphate though in some places the concentration of magnesium sulphate reaches proportions worth consideration. For the most part, the sulphates and chlorides of calcium and magnesium and the carbonate and chloride of sodium are represented in such minor proportions as to make them appear as only contaminations to the sodium sulphate. Fig. 7 represents analyses of alkali extracted from typical Glenn County soils according to the plotting system described in Bureau of Standards Technologic Paper 95.

Whatever harm attributed to alkali that has been done to the highway or brick buildings in the affected region must be due to a large extent to the water-soluble sulphates.

Drainage of Alkali—In a system of mixed salts such as the Glenn County alkali represents, it was expected that the physical-chemical laws governing the deposition of crystals from aqueous solution could be demonstrated. Calcium sulphate was the least soluble salt represented and was therefore found most abundantly in other than the surface accumulations, being the first crystals to drop from solution as concentration due to surface evaporation proceeded. Sodium sulphate, being less soluble than magnesium sulphate or sodium chloride, crystallized out along pond and ditch banks, leaving the water relatively richer in respect to magnesium sulphate and sodium chloride. So long as there was any water present, most of the magnesium sulphate and sodium chloride remained in solution. Whatever natural drainage there was to the district, therefore, should carry away magnesium sulphate and sodium

FIG. 2. SURFACE ALKALI ALONG A ROAD

chloride in solution and if the dilution of that drainage water was sufficient, then also should a general leaching of the sodium sulphate from the district be effected.

The natural drainage of the district trends towards the southeast. A sample of alkali taken in the path of natural drainage several miles from the heart of the Glenn County trouble zone is represented in Plot 5. In this the magnesium sulphate and sodium chloride predominate. This sample was taken in June when the normal temperature is over 100 deg. F., and when drainage is probably at the lowest ebb. Comparing Plots 4 and 6 which represent normal alkali composition in the Glenn District with Plot 5 representing alkali withdrawn by drainage, it would appear that there is a movement of sodium chloride and magnesium sulphate out of the district, even during the summer months.

It may be interesting to note that where a lateral concrete highway traverses the drainage path from the Glenn District, there also is concrete disintegration in evidence.

Brick Disintegration—In the heart of the Glenn County alkali district are two brick buildings, the Norman warehouse and the post office building. Both buildings show evidences of incipient disintegration, the Norman warehouse to the greater extent. Fig. 5 shows a portion of the affected area of the Norman warehouse and Fig. 6 is a detail of the wall of the Post Office building.

In attempting to retard the first phase of the disin-

FIG. 3. SURFACE OF A DISINTEGRATED CONCRETE ROAD

tegration, which was manifested in the gradual crumbling away of the mortar between bricks, a cement plaster was applied over the affected area of the Norman warehouse. At present writing, the disintegration has extended at a fairly uniform rate above the plaster all along the wall. In places, the cement plaster shows some signs of disintegration, not only checking but a tendency to peel or slab away from the wall. Most of the bricks in the affected area are more or less covered with a fine frost-like white crystaline powder. Many of these bricks have rounded corners and show tendencies to scale, powder and crumble. The wall above the present affected area is in normal condition, the mortar is in fair state and the bricks are sharp edged.

While the immediate cause for brick disintegration in the Norman warehouse can unquestionably be attributed to alkali attack, it was thought worth while to determine if possible the relation of quality of brick to susceptibility to alkali attack. The bricks used in the Norman warehouse represent local manufacture from a local raw material consisting of a natural mixture of about one part clay to three parts of sand. The alkali content of the average material from the so-called clay beds was about 1 per cent. As plot 1 shows, sodium sulphate predominates. Surface samples taken at the clay beds yielded about 14 per cent alkali. The details of the alkali composition are shown in Plot 3. With exception of the apparent surface accumulation of magnesium salts, the average clay differed but little from the surface clay in respect to nature of alkali included. The principal difference was quantitative only. Plot 2 shows the composition of the water-soluble alkali now present in the bricks in the alkali affected area in the Norman warehouse. Plot 2 is directly comparable with Plots 1 and 3 since it represents water-soluble alkali content in the bricks as compared with the water-soluble alkali content of the parent material.

FIG. 4. CONCRETE ABUTMENT GOING TO PIECES
Disintegration doubtless due to soil effect of alkali water.

The increase in calcium salt in the brick is probably attributable to a small admixture of lime mortar, an adherence to the bricks in sampling. The outstanding difference and conspicuously new phase found in the brick but not in the parent clay was water-soluble silica. The first impression here might be that a case had been found with chemical proof to support the theory that the attack of alkali on concrete and other siliceous materials is one of chemical replacement such as

$$CaSiO_3 + Na_2SO_4 = CaSO_4 + Na_2SiO_3$$

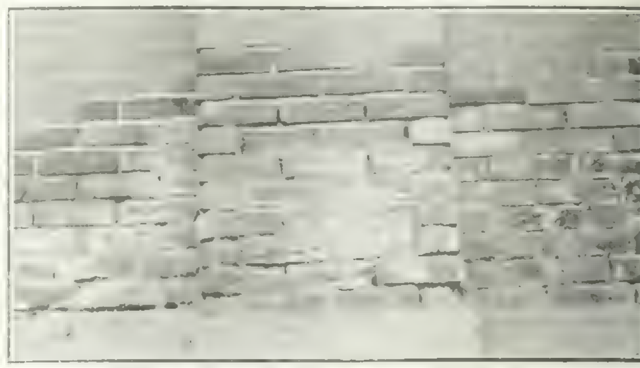
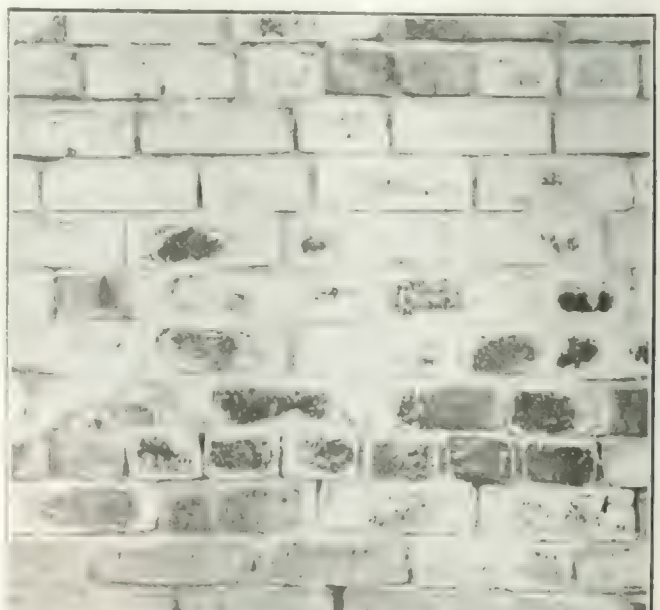


FIG. 5. PART OF ALKALI-AFFECTED BRICK WALL ON WAREHOUSE

Such a reaction would convert a water-insoluble silicate into a water-soluble silicate. However, other facts in the case do not bear out the idea that such a reaction is taking place in the Norman warehouse bricks. If the concentration of alkali present, over a long period of years, could effect such a transformation in semi-vitreous brick, then the same concentration of alkali could and would with far greater rapidity attack all of the silicates in the entire alkali district. However, water-soluble silica was found in the bricks only. It is not therefore thought that the soluble silica in the bricks is not due to any prolonged attack of alkali on silicate but that it is a product of reaction during the burning of the brick. Fusing alkali with water-insoluble silicate will always produce some water-soluble silicate. Hence, the soluble silica now present in the Norman warehouse brick was probably there when the bricks were laid, a result of the temperatures of manufacture.

A close study of Photo 5 will reveal that a few of the bricks in the affected area have apparently been immune to disintegration in any form. A field study of such bricks indicates that they had been more thoroughly burned than the adjacent bricks suffering



[illegible]ICK WALL OF POST OFFICE BUILDING

disintegration. More thorough burning brought about a sealed condition in respect to percolating waters. No chance was left for solution and removal of any constituent in such a brick nor could percolating waters carry alkali in to function later as a splitting agent.

It has been demonstrated many times that the porous concretes give way to alkali attack much faster than the dense non-porous mixes. It seems demonstrated here that this applies also to bricks. The well burned sealed bricks are standing up, the under-burned porous bricks are giving way under alkali attack.

To whatever cause may be assigned the splitting action of percolating alkali water in concrete, the same action appears to affect brick, though possibly at a slower rate. The Norman warehouse is gradually giving way to the same agencies, principally sodium sulphate, that have already fatally attacked the concrete highway near by.

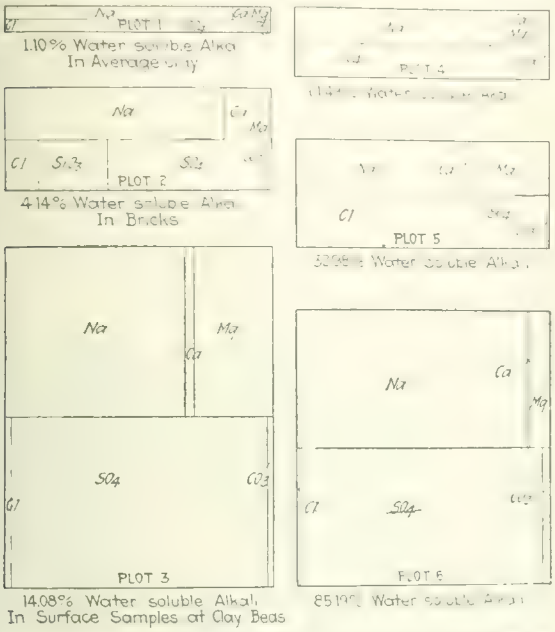


FIG. 7. PLOTS OF VARIOUS SOILS AND WATERS BEARING ALKALI IN GLENN CO., CALIFORNIA

In spite of the alkali content, the local clay could have been burned into a good sound brick had the burning been properly carried out. Even under-burned brick would have yielded long satisfactory service if not used in contact with alkali water.

British Tidal Power Scheme Held Up

The proposed utilization of tidal power on the Severn River in England, for which a number of studies were made by the British government, is apparently not progressing. According to *The Engineer* the Water Power Resources Committee has considered the subject of tidal power, and expressed the view that the technical information available in regard to the possibility of utilizing the tides in the Severn for the generation of power was not sufficiently precise to enable it to express a final opinion. The committee recommended that a technical commission should be set up by the Board of Trade, in consultation with the Ministry of Transport, to investigate the possibility from a commercial standpoint with special reference to the Severn Estuary. The proposed commission has not, however, been set up.

Hydraulics of Dosing Tanks and Trickling Filters

How to Design So That Settled Sewage Will Be Delivered Intermittently at Uniform Rate Per Square Foot

BY E. E. SANDS
Consulting Engineer, Houston, Tex.

THE designer of a trickling filter endeavors to plan a plant that will deliver the settled sewage intermittently onto the surface of the filter at a uniform rate per square foot. The usual design involves a dosing tank, a system of distributing pipes and spraying nozzles. When the plant is of large magnitude it may be necessary to slope the surface of the filter or vary the spacing of the nozzles in order to get as high a rate per square foot on the areas remote from the dosing tank as is used on the area nearest to the dosing tank. This discussion will be confined to the application of sewage to a level bed of moderate area, the settled sewage being applied by a dosing tank controlled by an automatic siphon, a system of distributing pipes and the usual commercial nozzles.

Generally Accepted Conclusions—At the outset attention is invited to the conclusions that have already been brought to the attention of the profession by various investigators and to certain facts that are apparent to all persons who have designed and operated sewage-works: (1) No designer for a municipality knows anything about the quantity of sewage the plant will be required to handle before it is replaced by a larger one. (2) Anticipated results from the use of refinement in the hydraulic calculation are apt to be nullified by careless operation and other conditions beyond the control of the designer. (3) Ideal conditions seldom exist and even if the system would give absolutely uniform distribution in a laboratory test these conditions would be upset by the wind blowing across the filter. (4) Experimental work has shown that a dosing tank shaped like an inverted pyramid gives a nearer approach to uniform distribution than any other easily constructed form. (See "Aërial Distribution of Sewage Over Percolating Filters," by William Gavin Taylor, *Engineering News*, Nov. 11, 1909, p. 511.) (5) The area served by a nozzle under the maximum head is directly proportional to the head. In other words, the spacing of the nozzle will vary as the square root of the maximum head. (6) The discharge of a nozzle at any head will vary directly as the area of the orifice of the nozzle dome and as the square root of the head. (7) The automatic siphon usually employed consumes head which varies as the square of the quantity discharged. In other words, the discharge follows the law of an orifice and $Q = k\sqrt{h}$.

From (5) and (6) it follows that using nozzles with the same area of orifice and the same cycle of application, we increase the rate of sewage applied per square foot or per acre by reducing the maximum head and the spacing of the nozzles. The same result may be accomplished by increasing the area of the orifice of the nozzles but there are practical limits to this procedure.

Hydraulic Theorem—Before proceeding further it is necessary to demonstrate an elementary theorem in

hydraulics. Quite probably it may be found in various textbooks but the writer has never seen it. If several units of hydraulic apparatus form a system which delivers water under pressure and each unit or part of the system is governed by the law $Q = k\sqrt{h}$, where h is the lost head or fall in hydraulic gradient for the unit, then the discharge of the whole system is $Q = K\sqrt{H}$, where K is a new constant and $H = \Sigma h$ and any ratio $\frac{H}{h}$ remains constant.

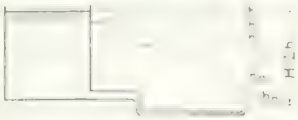


FIG. 1

$$Q = k_1\sqrt{h_1} = k_2\sqrt{h_2} = k_3\sqrt{h_3} = \ldots\ldots = k_n\sqrt{h_n}$$

$$Q^2 = k_1^2h_1 = k_2^2h_2 = k_3^2h_3 = \ldots\ldots = k_n^2h_n$$

$$\frac{Q^2}{k_1^2k_2^2k_3^2\ldots k_n^2} = \frac{h_1}{k_2^2k_3^2\ldots k_n^2} = \frac{h_2}{k_1^2k_3^2\ldots k_n^2}$$

$$= \frac{h_3}{k_1^2k_2^2k_4^2\ldots k_n^2} = \frac{h_n}{k_1^2k_2^2k_3^2\ldots k_{n-1}^2}$$

$$\text{Let } K = \sqrt{\frac{k_1^2k_2^2k_3^2\ldots k_n^2}{(k_2^2k_3^2\ldots k_n^2) + (k_1^2k_3^2\ldots k_n^2) + (k_1^2k_2^2k_4^2\ldots k_n^2) + (\;)\ldots(\;) + (k_1^2k_2^2k_3^2\ldots k_{n-1}^2)}}$$

Let $H = \Sigma h$. Then $Q^2 = K^2H$ and $Q = K\sqrt{H}$.

Fortunately the value of K never has to be solved by the use of the formula.

Design of Dosing Tank and Distributing System—With this preliminary work let us now consider the design of a dosing tank and the distributing system of a trickling filter. The problems that confront the designer are: Nozzle spacing; size of distributing pipes; time required to empty the tank; the time required to fill the tank.

Since it is proposed to use a hopper of an inverted pyramid for our tank ($ABCD$, Fig. 2) let us place the apex of the pyramid (O) at the same elevation as the nozzle orifices (E). The advantage of this practice will soon be apparent. An investigation will now be made of the time required to empty such a dosing tank.

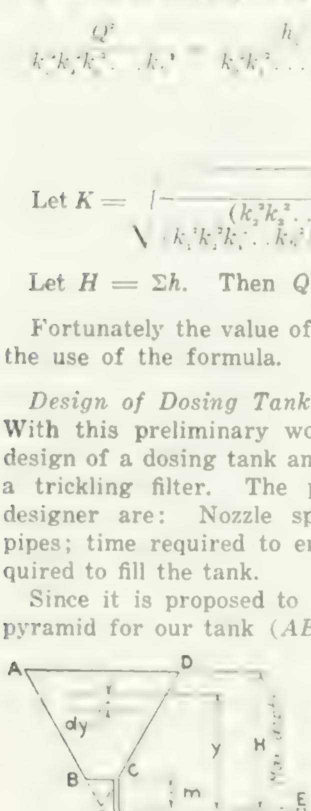


FIG. 2

To avoid confusion we will let y = the elevation of the water surface above the orifice or dome of the nozzles, and by geometry the area of the water surface = by, where b is a constant depending upon the side slopes of the tank. Let T = seconds required to empty tank with a constant inflow of R sec.-ft. and T_1 = seconds to empty tank with $R = 0$. Let all dimensions be in feet, quantities in second-feet and time in seconds.

The discharge is influenced by friction heads in the siphon located at C; in the pipe leading from C to E, and at the nozzle E. The discharge of each of these appurtenances is approximately as follows: Siphon = $K_1\sqrt{y_1}$ (includes velocity and entrance heads); pipe = $K_2\sqrt{y_2}$; nozzle = $K_3\sqrt{y_3}$; combined = $K\sqrt{y}$. The area of the water surface at any elevation $y = by^2$ where b is a constant.

Now as the tank is being emptied there will be an inflow of R sec.-ft. Then the net rate of reduction in the contents of the tank for any head y will be $Q = K\sqrt{y} - R$. dQ for any time $dt = by^2dy = dt(K\sqrt{y} - R)$. $dt = \frac{by^2dy}{K\sqrt{y} - R}$.

For convenience let $Kn = R$ and $n = \frac{R}{K}$; let $z = \sqrt{y}$. Then $dt = \frac{b}{K}\left(\frac{y^2}{\sqrt{y} - n}\right)dy = \frac{b}{K}\left(\frac{z^4}{z - n}\right)2z\,dz = \frac{2b}{K}\left(\frac{z^5}{z - n}\right)dz$.

$$dt = \frac{2b}{K}\left(z^4 + z^3n + z^2n^2 + zn^3 + n^4 + n^5\frac{1}{z - n}\right)dz$$

$$T = \frac{2b}{K}\int_{\sqrt{m}}^{\sqrt{H}}\left[\left(\frac{z^5}{5} + \frac{nz^4}{4} + \frac{n^2z^3}{3} + \frac{n^3z^2}{2} + n^4z + n^5\log_e(z - n)\right)\right]$$

$$T = \frac{2b}{K}\int_{m}^{H}\left[\left(\frac{y^{5/2}}{5} + \frac{ny^2}{4} + \frac{n^2y^{3/2}}{3} + \frac{n^3y}{2} + n^4y^{1/2} + n^5 2.3026\log_{10}(\sqrt{y} - n)\right)\right]$$

Let $R = O$. Then $n = o$ and $T_1 = \frac{2b}{5K}\int_m^H y^{5/2}$ = time to empty tank down to m with no inflow.

Design of a Small Plant—Let us design a dosing tank and distribution system to apply 0.5 m.g.d. a day to a filter bed at the rate of $2\frac{1}{2}$ m.g. per acre per day. For southern conditions we will place the distributing pipes on the surface of the filter, using no risers. As the sewage is well settled we will use comparatively low velocities in the distributing pipes, thus reducing pipe friction to a minimum. Clean-out or blow-off plugs will be provided at the ends of each pipe lateral. Assume: Maximum available head (H), water surface dosing tank to dome of nozzles = 7 ft. Average flow = 350 g.p.m. = 0.78 sec.-ft. Maximum flow = 500 g.p.m. = 1.11 sec.-ft. Use Taylor square nozzles. Area filter bed = $\frac{1}{5}$ acre = 8,710 sq.ft. With a total head of 7 ft. it is probable there will be 6 ft. available for nozzles. (The head available for the nozzles will usually be from 80 to 90 per cent of the total.) Space nozzles 12 ft. apart. (See curves furnished by manufacturer.) Area served by nozzle = 144 sq.ft. Number nozzles required = 60. Make bed 6 x 10 nozzles = 72 x 120 ft.

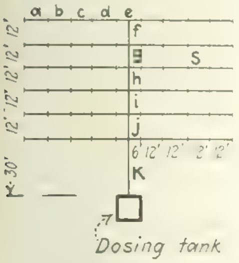
For preliminary design let us assume a maximum discharge = 3 times maximum rate of sewage inflow = 1,500 g.p.m. = 3.34 sec.-ft. Then the maximum rate of flow for each nozzle = 25 gal. per min. Select a size orifice to give, as nearly as possible, a discharge of 25 g.p.m. under a 6-ft. head. A Taylor square nozzle with a $\frac{3}{4}$-in. orifice and a $\frac{3}{8}$-in. spindle discharges 23 g.p.m. under a head of 6 ft. Try a design using 60 of these nozzles. Then the maximum discharge = 23 $\times$ 60 = 1,380 g.p.m. = 3.08 second-feet.

The accompanying diagram (Fig. 3) and table give the maximum discharges for the various pipe elements, together with velocities and friction losses.

Next try a 12-in. Miller siphon. Head for 1,380 g.p.m. = 4.93 in. = 0.41 ft. (P. 63, Catalogue 14) Pacific Flush Tank Co. Select nozzle S as representing average conditions and compute lost heads for maximum flow:

	[illegible] Head, Ft.
Nozzle	= 6.00
12 ft. pipe @ 5½ ft. per 1,000 ft.	= 0.07
12 ft. pipe @ 9.0 ft. " "	0.11
6 ft. pipe @ 2.0 ft. " "	= 0.01
Entrance and vel. head ([illegible])	= 0.05
12 ft. pipe @ 1.7 ft. per 1,000 ft.	= 0.02
12 ft. pipe @ 2.8 ft. per 1,000 ft.	= 0.03
12 ft. pipe @ 4.0 ft. per 1,000 ft.	= 0.05
30 ft. pipe @ 6.0 ft per 1,000 ft.	= 0.18
Loss in siphon	0.41
Total	6.93, say 7 ft.

The formula for the discharge of this system will now be computed. 1,380 g.p.m. = 3.08 sec.-ft. Then $3.08 = K\sqrt{7}$, and $K = 1.163$. The discharge in second-feet for any head $y = 1.163\sqrt{y}$. Determine the elevation of the bottom of the bell of the siphon. The maximum rate of inflow into dosing tank = 500 g.p.m. We should allow a factor of safety of at least 50 per



PIPE	MAX. [illegible] G.P.M.	SIZE PIPE INCHES	VEL. FT	FRICTION LOSS IN FT PER 1000 FT
a	[illegible]	3	1.1	3½
b	[illegible]	3	[illegible]	0½
c	60	4	[illegible]	5½
d	92	4	24	9.0
e	5	6	14	2.0
f	230	8	1.5	16
g	460	10	1.9	2.0
h	690	12	2.0	1.7
i	920	12	2.6	2.8
j	1150	12	3.3	4.0
k	1380	12	4.0	6.0

FIG. 3. PIPE SYSTEM FOR TRICKLING FILTERS

cent on this item, so we will assume inflow into dosing tank = 750 g.p.m. = 1.67 sec.-ft. $1.67 = 1.163\sqrt{y}$. $\sqrt{y} = 1.436$. $y = 2.06$ ft. Let $m = 2$ ft. $Q = 1.163\sqrt{2} = 1.646$ sec.-ft. = 739 g.p.m.

Place the bell of siphon 2 ft. above the nozzle orifices and it will sniff with any probable rate of inflow and continuous operation will be avoided.

The next step is to design the dosing tank. The time required to empty can be approximated quite closely without the use of the formula. If we compute the rates of discharge for the maximum and minimum heads and average them we get what may be called the average rate of discharge. The true mean discharge will be from 8 to 16 per cent above this average. For preliminary design we may assume that the mean rate of discharge is 110 per cent of the average rate.

For the tank we are considering the various rates of discharge in second-feet are: Maximum, 3.08 ($1.163\sqrt{7}$). Minimum, 1.65 ($1.163\sqrt{2}$). Average, 2.365. Mean, about 2.60 sec.-ft. Then the net rate of emptying the tank for an inflow of: 500 g.p.m. = 2.60 — 1.11 = 1.49 sec.-ft. and for 350 g.p.m. = 2.60 — 0.78 = 1.82 sec.-ft.

We will now try various sizes of tanks and see about what sort of dosing cycles will result. Try a tank that holds 200 cu.ft. Then for maximum inflow at 500 g.p.m. we would dose 134 sec. = 2 min. 14 sec. and rest 180 sec. = 3 min. 0 sec. For 350 g.p.m. flow we would dose 110 sec. = 1 min. 50 sec. and rest 257 sec. = 4 min. 17 sec.

A few years ago a cycle of 3 minutes' dosing time and 7 minutes' rest was considered good practice. At present the tendency is toward a very short period of rest. All that is necessary to vary the cycle is to increase or reduce the size of the tank.

Suppose that the above cycle is satisfactory to the designer. Then the tank must be a 5-ft. frustrum of a 7-ft. pyramid and hold 200 cu.ft. This is solved by elementary geometry and the area of the maximum water surface (base of pyramid) = 87 sq.ft.—say 8¾ x 10 ft.

We now have completed the design by approximate methods, the next step is to investigate the design by using the formula. We have all the constants: Maximum water surface = 87 = $b\,y = b\,7^2 = 49\,b$. $b = 1.77$. $K = 1.163$. $H = 7.0$. $m = 2.0$. $n = \frac{R}{K} = \frac{1.11}{1.163} = 0.954$ for 500 g.p.m. inflow; and $\frac{.78}{1.163} = 0.671$ for 350 g.p.m. inflow.

Applying the formula we find the actual time to empty tank for inflow of 500 g.p.m. (= 1.11 sec.-ft.) = 135 sec. = 2 min. 15 sec.; 350 g.p.m. (= 0.78 sec.-ft.) = 109 sec. = 1 min. 49 sec.

It is realized that the method here presented is subject to criticism. For instance, the exponent in the formula for the discharge of a cast-iron pipe is nearer ⅘ than it is to ½. The coefficients do not remain constant under variable heads, but the error resulting from the use of the formula will be small and it is believed that the method outlined is sufficiently accurate for all practical purposes.

For Consolidation of Society Effort

Extract from Paper by Adolph F. Meyer, President, Minnesota Federation of Architectural and Engineering Societies, Presented to the Federation at Its Recent Meeting.

WE engineers and architects have really been "penny wise and pound foolish" in the management of our own affairs. A similar policy pursued in our professional work would have been ruinous. We have split up into societies and sections that promise to outnumber even the branches of the Christian church. Highly specialized technical problems may advantageously be discussed by small professional groups, but these groups should leave to single community organizations those matters that affect the relation of our profession to that community, and such organizations should in turn act on matters of state-wide interest through this federation.

Civic problems can advantageously be handled through the committees of civic bodies on which our profession should have better representation. We should establish contact between our technical societies and civic bodies through the medium of those of our members who are appointed on the committees of these bodies so that these men might express the judgment of entire professional organizations rather than merely their own.

As the result of endless subdivision of the profession, technical meetings have multiplied in number until they have become burdensome and interest has flagged. Men's activities have been divided until the fractions thereof have become almost invisible and quite ineffective. A single monthly meeting in each large city, always at the same place and date, featuring a variety of subjects of general interest and dealing with all branches of the profession, each well-attended, would conserve our time and effort, tend to consolidate our interests and do more to further our professional standing than the present multiplicity of group gatherings.

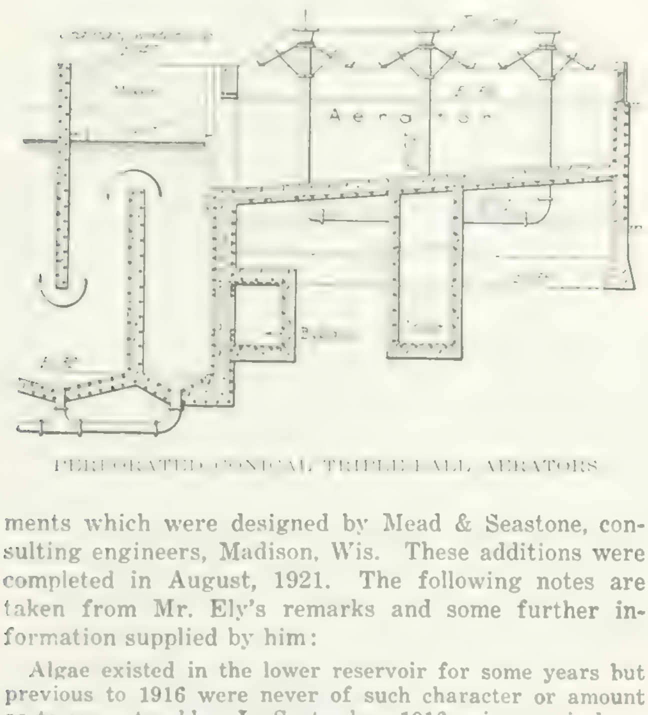
A similar criticism might well be directed at publications. Every organization, every industry and every branch thereof is publishing some form of "official paper." Most of these publications are forced to live on their advertising income. Advertising in such minor publications seldom reaches new prospective buyers and is usually in essence a donation prompted by friendship. As such it cannot justify its existence.

Aerators and Copper Sulphate for Tastes and Odors

Six-Years' Experience with Impounded Supply Leads to Use of Fountain Aerators to Augment Action of Copper Sulphate

IMPROVEMENTS made recently to the water-treatment plant at Danville, Ill., include six fountain aerators of novel design to assist copper sulphate in eliminating tastes and odors. The aerated water will pass through a new up-and-down baffled mixing chamber and a large new settling basin.

Danville's water supply is impounded by two dams on the north fork of the Vermillion River, one in service since 1903 of 75-m.g. capacity at the pumping station and the second, completed in 1915, of 450-m.g. capacity four miles upstream. H. M. Ely, superintendent of the Interstate Water Co., which owns the Danville water-works, at the recent meeting of the Illinois section of the American Water Works Association, noted in a round-table discussion his experience with algae growths since 1916 and outlined the improvements which were designed by Mead & Seastone, consulting engineers, Madison, Wis. These additions were completed in August, 1921. The following notes are taken from Mr. Ely's remarks and some further information supplied by him:

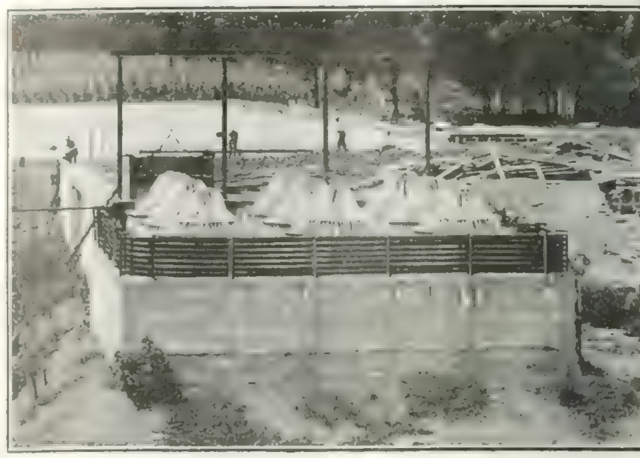


PERFORATED CONICAL TRIPLE-FALL AERATORS

Algae existed in the lower reservoir for some years but previous to 1916 were never of such character or amount as to cause trouble. In September, 1916, microscopical examinations of water from each reservoir made by the State Water Survey showed moderate algae growths. The micro-organisms found were protozoa, rotifers, chlorophyceae, crustacea rather numerous, protococcus most numerous and euglena in small numbers. In July, 1917, the organisms present were diatoms, protococcus, rotifers, crustacea and the algae forms but no euglena.

Drought and Odors—From July 1 to the latter part of October, 1919, Danville experienced a severe drought, following a deficient rainfall in all the preceding months of the year. The lower reservoir was drawn down 5 ft. but maintained at that level by allowing water to flow from the upper reservoir through a gate in the dam downstream into the lower reservoir. In doing this the upper reservoir was drawn down 9 ft.

On Aug. 18 obnoxious tastes and odors suddenly appeared rendering the water unpalatable. Bacterially the water was safe for drinking purposes. Inspection of the reservoirs on Aug. 20 and 21 showed patches of green scum and in places streaks of brick-red colored scum were noted. The effect seemed to be distributed throughout the reservoir, for even where no scum existed on the surface, the water had a reddish cast. The scum area was much smaller than in previous years and was composed of different forms of micro-organisms. On Aug. 26 the State Water Survey found that each reservoir contained euglena, which was dominant, uroglena, peridinium, anabaena, arcella, diatoms and rotifers. The first three organisms are known to impart a fishy and oily taste to the water and the fourth a greasy or moldy taste.



TRIPLE-FALL FOUNTAIN AERATORS IN ACTION

Gallows frame supports stop-log gate controlling mixing chamber directly in the rear. Part of new settling chamber further back.

Copper Sulphate Used—On Aug. 27 the lower reservoir was treated with copper sulphate. As nearly as could be determined, 1½ lb. p.m.g. or 0.2 p.p.m. were used. This had no effect upon the taste and odor. From Oct. 2 to 9 the water flow from the upper reservoir was treated with copper sulphate at the rate of 5 lb. p.m.g. The lower reservoir was again treated, but at a rate of 8 lb. p.m.g. About Oct. 7 the taste and odor began to disappear and in a few days the character of the water was back to normal. On Oct. 5 and also on Oct. 9 a heavy rainfall occurred, which may have been a factor in bringing about the improvement.

An unusually severe drought occurred in 1920, from June to December. The lower reservoir was drawn 11 ft. and the upper reservoir 16 ft. During this period there was a slight odor at times, but not enough to cause annoyance. No microscopical examinations were made.

In 1921 the water company bought a microscope and began to make frequent examinations in order to anticipate any possible trouble by gaining a knowledge of the condition of the water and by beginning the copper-sulphate treatment early. The organisms found during that summer were volvox, protococcus, pediastrum and scenedesmus, all of the chlorophyceae group; peridinium of the protozoa group, and anabaena of the cyanophyceae group. Volvox and peridinium impart a fishy taste, anabaena a moldy taste. The other organisms are not troublesome. While the fishy odors were eliminated, the moldy odor was not altogether dissipated by copper-sulphate treatment nor by aeration after it was started in August, 1921. The moldy odor lasted several weeks, and while rather disagreeable was not nearly so serious as the odor in 1919.

The aerator was built to remove the taste and odor from the water. It consists of a group of fountains set 8 ft. c. to c. in a concrete basin which is 25 ft. square in plan inside at the top and has a bottom that slopes toward the mixing chamber, giving an ordinary water depth of from 1 to 3 ft. The fountains consist of vertical pipes, near the top of which are placed perforated boiler-plate conical hoods, 6 ft. in diameter. Perforated circular baffles on the hoods at the center line and bottom still further break up the flow. The water falls from the top of these pipes down over the hoods and through the perforations. The minimum fall from the rim of the hoods to the ordinary water level

is 5 ft. The fountains are anchored in place by $\frac{3}{8}$-in. tie rods. The concrete basin walls are surmounted by louvres to permit a free circulation of air.

As the aerator was not completed until August, 1921, there has not yet been an opportunity to make a thorough test as to its removal of tastes and odors. While the experience has not yet been sufficiently broad to state just what can be accomplished by the combination of copper sulphate and aeration, it is believed that a material improvement can be made in the character of the water when such tastes and odors occur.

Models in Civil Engineering Instruction

By J. T. Thompson
Associate Professor, Civil Engineering Department, Johns Hopkins University, Baltimore

IT IS a common experience that the appeal to the mind through the senses of sight and touch is much stronger than that through the sense of hearing. The instructor in civil engineering may therefore at times be at a disadvantage when compared with the instructor in electrical or mechanical engineering. The latter is usually able to show his students the motor-generator set or the turbine he is discussing for the reason that practically every technical school has such equipment, but what can the instructor in civil engineering do about the dam or bridge that he wishes to discuss? True, he can show his students a photograph of it, can describe it in detail, can even make blackboard sketches of it; but with all this his colleague in the other department has some advantage. For, not only can he do all this but in addition his students can handle the full-sized apparatus, run it, play with it, and leave it with a far stronger mental picture and more intimate knowledge than if they had merely seen a picture or a blackboard sketch of it or had merely listened to a description of it.

It is, of course, rarely possible for a civil engineering department to have a couple of bridges on the campus for class demonstration, but there is much that can be done along substitute lines. Inspection trips to local structures, which are undoubtedly of great value, are not always possible or convenient and so we face the necessity of providing other means of instruction. Why not by the more intensive use of practical models? The paragraphs which follow describe, as an example, a model in use in the civil engineering department of the Johns Hopkins University, and tell how it is used and with what success its use has met.

Plate-Girder Bridge Model—The accompanying photographs depict a model of a through plate-girder bridge of 100 ft. span. The model is 52 in. long and has a web 4 in. deep, the scale being 1 in. to 2 ft. It is made entirely of brass; the angles were milled from square brass stock. In place of rivets, the parts are connected throughout with No. 6 32-thread machine screws with hexagon nuts. The rivet pitch in all flange angles is $\frac{1}{2}$ in., no attempt having been made to represent the true pitch.

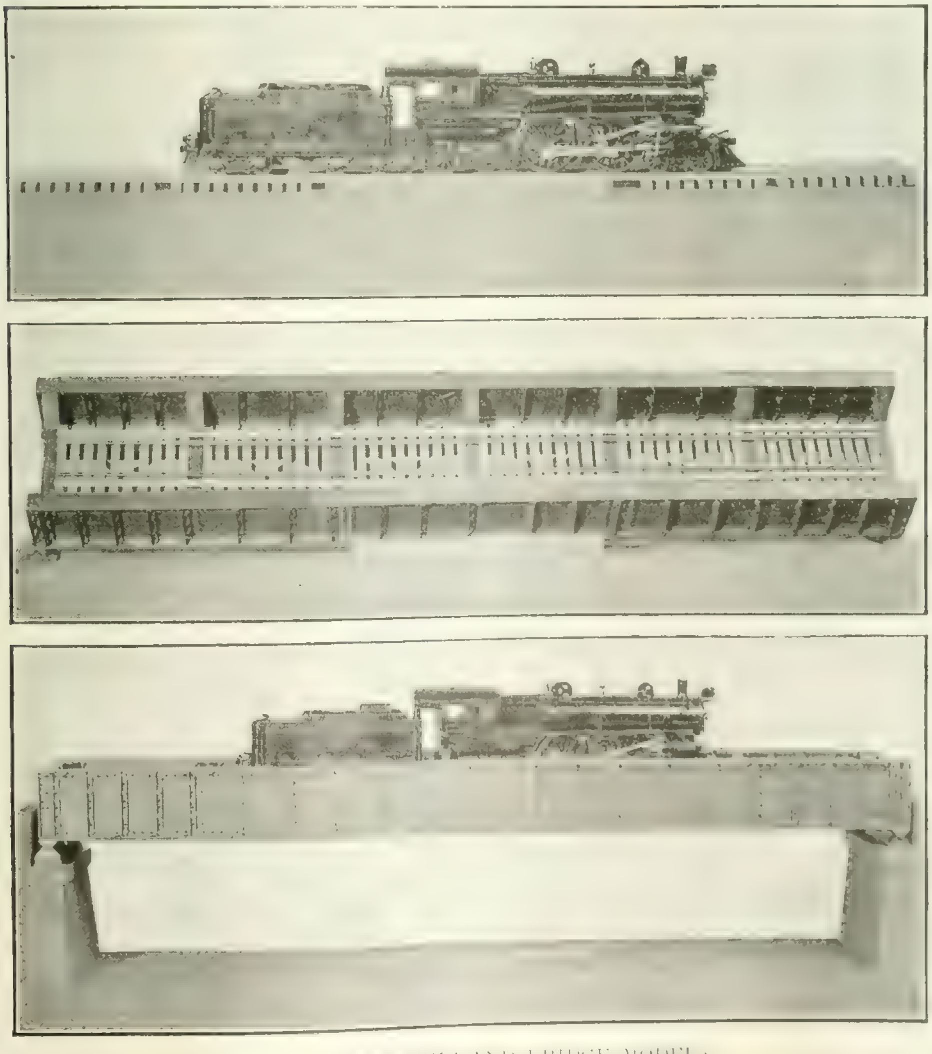


FIG. 1. LOCOMOTIVE AND BRIDGE MODELS

Used in connection with a model locomotive, the model conveys instantly to the student's mind how the load is carried to the main girders and impresses him once and for all with a fact that is often hard for him to see otherwise—that the live load can come into the main girders only at the panel points.

Web-Action Shown—One of the most useful and interesting points brought out by this model is shown in Fig. 2, which demonstrates the action of the web under stress. Here the brass web has been removed from one of the girders and a heavy paper web substituted for it. Loads applied at the third-points under two different conditions are shown in the cut. The effect of diagonal compression due to shear is clearly demonstrated by the long buckles which appear in the web between the loads and the supports. From the upper view it is apparent that this buckling of the web is due to shear, since between the loads, where the shear is zero, no buckles appear. The buckling of the web involves the column action of a strip of web in-

clined to the horizontal, roughly at right angles to the buckles.

The middle view in Fig. 2 shows the girder with stiffeners applied between one of the loads and a support. It is obvious that, if we consider an elementary column strip at right angles to the buckles as they exist in this view, its length will still be terminated by the flange angles; the stiffeners are too far apart to be materially effective in reducing this column length, thereby strengthening the web. In the bottom view of Fig. 2 the stiffeners are properly spaced, effectively reducing the length of the column strip, and adding greatly to web strength.

The seeing of these lines of diagonal stress was a revelation to the students, especially to those who were studying reinforced concrete, and who were designing web reinforcement against just this sort of thing.

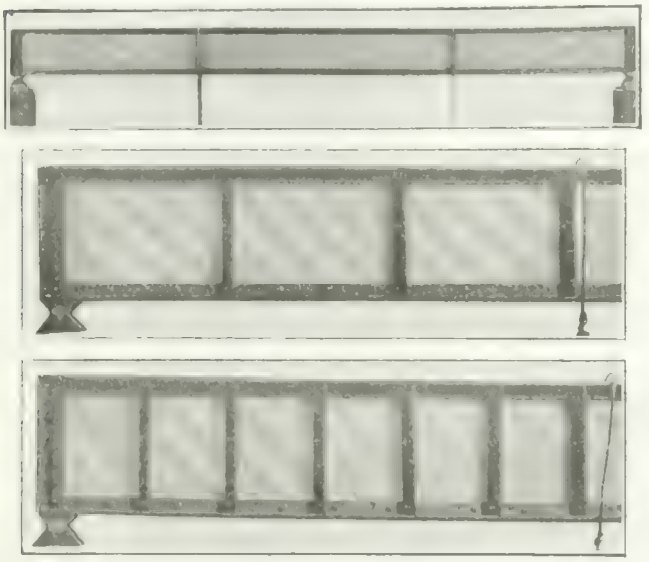


FIG. 2—PAPER WEB EXHIBITS DIAGONAL TENSION

True, they had theorized about these stresses and knew they existed, but seeing them made a great impression, one that they will never forget.

Help to the Student.—In the drafting room, where the students were designing a through plate-girder bridge, the model was found indispensable. Naturally a great many questions arose as to how the parts go together, how splices are arranged, which rivets are field-driven, etc. The model answered most of these questions, or rather it caused the student to answer them for himself, which is still better.

Working two afternoons a week it takes the average student about three months to design and make a drawing of a through plate-girder bridge. Formerly some trouble was experienced in keeping the students interested, but since the advent of this model it has been found that, if they can have it there in the drafting room where they can examine it and handle it, they turn out not only quicker and more intelligent but also more *interested* work.

In conclusion it may be said that we have found this model well worth every cent of money and hour of time spent upon it, and that we are preparing to construct more models along the same general lines to illustrate different types of structures.

Acknowledgements—The bridge model was made by S. F. Styers in the mechanical shops of Johns Hopkins University after plans prepared by the writer. The locomotive model was made by H. E. Askew of the Baltimore Polytechnic Institute. As far as all visible details are concerned it is an exact reproduction of a standard passenger locomotive.

Report on Calcutta Bridge Proposes 1,500-Ft. Cantilever Structure

Reporting on the problem of renewal of the pontoon bridge across the Hooghly River between Calcutta and Howrah, India, a committee of engineers appointed by the government has recommended a fixed bridge crossing the river by a single span of 1,500 ft. with a clearance height of 29 ft. above high water. A cantilever structure is recommended, after consideration of arch and suspension types. Foundations on firm clay are expected to be found between 80 and 100 ft. below surface. The cost of the structure is estimated at $10,000,000.

The old pontoon bridge, built about half a century ago, required extensive repairs in 1916, at which time the old wooden floor system was replaced by steel members. It was known at that time, however, that the bridge as repaired would not be serviceable for more than a few years, and at the present time the construction of the new crossing is imperatively needed.

According to the terms of appointment of the committee, navigation does not require a movable span. A floating bridge was considered by the committee, but the report states that such a structure would not meet the loading requirements because a floor of sufficient strength could not be provided. Suspension or arch construction was rejected by the committee partly on account of the lateral thrust involved and the virtual impossibility of providing suitable foundations in the soft subsoil. Piers in the river are not permissible, either with regard to navigation interests—the commissioners of the port of Calcutta having established the principle that no river piers should be permitted—or with regard to the difficulty of providing piers secure against scour.

Upon these considerations a cantilever design was evolved. As outlined by the committee, the structure would have a straight bottom chord, top chords of the cantilevers sloping down from towers over the main piers to the anchorage end and the suspended span respectively, and curved top chord in the suspended span. Approach grades of 1¼ to 2½ per cent would suit the required street connections.

In view of the heavy traffic demands expected, especially those corresponding to an increased suburban trolley traffic, a total deck width of 100 ft. is suggested as necessary, which would include, besides a double-track trolley line, a 58-ft. width for six lines of vehicle traffic and two 12-ft. sidewalks. The latter would probably be placed outside the trusses. For the floor design the committee recommends that an allowance of 40 per cent impact be made for trolley loads and 50 per cent impact for motor-truck loads.

Immediate prosecution of the scheme is recommended by the committee. The location suggested for the bridge is about 600 ft. upstream from the present pontoon bridge. It is estimated that 3½ years would be required for the construction.

Continuous-Mat Foundations for 22-Story Building

Standard Oil Building in San Francisco Founded on Inverted Floor 3-Ft. Thick, Reinforced by Ribs Between Columns

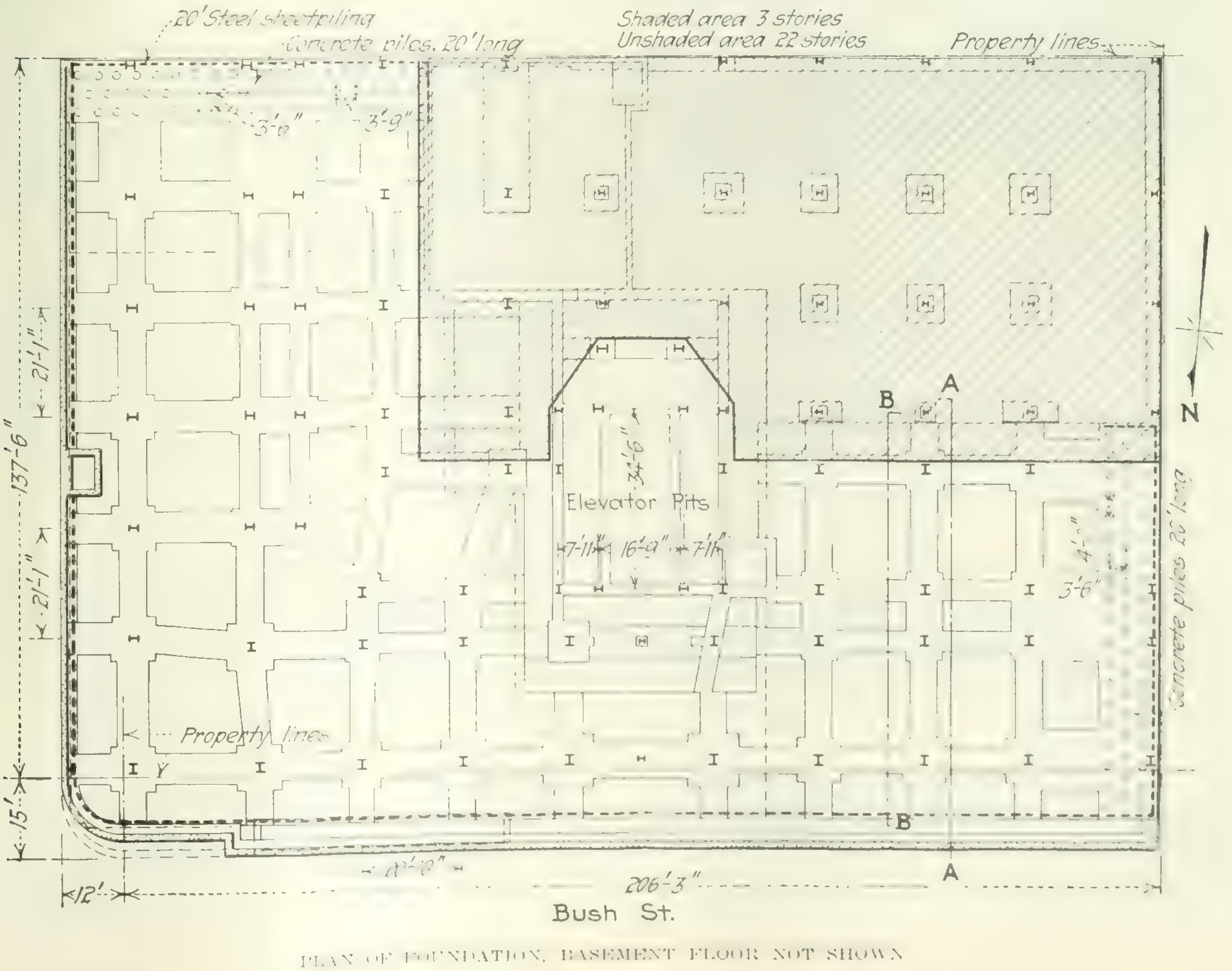
A TWENTY-TWO-STORY office building is now being built for the Standard Oil Co. in San Francisco at Sansome and Bush Sts., which is on the old shore line of San Francisco Bay, about one-half mile inland from the present shore line. Core borings taken on the site showed the underlying material to be sand, clay and water in varying proportions; rock was encountered about 160 ft. below the street level. After a study of local conditions and a comparison of various methods, it was decided to build the structure on a continuous mat of reinforced concrete.

Carrying the foundation down to rock was obviously impossible, or at least impracticable. The use of the ordinary pile foundation was discarded because experience with this type of soil had shown that it would be practically impossible to drive piles through it. The use of jetted piles was considered inadvisable because the underlying strata would have been very much disturbed in the process of getting the piles into position in this way due to the high pressures which would be required for the jet. Moreover, the bearing value of piles in this disturbed material was doubtful. The use of spread footings was then considered. Preliminary computations were made for a design using isolated footings and assuming a soil pressure of 5,000 lb. per sq.ft. This showed that the area of footings needed was such that a continuous mat would be required.

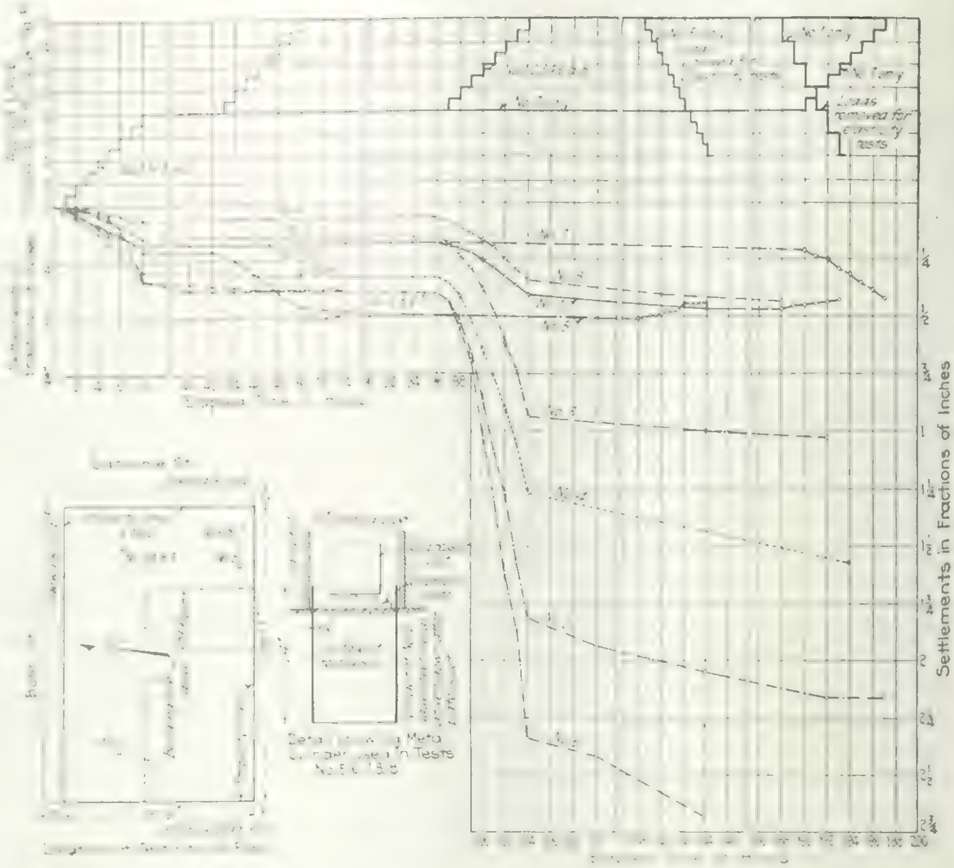
It was then determined to make some compression tests on the soil to actually determine its carrying capacity. Eight tests were made, the apparatus used closely following the type recommended by "The Special Committee to Codify Present Practice on the Bearing Value of Soils for Foundations" in its progress report to the Am. Soc. C. E. which was published in August, 1920, issue of *Proceedings*, p. 906. This apparatus proved easy to construct, very simple to operate and gave excellent results.

The soil loading tests were made in increments of 1,000 lb. per sq.ft. every half hour until a total of 8,000 lb. had been reached. After a lapse of about 24 hr., eight more 1,000-lb. increments were added at half-hour intervals, bringing the total load up to 16,000 lb. As the percentage of sand and clay in the soil varied in different portions of the site in any horizontal plane, uniform results naturally could not be expected. However, as the average settlement recorded by the apparatus for a load approximating the unit dead load carried to the soil by the building (which was about 4,800 lb. per sq.ft.) was less than an $\frac{1}{8}$ in., it was considered amply safe to found the building on a continuous mat.

The mat was designed in the customary manner as



PLAN OF FOUNDATION, BASEMENT FLOOR NOT SHOWN



RESULTS OF TESTS TO DETERMINE BEARING VALUE OF THE SOIL

an inverted floor, with ribs extending between the columns. The slab between ribs was designed with two-way reinforcing and, in general, considered as continuous on the four edges. The moments and shears in the ribs were computed on the basis of the theorem of three moments, assuming a uniform soil pressure under the mat. While it was realized that the assumption of uniform soil pressure under the mat is not theoretically true, it was felt that practically, because of the non-uniform character of the soil and the extremely small magnitude of the probable deflections, the assumption was justified.

At the ends of the south and west wings the spread of the mat was limited by the property lines, thereby increasing the soil pressure at these places. To take care of the excess loading along these sides, concrete piles were used. These piles are 20 ft. long and were formed by sinking 18-in. diameter well casing in the usual manner to a hard clay stratum and filling them with concrete.

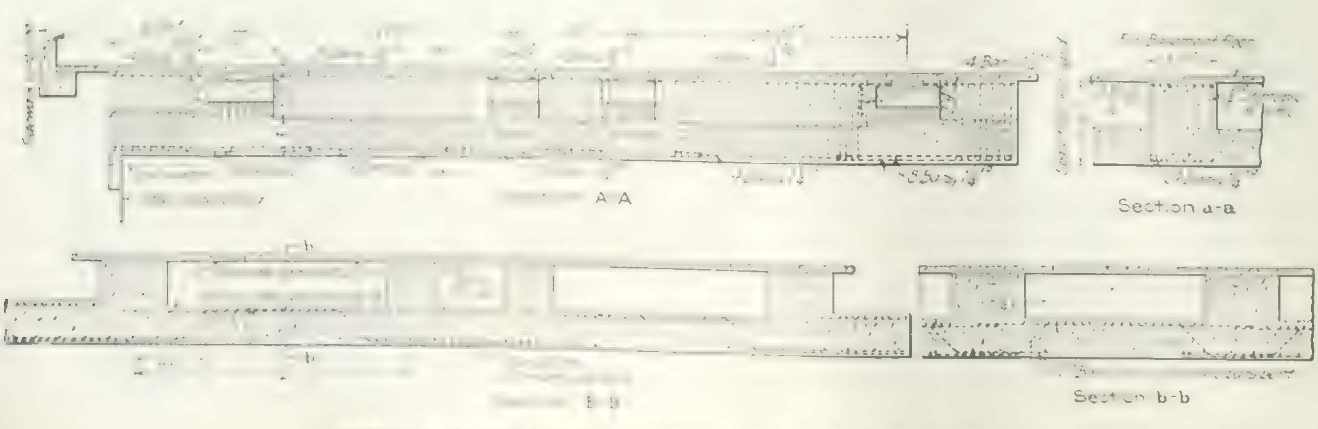
In order to prevent any flow of the subsoil by reason of any future excavation in the streets or adjoining property, interlocking steel sheet-piling was driven near the outside of the mat and entirely around the portion of the area occupied by the 22-story structure. These were in 20-ft. lengths and were driven with a steam hammer without difficulty.

In placing the foundation the site was first excavated, one section at a time, to a depth about 8 ft. below the level of the basement floor. These sections were then leveled off and a 3-in. concrete slab poured to give a clean, dry bed on which to work and lay steel. The bars in the lower slab and bottom part of the ribs were then set and the 3-ft. slab poured. The steel grillages for the column bases were next placed and the remainder of the ribs were formed up, after which the top steel was placed. The next pour finished the ribs and completely embedded the steel grillage. By embedding the grillage in the ribs instead of placing it on top, several feet of excavation were saved and a more compact design was secured. Care was taken that the joint in the ribs at the top of the 3-ft. slab and the vertical joints at the end of the day's pour (which were at center lines between columns) were thoroughly roughened, picked, and painted with neat cement grout just before pouring.

The order of procedure in the excavation and the pouring of the sections was such that the sand used for the back-fill under the basement floor slab was taken by wheel-barrows from the excavation direct to sections ready to be backfilled.

A complication in the design was caused by the necessity of dropping the mat for the pits of the high-speed elevators and trenches for the mechanical equipment in the south wing.

Typical reinforcing of the ribs is shown in section



TYPICAL SECTIONS OF INVERTED-FLOOR FOUNDATION

A-A of the accompanying drawing. All the bars were made straight for practical reasons and the shear not taken by the concrete was taken care of by four-legged stirrups, $\frac{5}{8}$ in. square. These stirrups were spaced uniformly 6 in. apart in all ribs, which simplified the design and field work and insured a good mechanical bond between the first and second pours in the ribs.

Typical reinforcing in the slabs is shown in section B-B. This was designed by the usual method applied to floor slabs with two-way reinforcing, the bent bars taking shear and negative moment.

The design was made by H. J. Brunnier, consulting structural engineer of San Francisco, by whose office the foregoing data were supplied. George W. Kelham of San Francisco was the architect.

Drilled Wells for Draining Land

By R. M. Downie
Keystone Driller Co., Beaver Falls, Pa.

ONE of the most curious things found in Florida (and it may be found in other places as well) is the use of drilled wells for the double purpose of supply and drainage. In dry weather the wells may be used as a source of water for irrigating and in the wet season the same wells may be used for draining the land. When the latter purpose only is to be served a 6- or 8-in. well is drilled to a depth of 400 to 600 ft., or until porous rock is found. At this depth the water in the well, which may have previously stood at a few feet below the surface or even have been flowing out, will drop to 20, 50 or more feet from the surface. A little test by turning in a stream of water will show that when the well is filled up a few feet the water will begin to run away.

It only remains to form a brick or concrete sump or settling basin 10 or 12 ft. in diameter about the top of the well, to catch all drift or sand, as otherwise the well will in time be choked. The well casing is cut off at 3 to 8 ft. below the ground and 18 or 20 in. above the bottom of the sump. This allows the surrounding land to be drained into the sump and in this way the level in small lakes may be kept at a predetermined height during the wet and dry seasons. Sewage from small towns and cities may be disposed of by passing it through a septic tank and then conducting the effluent to the well. The outlet from the wells is always some hundreds of feet below sea-level and the sewage does not at all contaminate the underground water.

If a well is made for obtaining water, usually a depth of 100 to 150 ft. will yield all that can be pumped.

[Drainage by means of wells has been practised in the central and western states, as noted in *Engineering News-Record*, Dec. 10, 1914, p. 1169, and *Engineering News-Record*, July 19, 1917, p. 120.—Editor.]

Spray Painting Tried on Bridges

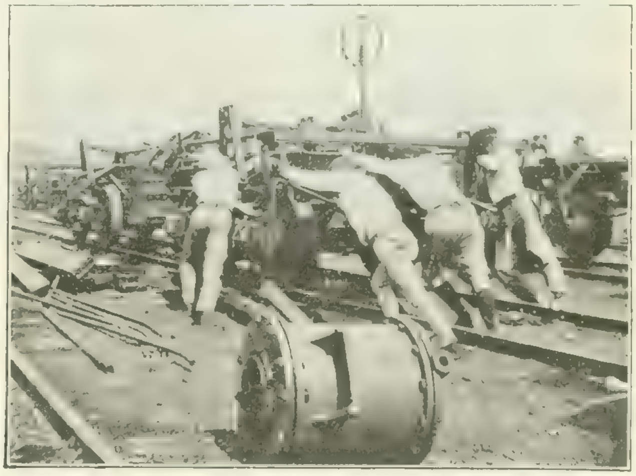
Painting bridges by compressed air was given a tryout recently by the maintenance department of the Indiana Highway Commission, John Williams, director of maintenance. Because of the increasing number of bridges taken over by the commission, economy in maintenance is increasingly important, and a cheaper and quicker method of painting than hand brush work is desired. It is reported that the test showed the spray painting to be considerably cheaper than hand work.

Irrigation Works in Formosa Being Built by Japan

Dry Side of Island to be Irrigated by a Diversion from West Side—Bricks for Tunnel Lining Carried 14 Miles by Cableway

TWO crops per year instead of one may be raised on the dry side of the Island of Formosa when the Japanese finish irrigation works now under construction, consisting of the diversion of a river by means of a tunnel bored through a mountain, a storage reservoir, 638 miles of ditches and an equal mileage of drains.

Formosa, or Taiwan, as it is called in Japan, is an oblong-shaped island with a high mountain range extending through the center from north to south. On one side of the range is the Sabon River, offering an ample water supply; on the other side of the mountains is a fertile area, needing more water. The land is cultivated



JAPANESE GANG ERECTING AMERICAN MACHINERY

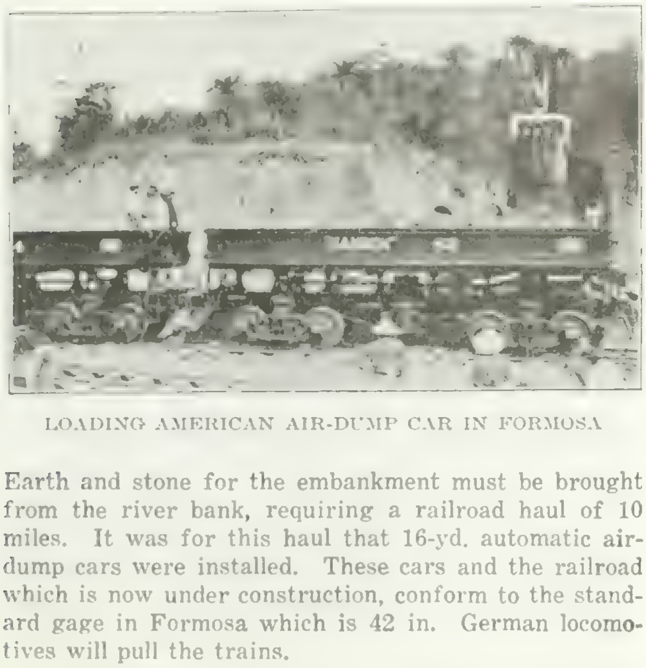
by Chinese farmers, whose ancestors settled there a thousand or more years ago. They have made some crude attempts at irrigation, but the water supply is insufficient. The entire rainfall is confined to the months from June to September and in consequence sugar cane is the only crop raised. A young Japanese engineer, Y. Hatta, conceived the idea of carrying the waters of the Sabon River through the mountain range by means of a tunnel, so that by irrigation the farmers could raise a crop of rice after their sugar cane had been harvested. This was in 1914. It took him three years to convince the government of the feasibility of the enterprise, but finally in 1917 Japan decided to undertake the project. The Kanden Irrigation Assotion was formed to handle the work and Mr. Hatta was made chief engineer. The preliminary work is now well out of the way and actual construction has commenced. The following information on certain details and methods of construction was brought from Japan recently by R. E. Bressler, of Aurora, Ill., works engineer for the Western Wheeled Scraper Co., who went to Formosa last summer to install American-made air-dump cars on the work.

One mile of the tunnel will be through solid rock. The bore will be a half-ellipse in form, 18 ft. wide at the base and 18 ft. high; it will be brick lined. To make the 20,000,000 bricks required for the lining, a factory has

been built having a capacity of 5,000,000 bricks per month, in which bricks are being made at a cost of 0.7c. each.

The method of handling these bricks is interesting. The factory is 7 miles from the nearest end of the tunnel and the bricks are conveyed across the mountain by 14 miles of endless cable mounted on towers. At the factory the cable delivers the empty material buckets on to an overhead track which feeds the loaded buckets back on to the cable at the other end.

The dam, on which work was to start about April 1, will be 170 ft. high, 4,500 ft. long at the top, 1,000 ft. wide at the bottom and 50 ft. wide at the top. It will be of semi-hydraulic construction. A concrete core will extend 50 ft. below ground and 50 ft. above ground.



LOADING AMERICAN AIR-DUMP CAR IN FORMOSA

Earth and stone for the embankment must be brought from the river bank, requiring a railroad haul of 10 miles. It was for this haul that 16-yd. automatic air-dump cars were installed. These cars and the railroad which is now under construction, conform to the standard gage in Formosa which is 42 in. German locomotives will pull the trains.

The reservoir will be 7 miles long and 4 miles wide, resembling, on the map, a piece of coral, as the water will back up into innumerable small valleys. On this account it is called Coral reservoir. Its maximum capacity is 5,500,000,000 cu.ft. of water. The area of the district to be irrigated is approximately 47 miles long by 17 miles wide. There are to be 638 miles of supply canals and an equal mileage of drainage ditches. The largest canals, of which there are 100 miles, will be 90 ft. wide at the top and 7 ft. deep. To build these large canals the Japanese will use an excavator of their own, designed and manufactured in Japan, resembling somewhat an American trench machine except that it works sidewise.

The Kanden Irrigation Association has established headquarters with an office force of 120 Japanese at Kagi. It has built houses there for 56 families. A whole town, called Usanto, has been built, with houses for 300 families, waterworks, brick factory and shops. At present 100 Japanese and 400 Chinese are working at Usanto, the former in a supervisory capacity. Eventually from 2,000 to 3,000 men will be employed.

The total cost of the project will be 45,000,000 yen, a yen being about 50c. in American money. It is estimated that the value of the crops will be increased by 15,084,887 yen annually and that the increase in the value of the land in consequence will amount to 96,907,200 yen.

It is worthy of note, says Mr. Bressler, that this great benefit will not accrue to the Japanese people directly, but to the Chinese farmers, whom Japan found on the land when Formosa was taken over from China at the close of the Chino-Japanese war. Half of the entire cost of the project to benefit the natives of the island will be paid by the government of Japan; the other half by the farmers to be benefited. The plan is to complete the payments in ten years, after which there will be no further direct cost to the farmers, the government taking care of the maintenance.

When Formosa came under the control of Japan, 26 years ago, there were no improvements on the island. Today, according to the observations of Mr. Bressler, there are railroads, beautiful parks and buildings, including one of the finest hospitals in the world. A breakwater, costing about 15,000,000 yen, is being built at Takao to create a great sugar harbor; there is a harbor development at Kellung and a hydroelectric development in the central part of the island.

Public Health and Sanitary Engineering Work at Harvard Revised

TWO announcements of interest to engineers and sanitarians have just been made at Harvard University—the reorganization of the School of Public Health and a new programme of studies in the Engineering School leading to a master's degree in Sanitary and Municipal Engineering.

The Harvard School of Public Health will take the place of the school which since 1913 has been conducted jointly by Harvard University and the Massachusetts Institute of Technology, the new school being in fact the outgrowth and continuation of the older one. There will still be active co-operation between the University and the Institute, but the administration will henceforth be wholly under Harvard University, a plan made necessary by the fact that the recent munificent gift, known as the Henry P. Walcott Fund, from the Rockefeller Foundation was to Harvard University. The older school had no power to grant degrees, but students will now have opportunities to study for degrees in public health granted by the Harvard Corporation—namely, Bachelor, Master and Doctor of Public Health. The medical degree is not a prerequisite for candidates for the bachelor's or master's degree, but it is required for the doctorate in public health. The Harvard School of Public Health will have its own faculty and its own organization, although it will be adjacent to the Harvard Medical School and naturally affiliated with it in a very close way. Dr. Edsall, the Dean of the School of Public Health, is also Dean of the Medical School.

Courses Arranged on the Intensive Plan—The courses of study are arranged upon the intensive plan. For example, students will spend the forenoons of every day during October and November in Prof. Whipple's Department of Sanitary Engineering; the forenoons of December and January in Prof. Wilson's Department of Vital Statistics; the forenoons of February either with Dr. Drinker studying Ventilation and Illumination or with M. C. Whipple, studying Water and Sewage Analyses. The afternoons are more sub-divided and are devoted to such subjects as bacteriology, physiology, preventive medicine, epidemiology, public health administration, and the like.

The growing importance of vital statistics in public health work is shown by the fact that Prof. E. B. Wilson, recently head of the Physics Department of the Massachusetts Institute of Technology, has been made full professor of Vital Statistics in the Harvard School of Public Health. He will take over the course in that subject which Prof. George C. Whipple has been giving during the past ten years, thus enabling Prof. Whipple to devote his attention to the teaching of sanitary engineering and to his professional work. The Department of Public Health Administration is not yet fully organized, but temporarily this subject will be in charge of Dr. M. J. Rosenau, assisted by a professor in the Law School, and by Prof. C. E. Turner of the Massachusetts Institute of Technology, who will give lectures in Public Health Education.

Five-Year Program of Engineering School—The change in the Harvard Engineering School consists in the establishment of a fifth-year programme leading to the degree of Master of Science in Sanitary and Municipal Engineering following the regular four-year programme in civil engineering. It has been found by experience that a four-year course is not long enough to cover both the fundamental subjects of engineering and the special work required for this branch of the profession. The Engineering School will maintain its present four-year programme in Sanitary Chemistry and Biology.

As in the School of Public Health, the programme of Sanitary and Municipal Engineering is arranged on the intensive plan. A laboratory course in chemistry and biology extends through the year, and a new course in hydrology, which will include meteorology and limnology as well as the hydraulics of rivers, will extend through the first term; but four of the principal topics will be taken up intensively, half of the students' times for two months each being devoted to water purification, water-works management, sewerage design and sewage treatment. There will be no lectures in these four courses, each student working individually with the instructor, taking up a series of practical problems of considerable magnitude, thus applying to engineering instruction the case system so well known in the Harvard Law School and recently adopted in the Harvard School of Business Administration.

Chance to Specialize in Water Supply and Sewerage—Moreover, the courses are so arranged that the general subject of water supply is treated during the first term and sewerage during the second term, thus making it possible for special advanced students to attend either term in case they can obtain a leave of absence of only four months from their regular work. Another innovation is that a considerable part of their work will be done in the field, advantage being taken of the many sanitary works in the vicinity of Boston. It is hoped to make the first term the beginning of a movement to train men for the water works business.

Gordon M. Fair, who has recently returned from sanitary work with the League of Red Cross Societies in Europe, has been appointed Instructor in Sanitary Engineering and will teach both in the Engineering and in the Public Health Schools.

The Harvard Engineering School is now entirely separate from the Massachusetts Institute of Technology; but as both institutions are now located in Cambridge, only a few miles apart, the opportunities for the exchange of academic courtesies are obvious.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Highway Bridge Safety

Sir—Your editorial remarks p. 1023, June 22, are right in their assertion that the state is at fault in the matter of bridge accidents, for not placing the planning of important bridges and roads in the hands of competent engineers. To convince the voters of this fact is a matter of education. The work of state highway departments should educate the people to the point where important engineering work in connection with highways, bridges, and the like will be placed under the administration of the state highway department. I believe that progress is being made in this direction.

Such articles as the one on the failure of the Marlin bridge will be helpful in calling the attention of the public to the importance of employing competent engineers for important engineering work. BRIDGE ENGINEER.

June 28.

Backwater Suppression

Sir—I note in *Engineering News-Record*, June 8, 1922, p. 964, an article describing some special features of the last Coosa River hydro-electric plant, especially the "backwater suppression" by the effect of spillway overflow on the tailwater at the toe of the dam.

This is not an innovation in any sense; like results were obtained in a hydro-electric plant on the Patapsco River near Ellicott City, Md., by utilizing my program and design of the submerged power house located in the interior of a concrete-steel dam where turbine water is drawn through the deck and discharged at the toe. This plant has operated for about 16 years with practically steady head no matter what the spillway overflow is.

matter what the spillway overflow is. H. VON SCHON,

South Bend, Ind., June 30. Consulting Engineer.

Lost in Russia Five Years, Surveying Instruments Return to U. S. A.

Sir—We have had a rather curious experience in having had returned to us a shipment of instruments which we sent to a dealer in Moscow, Russia, in October, 1916. For about two years we tried to collect this account, but due to the mails having gone bad we concluded that the shipment was lost and practically forgot the matter.

About six months ago we received notice from the Foreign Department of the American Express Co. in Vladivostok, Russia, stating that a case of instruments bearing our name as shippers was in their storehouse and that if we would guarantee the return charges, the case could undoubtedly be returned to us. We agreed and the instruments finally reached our factory after an interval of about five years.

Three levels, one transit and one current meter, constituting the shipment, were found to be in absolutely first-class condition, after having been subjected to all kinds of rough handling, great variations of temperature, etc. It would seem that this is a splendid testimonial to the excellent care used in packing, both of the instruments within their respective boxes and the outside packing and waterproofing. It is also a splendid testimonial of the care with which the American Express Co. looks after the interests of its clients.

I am giving you these facts, as it occurred to me that

they might be of interest to readers of *Engineering News-Record*. It is certainly rare to cast bread upon the waters and have it come back to you after such a long interval.

H. [illegible]

Troy, N. Y. Sales Manager, W. & L. E. Gurley.

Foundation Pressures in Multiple-Arch Dams

Sir—The circumstances [illegible] desirable in connection with the query on multiple-arch dam foundation pressures, which appeared in your issue of April 13, "Enquirer" will now assume his rightful name and such responsibility as may attach.

I have read with great interest and satisfaction the replies of Mr. Nishkian and Mr. Noetzli in your issue of June 15. Certainly it would have been difficult to secure expressions from two more highly qualified authorities, and the fact that they are both in entire accord with my method of analysis is very gratifying. Judging by appearances only, it may seem that I am in error in including Mr. Noetzli in this category, but such is not the case, as will be shown. In fact, the entire accord between Mr. Noetzli's method of analysis and that used by me is the more remarkable because of the wide divergence of mathematical method.

The subject presented being one of no mean importance, the discussion open to all comers, and personal invitations to participate having been extended to certain engineers who presumably held opinions differing from those of the writer, it is significant that no one came forward to champion the "free-body buttress, total load" scheme which has enjoyed popularity in certain quarters, and to which the writer took exception.

It is evident that Mr. Nishkian is in entire accord with the writer's method. As he states, this involves certain assumptions which are never exactly fulfilled, but are sufficiently approximated to satisfy the conditions imposed. Of course, the same comment applies equally to all accepted methods of foundation pressure determination, in any case, and to a certain extent to all methods of stress determination in any structure or structural member. The only plausible argument which could be advanced against the use of this method of analysis in connection with the multiple-arch dam, is that one based upon the assumption of the relative flexibility of the arch footings as compared to those of the buttress. The writer is inclined to believe that such critics would over-rate the flexibility of the arches under such stress. Furthermore, unless the form and dimensions of the multiple-arch dam are very greatly modified from the present standard, the compression under the arch rings will be so relatively small that there is no question but that the rigidity of the arch will be sufficient to absorb this loading without appreciable deformation. Certainly, if an analysis by my method shows tension at the arch crown, the arch deformation argument has no place in the discussion. Finally, as Mr. Nishkian says, the method may not give results which are in absolute harmony with the actual facts, but it does approximate these facts as closely as any method could be expected to, and possesses the merit of leaning on the side of safety.

Concerning the apparent discrepancy as between the results by Mr. Noetzli's method and that employed by me. This is due to his use of certain statements which appeared in my letter, and which were grossly in error. The responsibility for this, however, belongs to the designer of the dam, since in these statements I merely quoted him, and so stated in my original letter.

In my previous letter I stated that the designer of the particular dam in question, under the "free-body buttress, total load" method used by him, found pressures of about six and eight tons, respectively, at the ends of the abutment. And so he did, as the exhibits and statements submitted by him show, but his results bear no relation whatever to the primary data as shown by him and from which they must necessarily have been derived. I did not check his stated results previously. At the time of writing my previous letter, time was the essence of the situation, and I was too busy with my own analysis and results to bother with an investigation of the accuracy of his. Since then the same condition has obtained, and my attention has only now been called to his error through the results obtained by Mr. Noetzli.

Mr. Noetzli, desiring to find a starting place for his work, very naturally seized upon the stated pressures as given by the "free-body buttress" method, and these being in error it follows that all of his deductions therefrom are also, as respects the actual conditions of the given problem which were used by me in deriving my stated results under the "monolith" theory. Referring to Mr. Noetzli's sketch and nomenclature, as given in his letter the actual data are as follows:

$P_o = 4010$ tons $A = 570$ sq.ft. $a_o = 37.3$ ft.

$d = 62.2$ ft. $c = \begin{cases} 26.1 \text{ (Noetzli notation)} \\ 51.0 \ \& \ 37.3 \text{ (Notation } Mc/I) \end{cases}$

I, about axis through c.g. of area $= 443{,}600$
Eccentricity of P_o about c.g. $= 24.9$ ft. toward toe
$e =$ distance from axis 1 - 1 to neutral axis, $= a_o - z$.
$z =$ distance from c.g. to neutral axis
$x =$ distance from neutral axis to P_o

By changing the value of I to conform to the neutral axis as the plane of reference, we have all of the necessary data for substitution in both Mr. Noetzli's formula and that one used by me. This is done and the consequences shown in the two solutions which follow:

Solution by formula, $f = P/A \pm Mc/I$.

$$f_1 = \frac{4010}{570} + \frac{4010 \times 24.9 \times 51}{443{,}600} =$$

$$7.03 + 11.47 = 18.50 \text{ tons per sq.ft.}$$

$$f_2 = \frac{4010}{570} - \frac{4010 \times 24.9 \times 37.3}{443{,}600} =$$

$$7.03 - 8.39 = -1.36 \text{ tons per sq.ft. (tension)}$$

$$z = \frac{4010 \times 443{,}600}{570 \times 4010 \times 24.9} = 31.2 \text{ ft.}$$

$$e = a_o - z = 37.3 - 31.2 = 6.1 \text{ ft.}$$

For derivation and proof of the above formulas, see pages 214 and 215, Merriman's "Mechanics of Materials," 11th Edition.

SOLUTION BY MR. NOETZLI'S FORMULA

$$I_{1-1} = 443{,}600 + (570 \times 37.3^2) = 1{,}236{,}600$$

$$S_1 = 570 \times 37.3 = 21{,}261$$

$$e = \frac{1{,}236{,}600 - (62.2 \times 21{,}261)}{21{,}261 + 570\,(62.2 - 2 \times 37.3)} = -\frac{85{,}800}{14{,}193} = -6.04$$

$$S = 21{,}261 - 570 \times 6.04 = 17{,}818$$

$$f_1 = \frac{4010 \times 82.1}{17{,}818} = 18.48 \text{ tons per sq.ft.}$$

$$f_2 = \frac{4010 \times -6.04}{17{,}818} = -1.36 \text{ tons per sq.ft. (tension)}$$

A comparison demonstrates that the results are identical as given by both formulas, within the requisite or expected limits of accuracy, and that the values as derived by me, using the monolithic theory, as stated in my original letter, were correct. Of course, only approximate values were noted there, since the matter involved was one of general theory and not of numerical values.

It is apparent that the solution by use of the general formula, $f = P/A \pm Mc/I$, involves considerably less labor than does Mr. Noetzli's. It has the additional advantage of being more direct in application and more generally known and understood. I compliment Mr. Noetzli upon the mathematical genius displayed in the development of his new formula, but it would appear that for all practical purposes the old keystone formula of structural science will serve us better.

Under the application of the "free-body buttress" method, using the data as before established, the correct value of f_1 is 19.9 tons per sq. ft., and of f_2 is 2.7 tons, both

compression. For this particular case, therefore, there is actually no great difference in the value of f_1 as obtained by the two different methods of analysis. The difference in the values of f_2 is very important, because of the consequent radical change in stress distribution which follows. The "monolith theory" shows that there is tension at the crown of the arch footing, whereas the other shows nothing, but indicates compression. It is suggested, however, that it would be a mistake to attempt any generalizations as to the relative effect of applying these different methods of analysis, since the difference in derived values will depend entirely upon the conditions of the particular problem under consideration. It is to be remarked also that in what has preceded, it has been assumed for the purposes of this discussion that the section is capable of taking tension, which may or may not be true as concerns any given problem.

Mr. Noetzli states that my use of the general formula, $f = P/A \pm Mc/I$ is correct, but that I apparently used the wrong axis for I. It is my understanding that in this formula, I is always taken with respect to an axis perpendicular to the plane of bending, and passing through the c.g. of the static area. (See page 428, Spofford's "Theory of Structures.") I have so used it in the preceding solution, and since the results obtained are identical with those by Mr. Noetzli's formula, it appears that he was in error in this matter. Obviously, had I used the axis suggested by him, there would have been no similarity between the results.

At the time of writing my previous letter, I was aware that there was nothing original in my use of the proposed formula for determining the distribution of stress, but I had been unable to find any authority in technical literature for applying it to this particular case. Since that time, additional research has developed the fact that the "monolith method" of analysis is described and advocated by W. P. Creager in his book, "Engineering for Masonry Dams," particularly on pages 45 and 140, and by Wm. G. Bligh on page 116, Vol. IX, "Cyclopedia of Civil Engineering." The last-named treatment is very brief and lacking in detail, but is conclusive nevertheless. I further find that my criticism regarding the writers of text-books is inapplicable in at least one instance. In C. M. Spofford's "Theory of Structures," pages 428 to 430, he gives a very clear exposition of the derivation and characteristics of the formula, $f = P/A \pm Mc/I$. Quite possibly there are other texts which give an equally clear and direct explanation, but I have not had the pleasure of seeing them.

S. M. COTTEN ("Enquirer").

Phoenix, Ariz., June 27.

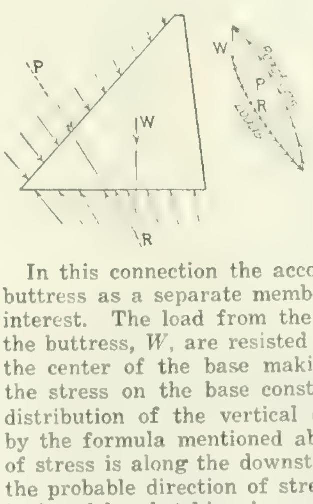
Sir—We have read with interest the answers in your issue of June 15 to the communication of "Enquirer" in your issue of April 13, 1922, p. 623, and as it does not seem to us that the question propounded has been very clearly answered we submit the following:

The inquiry was as to what part of a foundation in general should be considered as carrying the load, and in particular whether the footings under the arches of a multiple-arch dam should be included with the buttress footings is computing foundation pressures. The question as stated in its general form cannot be answered as each case must be considered on its own merits, but a little consideration of the formula $f = P/A \pm Mc/I$ will be helpful to an understanding of its applicability to a given case. The expression gives the stress on the extreme fiber of a combined beam and tie or struct whose length is several times its width and it is based on the assumption that sections plane before loading remain plane after loading, from which it follows that the stress varies uniformly over a right section. The expression may also be reasonably applied to compute the pressure on an earth foundation on the assumption that the intensity of pressure is proportional to the amount the earth is compressed.

It may, of course, be applied to a rock foundation just as it may be applied to find the stress on any horizontal section of the structure above the footing, but if the structure has a form which bears little resemblance to the usual forms of beams, there is small reason for thinking that stresses computed from the beam formula will give accurate results. The pressures on any foundation must be produced by the stresses in the structure itself just above the foundation.

To pass to the given case of the multiple-arch dam; it would seem, if such a structure were built on earth, which is much more yielding than concrete, that the structure could be considered as a rigid whole in relation to the foundation and that the part of the footings under the arches would carry its share of the load, provided the arch barrel were strong enough to help distribute the load. There could be no tension on the footing although "Enquirer" computed one. Any part of the footing under tension should be eliminated from the area of the computations and a new area found by trial to fit the condition that the pressure at its edge shall be zero.

But if the dam rests on rock, the reasonable method of computation is to consider the load to be carried by the buttress footings, since the lower part of the arch is not stiff enough to throw much load on the curved footing. The full arch ribs throw their loads into the buttresses through which the loads can pass directly to the buttress footings and only a few short ribs near the base apply a load to the curved footings. Any considerable reaction over this part of the base would produce bending moments in the elements of the cylinder. There can be little question that the method of computation employed by the designer of the dam, who considered that the abutment footings carried all the load, was the better one to employ for a rock foundation. Of course, there is not an abrupt change of pressure from six tons per square foot to zero where the footing forks, and, indeed, a part of the footing under the arches near the buttress might well be included with the abutment footing, but how much is a matter of judgment. Presumably the intensity of pressure changes rapidly there. But rather than to assume the entire load on the structure to go to the abutment footing, it is better to pass a plane through the upstream end of the base of the buttress so that the plane separates the complete ribs, which spring from the buttresses, from the short ribs which rest on the ring footing and to assume that the load above the plane passes into the buttress and through it to the buttress footing and that the load below passes into the ring footing, a division of load which probably is not far from what actually exists.



In this connection the accompanying sketch showing the buttress as a separate member of the structure may be of interest. The load from the arches, P, and the weight of the buttress, W, are resisted by the reaction, R, which cuts the center of the base making the vertical component of the stress on the base constant. If R were eccentric the distribution of the vertical component could be computed by the formula mentioned above. At the toe the direction of stress is along the downstream edge of the buttress and the probable direction of stress at other points on the base is found by sketching in a polygon on R in the force diagram having the given direction at the lower end.

In solving problems of unusual type it is well to remember that rules and formulas derived from certain definite assumptions will not give exact values when mechanically applied to cases where the conditions do not fit those assumptions. It is quite out of the question to compute the distribution of pressure on a foundation with any such accuracy as we can compute the stresses on the cross-section of a steel beam for instance; the best we can do with a foundation is to make reasonable assumptions and find approximate stresses.

GARDINER S. WILLIAMS,
ALBERT E. GREENE.

Ann Arbor, Mich.
June 23.

NEWS OF THE WEEK

New York, July 13, 1922

Plan 30 Miles of Sewers to Relieve Los Angeles

Temporary Works To Be Built—Vote Aug. 29 on $13,000,000 Loan for Outfall and Screens

Progress is being made on measures for both temporary and permanent relief of the overcharged ocean outlet sewer of Los Angeles, Cal. An election is to be held Aug. 29 to vote on a $13,000,000 bond issue for a new outfall and branches and for screens. The outfall is designed to serve a metropolitan district now under consideration.

For temporary relief, Imhoff tanks and sprinkling filters in units of 1½-m.g.d. to be built successively as needed are proposed. Two of these units are to be built at once at a point below Culver City to handle the present overflow of untreated sewage into Bellona Creek above Culver City. In return for a right-of-way through Culver City, Los Angeles is to care for its sewage.

Bids were received July 3 for one mile of the 44-in. riveted-steel connecting sewer from Arlington to Mesa Drive. Bids for the remaining four miles will not be invited until all the rights of way have been obtained, but it is expected that the sewer and sewage-works can be finished within the three-month period called for by the court injunction against discharging untreated sewage into Bellona Creek. (See *Engineering News-Record*, Feb. 23, p. 336, March 2, p. 343, April 13, p. 596 and 618, and May 11, p. 806.)

Knowlton Gives Facts

For permanent disposal works which the city officials have concluded should be an outfall into the sea, near Hyperion, ultimately to care for a metropoliton district, a bond issue if $13,000,000 is to be voted upon on Aug. 29. Conferences are being held between officials of the various cities in the proposed metropolitan district, and at one on June 3, W. T. Knowlton, engineer of sewers, Los Angeles, outlined the situation as follows: Population increases have been so rapid that the present outfall, completed in 1907 for a population of 500,000 people, is now heavily overcharged and by 1925, if the present rate of increase persists, a population of 1,000,000 will be attained. Since the Fernando Valley has become a part of the city, requests have come in for sewerage system installations from various portions of the valley. For the present, disposal can be handled to the best advantage locally but as soon as the new outfall is completed extensions should be made to Burbank, Glendale and other cities to the north.

In an earlier statement to the public Mr. Knowlton gave the length of new outfall and main trunk sewers as 30 miles, reaching from the sea to the junction of the Los Angeles River and the Arrovo Seco. The ocean end of the outfall will be 12 ft. wide and 13 ft. high. Discharge after screening is to be at a point [illegible]

The Newly Elected President of the American Society for Testing Materials

Dr. George K. Burgess

Motor Traffic Banished from Brooklyn Bridge

Motor traffic is no longer permitted to use the Brooklyn Bridge, according to rules recently published by the commissioner of plant and structures of New York City. Under the same regulations horse-drawn traffic is not to use the Manhattan Bridge, the next bridge to the north in the series of bridges that cross the East River. According to the official announcement, the effect of the new regulations will be to avoid delays and the danger of accident on both spans that has resulted from mixing horse-drawn and motor traffic.

The point is made also that the loads on the roadways of the Brooklyn Bridge will be reduced and more uniformly distributed, although no statement has been made to indicate that the question of strength was dominant in deciding as to the change.

Short-Circuit Causes Near-Panic in New York Subway

Fire caused by a short-circuit on a panel board of one of the cars almost created a panic in a New York subway train on July 6. The accident occurred on the north-bound track of the Lexington Ave. route near 59th St. just before noon. Fortunately the train was not crowded and the passengers were able to gain access to the street through a nearby emergency exit. No fatalities have been reported but about 150 required treatment for the effects of smoke and fright. Investigations have been ordered by the City of New York, the Interborough Rapid Transit Co., and the New York Transit Commission.

To Study Concrete Specifications

At the recent meeting of the executive board of the Associated General Contractors, L. C. Wason, speaking for Col. Whitson, chairman of the A. G. C. special committee on concrete specifications, reported that the committee had concluded that the making of tests in various parts of the country by contractors, as suggested by Richard L. Humphrey, chairman of the Joint Committee on Concrete and Reinforced Concrete, would be futile and would not warrant the expense and trouble involved. The executive board after full discussion sustained the opinion of the special committee and disapproved the suggested series of tests.

The committee, however, was continued and authorized to prepare specifications for concrete and reinforced concrete, which in its opinion would be proper and reasonable. It is understood that it is not the intention of the contractors' committee to publish concrete specifications in competition with those of the joint committee of the engineering society, but that it was considered that the preparation of specifications would be the best way for the contractors to bring their ideas to the consideration of the Joint Committee, which has prepared tentative specifications, many features of which are not satisfactory to the contractors engaged in concrete work. Co-operation, not opposition, is intended.

Conferences Being Held on Lumber Standardization

A series of conferences began at the U. S. Forest Products Laboratory at Madison, Wis., July 12, to be continued at Chicago, July 20, and terminated at Portland, Ore., July 27, which have as their chief aim standardization in grade marking, simplification of grades, and inspection of lumber. The conferences are being participated in by representatives of national lumber manufacturing concerns, lumber wholesalers, retailers, representatives of technical building professions and trades, and those of interested government bureaus.

The Madison meeting will last a week and will deal with the simplification of grades and names and will be chiefly a conference of engineers and technical experts. On July 20 a committee representing the fourteen softwood and hardwood lumber producing associations will meet in Chicago to hear and consider the report of the technical committee on simplification of grades and names. During the next two days consideration will be given not only grades and nomenclature but grade marking and size standardization and the organization of a lumber inspection service.

At Portland July 27 discussion of simplification of grades and names, grade marking, standardization of sizes and national inspection will be had.

Hydraulic Conference in South Results in Permanent Body

As the result of a conference attended by the most outstanding men in hydraulic engineering in the southern states, together with representatives of private utilities and government agencies, held in Asheville, N. C., June 20-22, a permanent body to be known as the Southern Appalachian Water Power Conference was organized. Col. Joseph Hyde Pratt, director of the North Carolina Geological & Economic Survey, was named president, the other officers being: vice-president, Lincoln Green, first vice-president of the Southern R.R.; secretary, Prof. J. A. Switser, of Tennessee; and treasurer, Thorndike Saville, chief of the division of water resources of the North Carolina Geological & Economic Survey. Meetings of the conference were unusually well attended and papers were presented discussing the great possibilities of water power development in the southern states and the advantages to be derived from co-operation of all agencies involved.

The federal government was represented by N. C. Grover, chief hydraulic engineer of the U. S. Geological Survey; O. C. Merrill, executive secretary of the Federal Power Commission; C. H. Birdseye, chief topographer of the U. S. Geological Survey; C. V. Hodgson, of the U. S. Coast and Geodetic Survey; T. W. Norcross, chief engineer of the U. S. Forest Service; Col. H. B. Ferguson, assistant secretary of war; and Warren E. Hall, district engineer, U. S. Geological Survey.

The conference was considered a step toward the inauguration of complete co-operation among hydro-electric utilities, the federal and state commissions and promoters of water-power development. It is expected that as the work of the conference gets under way it will mean much for the development of water power in the South Atlantic states.

Various committees were appointed which will submit reports at the next meeting of the conference. One of these committees, on Energy Supply, will study location of undeveloped water powers in the southern Appalachian states, the order of development, the location of auxiliary steam plants, making of water-power surveys, taking of stream-flow measurements, the problem of silting, etc. Another will treat of inter-connection of the various power developments, and a third will consider proper federal and state legislation to aid in water-power development.

State Road Testing Engineers Get Together

The Committee on Tests of the American Association of State Highway Officials met with the officials of the U. S. Bureau of Public Roads in Washington on June 26 and 27 for further consideration of standardization of specifications and tests for road materials. The purpose of this meeting of representatives from all sections of the country was not so much to lay down rigid rules as to harmonize the general practice. Standardization taking into account local conditions is being brought about by a series of meetings between officials from groups of states and engineers of the bureau.

Appropriate $580,000 for Narrows Tunnel

The Board of Aldermen of New York City has appropriated $580,000 for preliminary expenses in connection with the construction of the proposed passenger and freight tunnel under the Narrows connecting Brooklyn and Staten Island. This tunnel has occasioned much controversy in technical and political circles because of its alleged interference with the Port Authority project for harbor improvement, which contemplates a freight tunnel farther up the bay. An injunction against the Narrows tunnel brought by the Citizens' Union, a civic organization, was recently dissolved as recorded in *Engineering News-Record* June 22, 1922, p. 1054.

Large Hard-Rock Heading Makes Record Progress

Record progress was made in a heading driven from Adit 1, Tunnel 3, of the Southern California Edison Co.'s Big Creek project during March, according to word received from the company. The month's progress of the heading was 476 ft. Ever since the opening of the adit, work has been in extremely hard granite, so hard that on many shifts three sets of drill steel were required for each hole.

The tunnel is 21 ft. square and is excavated to full size by a heading and a short bench. On the average forty-two holes are drilled for the heading and eighteen for the bench, the former being about 18 ft. deep while the bench holes range from 18 to 20 ft. One round is shot in 24 hr., making an advance of 12 to 17 ft. The firing is so arranged that the cut holes of the heading are shot first, then the lifting holes of the bench, and last the side holes of the heading. The total powder consumption is 1,500 to 2,000 lb. dynamite per round. Eight machines are used in the heading and six in the bench. They finish a round in 6 to 10 hr. Two 80-man shifts are worked. Mucking is done with steam shovels of standard size, operated by compressed air. The muck cars are hauled by electric locomotives of both battery and trolley types.

Knickerbocker Defendants Deny Joint Responsibility

Counsel for the five men indicted in connection with the roof collapse of the Knickerbocker Theater in Washington on Jan. 28 recently moved to have the indictments quashed. In arguing the motion they denied that the architect, the contractors, the superintendent, the inspector, and the material men engaged in constructing the theater are jointly responsible for each other's work to the extent of being liable to be held for the collapse of the building. Decision on the motion has not yet been rendered.

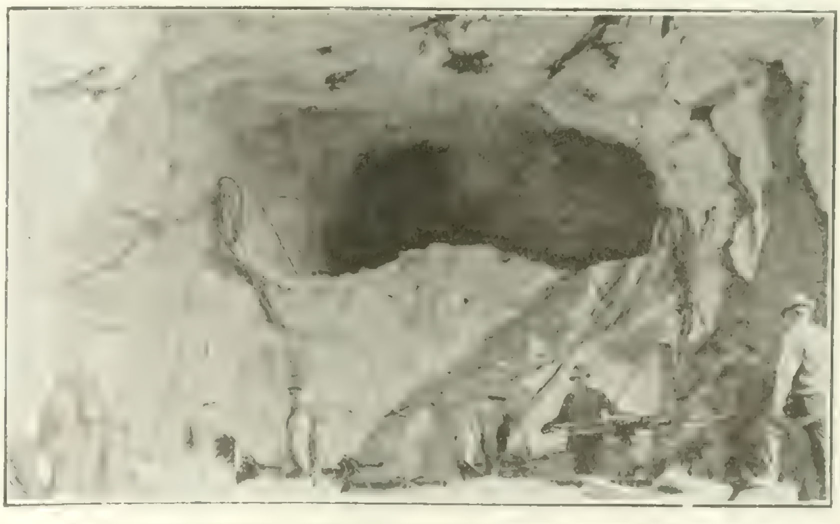
Invitations Out for International Engineering Congress

Definite arrangements have been made to hold an International Engineering Congress in Rio in connection with the Brazilian International Exposition which opens September 7 and will last until the end of March, 1923. The congress will be held under the auspices of the Brazilian government Sept. 7-30 inclusive. Invitations have been issued to all engineering societies in the United States and Canada and through them to members of the societies to participate. The Engineering Club of Rio is officially charged to organize the congress.

The principal subjects of discussion will be: The utilization of fuel resources, the best utilization of water power, recent advances in irrigation methods, the elimination of waste including standardization of supplies for agricultural and industrial purposes, coal as a factor in industrial development, essentials of a national railroad policy, inter-continental engineering co-operation, port developments, terminal facilities, and the iron and steel industries.

Missed Shot Kills Two on Hetch Hetchy

A drill striking a missed shot in Priest Portal of the Hetch Hetchy tunnel on June 16 caused the explosion of a powder charge that killed the shift boss and a driller's helper and also slightly injured four other men.



HEADING OF BIG CREEK, ADIT 1, TUNNEL 3, ADVANCED 476 FT. IN MONTH

Chandler, Retiring Am. Soc. C. E. Acting Secretary, Honored

Tribute to the service of Elbert M. Chandler as acting secretary of the American Society of Civil Engineers during the past year was offered by a number of resident members of the society at an informal dinner held at the Harvard Club in New York on the evening of July 5.

J. Vipond Davies, president of the New York Section of the society, presided. Other speakers were Otis E. Hovey, treasurer, Am. Soc. C. E. and Robert Ridgway, vice-president Am. Soc. C. E. and senior past-president of the New York Section. Letters of appreciation and good-will were read from Clemens Herschel, past-president, Am. Soc. C. E. and Prof. John H. Dunlap, the newly-elected secretary of the society.

Resolutions expressing the personal regard of those present for Mr. Chandler and their respect for his work as acting secretary were approved and will be engrossed and presented to him. In response, he emphasized the importance of harmony in the society and urged full support of the new secretary.

Congressional Committee Urges Transportation Institute

Establishment of a private research and educational institution under disinterested auspices to promote education in transportation will be recommended by the Joint Commission of Agricultural Inquiry in its report on transportation.

The chairman of the commission points out that there are approximately $50,000,000,000 invested in transportation in this country, including steam railways, electric railways, highways, automobiles, motor trucks, waterways, and shipping, while there is no way to learn the business of transportation except by apprenticeship in the business itself. The purpose of the proposed institution would be to provide a means for definitely establishing the facts and principles of transportation upon which can be predicated sound decisions respecting transportation policies, and for setting forth the relation between the various agencies of transportation and their relation to agriculture, industry, trade, and commerce.

Port Authorities Will Meet in Toronto

The eleventh annual convention of the American Association of Port Authorities is to be held in Toronto, Ont., Sept. 14 to 16, 1922. The convention will be followed by an excursion down the St. Lawrence River to Montreal and then to Quebec, at both of which cities the port facilities will be inspected under the auspices of the local authorities. The secretary of the association is M. P. Fennell, Jr., of the Port of Montreal.

Appoint Board of Engineers for Moffat Tunnel

In connection with the construction of the Moffat Tunnel, as recorded in *Engineering News-Record*, May 18, pp. 811 and 836 and July 6, p. 38, the tunnel commission in charge of the work has appointed a board of consulting engineers consisting of J. Vipond Davies and J. Waldo Smith of New York, and D. W. Brunton of Denver. The board convenes at Denver this week for consideration of the project, which is under the direction of L. D. Blauvelt, chief engineer for the commission.

Southern Ry. Adopts 100-Lb. Rail for Main Line Tracks

One hundred pound rail has been adopted by the Southern Railway System as the standard for its main lines in place of 85-pound rail, the heaviest used on the Southern up to this time according to an announcement by H. W. Miller, vice-president in charge of operation.

The first stretch to be laid with the heavier steel will extend from Washington to Manassas, Va., a distance of 33 miles. The rail and fastenings are already on the ground and will be put in the track as soon as the heavy traffic movement of the peach and watermelon season is over. The new rail will be laid on extra heavy tie plates.

The 85-pound rail released by the laying of 100-pound rail on the main lines will be used to replace lighter rail on branch lines.

Will Not Raise Reversible Falls Steel Cantilever Bridge

St. John lumber shipping interests have failed in an attempt to compel the Canadian Pacific Ry. to raise the new steel cantilever bridge spanning Reversible Falls at the mouth of St. John River. They demanded that the company be required to raise the bridge 7 ft., contending that large schooners were unable to pass under the structure at flow tide, which is the only time at which craft can be towed through from St. John harbor to Indiantown harbor or vice versa. It was claimed that schooners have broken top masts in passing under the bridge.

At a meeting attended by representatives of the shipping interests, of the railway, of the city of St. John, and of the provincial and federal governments the arguments for raising the bridge were set forth. Canadian Pacific engineers contended that raising the bridge would weaken it and produce a dangerous condition.

There are now three bridges at the falls, two belonging to the Canadian Pacific Ry. and a highway bridge. The latter, replacing the old suspension bridge built in 1870, is a steel arch bridge completed five or six years ago. The first contilever bridge of the Canadian Pacific, built in 1871, and the the new cantilever bridge, completed last year, are side by side. The new bridge is farthest down the river, and the agitation was directed against this structure, although it gives 2½ ft. more headroom for navigation than does the old cantilever bridge which is directly alongside.

The Engineer in Public Life

JAMES HARTNESS

At the election held Nov. 2, 1920, the State of Vermont chose an engineer, James Hartness, president of the Jones & Lamson Machine Company, of Springfield, as governor. His previous experience in public life included six years as chairman of the Vermont State Board of Education. Mr. Hartness was born Sept. 3, 1861, in Schenectady, N. Y., and at the age of sixteen began work in a machine shop at five cents an hour for a nine-hour day. Here he developed such skill that when twenty-one years old he was made foreman of a nut and bolt shop at Winsted, Conn. After various connections in New England he took charge of the Jones & Lamson Machine Co.'s plant at Springfield, Vt. The firm today employs 3,000 men compared with 75 when Mr. Hartness joined it, and produces $10,000,000 worth of machine tools per year, as against $30,000 worth of tools in the old days.

Mr. Hartness has taken out more than 100 patents relating principally to machine tool design. In 1913 he was elected president of the American Society of Mechanical Engineers, succeeding George Westinghouse. During the war his plant at Springfield made parts for 9-in. howitzers. He served as federal food administrator for Vermont and was chairman of the Vermont Committee of Public Safety and a member of the commission representing the United States Air Board at the Inter-Allied Aircraft Standardization Conference at London and Paris.

During his administration Governor Hartness has reorganized the state highway department, created a state commission on foreign and domestic commerce, and initiated a number of measures to further the state's industrial progress.

Ransdell Bill Proposes Federal Hydraulic Laboratory

A national hydraulic laboratory is proposed in bills introduced simultaneously in the Senate and in the House of Representatives on June 13. The bill sets forth that the laboratory is to conduct research, experiments and scientific studies in connection with the problems of river hydraulics. An appropriation of $200,000 is authorized for the purpose. The author of the bill is Senator Ransdell, of Louisiana, and the Federated American Engineering Societies had a good deal to do with the initiation of the legislation. The federation expects to conduct some educational work with the idea of pointing out the necessity for approaching flood control and other matters involved in river hydraulics from a scientific angle.

Horace E. Stevens

Horace E. Stevens, late vice-president of Winston Bros. Co., contractors, Minneapolis, whose death was noted in the columns of this journal recently, was one of those technical men whose early experiences in engineering were largely colored by the romance of transcontinental railroad building, although his activities embraced practically all of the various branches of civil engineering.

Mr. Stevens was one of the first two men to receive the degree of civil engineer from the University of Vermont, from which institution he was graduated with Henry H. Douglas in 1870. In the fall of the same year he went to St. Paul, Minn., securing a position in the engineering corps of the Northern Pacific R.R. Co., where he remained until October, 1873. In the meantime he was engaged in location and construction work of the lines of that railway between Carleton and Moorhead, Minn. In March, 1873 he was ordered with a party of six men and teams to drive with the greatest speed possible across country to the projected crossing of the Missouri River, to stake out claims and secure squatter's rights for the benefit of the railroad company before the arrival of a party of land speculators already on the way. The race was a hard one, through snow and blizzards for seven days. First one party forged ahead, and then the other, both arriving at the site of the proposed crossing in the early morning of April 1. Some of the engineers, however, were able to drive the claim stakes while the others, with their rifles, held the land speculators back. These stakes marked the beginning of Bismarck, the capital city of North Dakota.

In June of that year Mr. Stevens was transferred to an expedition detailed to make a survey west of the Missouri River. A party of government engineers accompanied the railroad locating outfit, as well as did a detachment of government troops under General Stanley, consisting of about 900 infantrymen and 800 of the 7th Cavalry, 100 Indian scouts and a supply train.

Government Work

From 1873 to 1881 Mr. Stevens was employed by the government in river and harbor work. He was engaged mainly in the Mississippi River basin in survey work. In 1882-83 he was identified with Robinson & Cary, dealers in machinery and contractors' supplies, in St. Paul. For the next two years he did his first contract work, which was a section of the aqueduct for the St. Paul water-works, and some government harbor work on the Mississippi at Stockholm, Wis. In 1886 he became superintendent for Shepard, Siems & Co. on the construction of the Great Northern Ry. For the next two years he was superintendent of construction of the Soo Line near Escanaba, Mich., for Henry & Balch, and from 1889-93 he was engaged in miscellaneous contracting work in Duluth and St. Paul, Minn., Superior, Wis., and Brainerd, Minn.

Early in 1898 he was selected as one of a committee of engineers and contractors to go over the proposed Nicaragua Canal route for the purpose of investigating and determining the possibilities of the project.

Later in 1898 he became associated with Winston Bros., Minneapolis, and from then on he was engaged on various railroad jobs for that company. When Winston Bros. incorporated in 1902 as Winston Bros. Co. Mr. Stevens became a stockholder and director, and from 1914 to 1920 he was vice-president of the corporation.

Mr. Stevens was a member of the American Society of Civil Engineers, the Chicago Engineers Club, the Engineers Society of St. Paul, and during 1919 was president of the Minnesota Joint Engineering Board.

Canadian Section, A. W. W. A., to Meet at Windsor in 1923

At the recent annual meeting of the Canadian Section of the American Water Works Association at Brantford, Ont., it was decided to hold the next annual convention of the section at Windsor, Ont., just across the line from Detroit, Mich., where the parent association will convene in 1923. Officers for 1922-3 elected by the Canadian Association are: Chairman, R. L. Dobbin, Peterboro, Ont.; vice-chairman, F. A. Dallyn, Toronto; secretary-treasurer, C. B. Brown, Waterville, Ont.

Oppose Incorporation of American Mathematical Society

Objections by Representatives Stafford, of Wisconsin, and Huddleston, of Alabama, recently prevented passage by the House of a bill to incorporate the American Mathematical Society. Representative Stafford said if Congress intended to incorporate every scientific society it should do so by a general law and not in special bills for each society, referring to the possibility that the American Automotive Society and the American Chemical Society might desire incorporation. Representative Huddleston opposed incorporation of societies by Congress on general principles.

Vehicle Tunnel Under Hackensack May Replace Wrecked Bridge

Substitution of a tunnel crossing under the Hackensack River for the wrecked bridge of the Lincoln Highway, between Jersey City and Newark, N. J., is being considered by the state highway commission. The draw-span of the bridge was destroyed June 22 by a colliding steamer, as reported in this journal, June 29, p. 1095. Contract has been let by the commission for a temporary bridge, the contractors being the Stillman, Delehanty & Ferris Co., Jersey City. The temporary crossing is to have a 40-ft. roadway, will be located just upstream of the old bridge but clear of the wreckage of the draw, and will contain a bascule or lift span in place of one of the channels of the old draw. The state took over the road from the counties July 1. Provision of a permanent crossing is likely to be delayed for some time.

The traffic capacity of the old bridge was not considered adequate for the heavy traffic which the Lincoln Highway now carries and the channel widths in the draw have not been considered satisfactory for navigation. A tunnel crossing is being considered as an alternative solution, to eliminate all interference between road and river traffic.

Government Completes Sale of Spruce Corporation Property

The Secretary of War announces the sale, as of June 26, of the remaining real properties of the U. S. Spruce Production Corp., consisting of Spruce Production Corporation Railroad (36 miles), running from Disque Junction to Lake Pleasant, Clallam County, Wash.; the Port Angeles saw mill and hotel owned by the corporation in Port Angeles, Wash.

The properties sold for $1,000,000 and the contract of sale contains many features advantageous to the government, such as the immediate elimination of operating and maintenance charges, and obligation on the part of the purchaser to make at least $200,000 worth of improvements in the properties within one year.

The purchasers of these properties Messrs. Hill, Scritsmier and Lyon, had previously purchased the Alsea Southern R. R., the Toledo saw mill, and the Blodgett timber tract, and have placed those properties on a basis where logging and lumbering operations can commence about the middle of July. The purchasers guarantee to operate the railroad as a common carrier.

The Secretary of War also announces that the sale of these properties removes the last obstacle to the commencement of dissolution proceedings by the U. S. Spruce Production Corp., in accordance with the provisions of the law which created it. Steps will be taken to file a petition for dissolution before the Superior Court of Clarke County, Wash., before July 2, 1922.

Baltimore Terminal Suffers $4,000,000 Fire Damage

Struck by lightning on the night of July 2, elevators B and C and pier 5 at the Locust Point terminal of the Baltimore & Ohio R.R., in Baltimore, were destroyed by fire. The elevators contained more than 500,000 bu. of grain, which was destroyed along with sixty carloads of export tobacco that was on the pier. The estimated loss to the railroad company is $4,000,000.

Purdue Acquires Land for Engineering School

Henry W. Marshall, acting president of Purdue University, has announced the purchase of a tract of land two blocks long and a half block wide from seven different owners to provide additional building space in anticipation of the future growth of the university's engineering school. The land borders the athletic field.

Civil Service Examinations

UNITED STATES

For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Vacancies in Signal Service at large, Camp Alfred Vail, N. J. Junior Radio Engineer, $1,700 per year. Examination Aug. 9.

Vacancies in the Technical Staff of the Income Tax Unit of the Bureau of Internal Revenue. Valuation Engineer, $3,600-$4,800 per year. Applications close Sept. 1.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

The Seattle chapter, Associated General Contractors of America, has elected H. V. Bogert, Seattle, executive secretary. Mr. Bogert was formerly business manager of the Central Sand & Gravel Co.

The Seattle chapter, American Association of Engineers, recently sponsored a public meeting at which Fred A. Adams, supervisor and educational director of the Columbia Basin project, and Ivan E. Goodner, chief engineer, explained the huge irrigation plans. Stereopticon slides illustrated the talks.

The National Safety Council will hold its annual Safety Congress at Detroit on Aug. 28-Sept. 1. There are numerous papers to be presented at the sessions of the Engineering Section of the Congress. The chairman of the Engineering Section is H. W. Forster, vice-chairman of the Independence Bureau, Phialdelphia, Pa.

The Engineers' Society of Milwaukee at its meeting on June 21 elected the following officers: President, Arthur Simon, engineer of the Cutler-Hammer Manufacturing Co.; vice-president, Fred H. Dorner, mechanical engineer; treasurer, A. Q. Dufour, mechanical engineer, and secretary, Fred T. Goes, engineer of the Vilter Manufacturing Co. At the conclusion of the meeting Mr. Dorner was presented with a gold watch in appreciation of his services as secretary of the society for the past ten years.

Personal Notes

SALVADOR QUINONES, who has been practising engineering in Rio Piedras, Porto Rico, has opened an office in Mayaguez, Porto Rico.

CHARLES W. BOCKELMAN announces the opening of a surveying office in Newark, N. J.

GEN. GEORGE W. GOETHALS has been elected a director of the American Smelting & Refining Co., and the American Smelters Securities Co.

C. F. KOPPISCH, engineer with the [illegible] Smith Construction Co., Charlotte, N. C., has resigned to accept a position as superintendent of the Harris Construction Co., whose home office is in Newton, N. C.

ST. GEORGE BOSWELL, chief engineer of the Quebec Harbor Commission, has resigned after forty-six years' service with the commission. He will be retained on the engineering staff as a consultant. He is succeeded as chief engineer by GEN. T. L. TREMBLAY.

CHARLES A. PATTERSON, borough engineer of Torrington, Conn., has recently resigned and has accepted a position as chief engineer of the contracting firm of Mascetti & Holley of Torrington.

CLAYTON E. SWAIN, superintendent of public works, Rockville, Conn., has resigned, effective July 29. Thereafter he will be associated with the U. S. Bureau of Public Roads.

ROBERT E. KELLEY, of Willimantic, Conn., graduate of the 1922 class of the University of Maine, has been appointed an engineer of bridge construction for the Maine State Highway Department.

ARTHUR PARENT, superintendent of the city lighting department and deputy director of public work of the City of Montreal, Que., has entered upon his thirty-third year in the service of the city.

WALTER J. KING has been appointed Kansas representative of the Portland Cement Association to succeed FRANK ALTMAN. Mr. King is an engineering graduate of Kansas State Agricultural College and has been county engineer of Labette County, Kan., for five years.

EDWIN J. STEPHENSON, until recently employed as contruction engineer by the United Light and Railway Cos., Davenport, Iowa, has been appointed chief engineer of public construction for the city of Davenport.

JOHN C. BRIGHAM has been reappointed city engineer of Summit, N. J., for a term of three years.

Obituary

JOHN E. SHOEMAKER, for a number of years connected with the contracting firm of Swensson & Co., Seattle, Wash., and former assistant engineer of the Port of Seattle, was killed in the recent Lester mine trouble near Herrin, Ill., when striking miners and strike breakers engaged in a pitched battle. At the time of his death Mr. Shoemaker was chief engineer of the Southern Illinois Coal Co.

FRANK E. CHESLEY, whose engineering practice included municipal and government work in Iowa, Illinois, Virginia, Pennsylvania, and North Carolina, died recently at Goldsboro, N. C., aged 43 years. His early professional experience included engineering supervision in connection with sanitary sewer construction in various Pennsylvania towns. He was a graduate of the State University of Iowa, a member of the Engineering Society of Pittsburgh, where he was located [illegible] member of the American Society of Civil Engineers. Mr. Chesley early became interested in licensing laws for engineers and was active in the passage of the Iowa and North Carolina laws.

HENRY S. HAINES, surveyor-general of New Jersey for 40 years, died at his home in Burlington, N. J., June 25, aged 87 years. He was formerly engineer of the City of Burlington and other New Jersey municipalities.

Business Notes

THE SPEARS-WELLS MACHINERY CO., Oakland, Cal., has been appointed an agency for the handling in Northern California of the sales of concrete mixers, pavers, and excavators and loaders made by the T. L. Smith Co. of Milwaukee.

CHARLES M. SCHWAB has been elected chairman of the board of directors of the Chicago Pneumatic Tool Co. At the annual meeting of the board of directors held in March the chairmanship was left open pending the return of JOHN R. MCGINLEY in the hope that he would reconsider his earlier expressed wish to retire from certain business activities. The election of Mr. Schwab was at the instance of Mr. McGinley.

THE WILSON WELDER & METALS CO., New York City, has appointed the King-Knight Co., San Francisco, exclusive representatives in central and northern California for the company's products.

THE WESTINGHOUSE ELECTRIC CO., East Pittsburgh, Pa., announces changes in its power sales department including the promotion of three managers and the creation of two new managerships. L. C. BURLINGTON, assistant to the manager of the power department for several years, has been made assistant manager. CHARLES F. LLOYD, former manager of the substation section, has been made manager of the electric division, and R. E. CAROTHERS, formerly manager of the turbine section, has been appointed manager of the steam division. Vacancies caused by the promotions of Mr. Lloyd and Mr. Carothers have been filled by elevating BRUCE H. LYTLE and D. O. TYLEE, the former becoming manager of the substation section and the latter, manager of the turbine section.

THE ECONOMY FUSE and MANUFACTURING CO., Chicago, announces appointment of CHARLES H. BLUSKE as district sales manager of the Los Angeles office. Mr. Bluske was formerly connected with the Pacific States Electric Co. of Los Angeles and succeeds GEORGE L. DAVIS.

DWIGHT P. ROBINSON & CO., engineers and constructors with main offices in New York City, have entered into a contract with the Metropolitan Life Insurance Co. by which policies are provided without expense for all members of the contracting organization reporting to the central office. Policies are provided under a group insurance plan without cost to the employees.

Road Builders Executive Committee Meets

At a meeting in New York, July 7, the executive committee of the American Road Builders Association decided to place the management of the Good Roads Show to be held in the Coliseum, Chicago, during the week of Jan. 14, 1923, in the hands of E. L. Powers, the association's secretary, provided the choice of Mr. Powers is satisfactory to the Highway Industries Exhibitors Association. The executive committee will meet with a committee of the exhibitors at an early date to discuss plans for next year's convention and show.

The executive committee also took steps to have the association's books audited, to secure an office in New York separate from that devoted to Mr. Powers' private publishing activities, to have a new constitution for the society prepared, and to initiate a campaign of increasing the organization's membership. The entire membership of the committee was present and consisted of Thomas J. Wasser, J. H. Cranford, C. M. Upham, James H. MacDonald and E. L. Powers.

EQUIPMENT AND MATERIALS

Contractors' Gasoline Hoist for Double Elevator Work

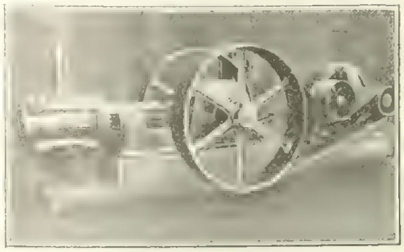
To the contractors' hoist and derrick line built by the Pawling & Harnischfeger Co., of Milwaukee, has been added a gasoline-operated elevator hoist for double elevator work. The standard contractors' hoist may now be obtained equipped with an elevator sheave in place of the nigger-head on the back drum. Reversing is accomplished by means of friction clutches. An endless rope passes around the elevator sheave, then over guide sheaves and elevator head sheaves to the up and down elevators. The elevator sheave operates through a jaw clutch and works independent of the main drums.

The main drums can be used for other purposes at any time.

The hoist shown in the illustration is the two-drum type equipped with a 5 x 6½-in. Waukesha motor. The single line pull of this unit is 5,000 lb.; hoist speed, 185 ft. per minute; elevator sheave speed 500 to 550 ft. per minute with a rated load of 1,000 lb.

Air Compressor for Small Installations

The Norwalk Iron Works, South Norwalk, Conn., has placed on the market a single-stage air compressor designed



especially to meet requirements of small shops where air under pressure is needed to operate hoists, drills, hammers and similar tools.

The machine, compact in design, is of the center-crank, double-action type with a belt and flywheel on opposite ends of the crankshaft. The cylinder overhangs, and all valves are therefore readily accessible. The cylinder and heads are water jacketed. The valves are of the multiple-port plate type, designed to operate at high speeds. The working parts are entirely enclosed in an oil tight casing and are lubricated by the splash system. The end of the main frame to which the cylinder is bolted is provided with open ports at both sides so that the stuffing box is accessible for adjustment and repacking.

The machine is built in ten sizes, ranging in capacity from 57.6 cu.ft. of free air per minute up to 748 cu.ft. per minute. The cylinder diameter of the smallest size is 6 in., with 6 in. stroke. The largest size has a cylinder diameter of 18 in., with 12 in. stroke.

Larger Motor in Excavator and Loader

The Wisconsin four-cylinder gasoline engine used on its pavers has lead to the adoption of this make of motor on the excavators and loaders made by The T. L. Smith Co., of Wilwaukee. The new motor has 3-in. bore and 5-in. stroke and runs at 1,200 r.p.m. It pro-

vides about 40 per cent additional power over the previous equipment. The excavators and loaders are designed for general drag-line work, for digging basements and loading directly into wagons or trucks on the surface, for grading, stripping, and miscellaneous earth-handling and loading.

Out-of-the-Ordinary Trade Publications

The latest bulletin (No. 369) of the JEFFREY MANUFACTURING CO., Columbus, Ohio, illustrates and describes a new belt conveyor designed for loading and unloading coal, cinders, sand, gravel, crushed stone and similar material. It may also be used for brick, tile, small boxes and bags. The apparatus may be operated either by electric motor or gasoline engine and the capacity varies from 20 to 50 tons per hour. It is built in three sizes, 18, 24 and 30 ft. long. Two or more of the conveyors may be used in tandem to extend storage piles.

Developments of modern American locomotives for railway and industrial service in this country and abroad are the main subjects of the first number of a new monthly house organ of the BALDWIN LOCOMOTIVE WORKS, issued under the name of *Baldwin Locomotives*. Besides descriptions of several recent locomotives of different types there are articles on "The First Uniform Gage Transcontinental Railway in South America," "Logging Locomotives" and "South American Business." There are also two articles in Spanish on "The Patagonia Railways" and "New Locomotives for the Argentine State Railways." The transcontinental railway mentioned will be a meter-gage line between Buenos Ayres and Antofagasta, the last link of which is being built.

Requirements for a tar-macadam road, including design and construction details, are described in a 48-page booklet issued by the AMERICAN TAR PRODUCTS CO., Chicago. The text deals with both the hot mix and the penetration methods and a number of excellent photographs are shown of Tar-mac construction. An advantage claimed for this type of road is that a wider range of choice in the quality of stone is possible than in the case of a waterbound macadam road. A number of pages of the book are devoted to maintenance and repair problems, with specific instructions as to best methods for patching holes and mending surface breaks.

A new railroad equipment catalog has been issued by the WHITING CORP., Harvey, Ill. It is a 48-page booklet, profusely illustrated, and is designed to present to railroad men the advantages and labor-saving features of the company's various specialties, including locomotive hoists, cranes, transport tables, turntable tractors, and car wheel foundries.

Details of its Type 00 gasoline shovel are presented in an 8-p. pamphlet just issued by the THEW SHOVEL CO., Lorain, Ohio. A table is presented showing the working range of the shovel with 14-ft. and with 12-ft. dipper stick, together with text and pictures devoted to such details as the dipper, boom hinges, truck frame, etc.

"The Modern Chimney" is the title of an 18-page illustrated booklet which the WIEDERHOLT CONSTRUCTION CO., St. Louis, has published describing the use of its patented concrete-tile construction for chimneys, cooling towers, storage bins, and similar structures. The Wiederholt chimney is a continuous one-piece inside wall of reinforced concrete entirely inclosed by indestructible hard-burned tile of special shape forming a mold for the concrete. Tables are given showing the proper diameters and heights of chimneys for a wide range of horsepower.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Price Trend Since 1810 And What The Future May Hold

I. F. McDonnell Believes Future Trend Will Lie Between 1914 Trend and the Declines Following Other Wars

I. F. McDonnell, consulting engineer of the Alabama Public Service Commission, has given *Engineering News-Record* his opinion of future prices, based upon history.

"It is interesting in connection with the study of price fluctuations and their relation to business to compare the present after-war period with the same period after other wars. The chart shows prices during three wars from 1810 to 1922. It is interesting to note the similarity in the war peaks and perhaps it is significant that these war peaks have occurred at exactly fifty-year intervals. Studying the two previous after-war periods, it will be noticed that the previous war peaks have been followed by a thirty-year period of irregularly falling prices and a twenty-year period of rising prices.

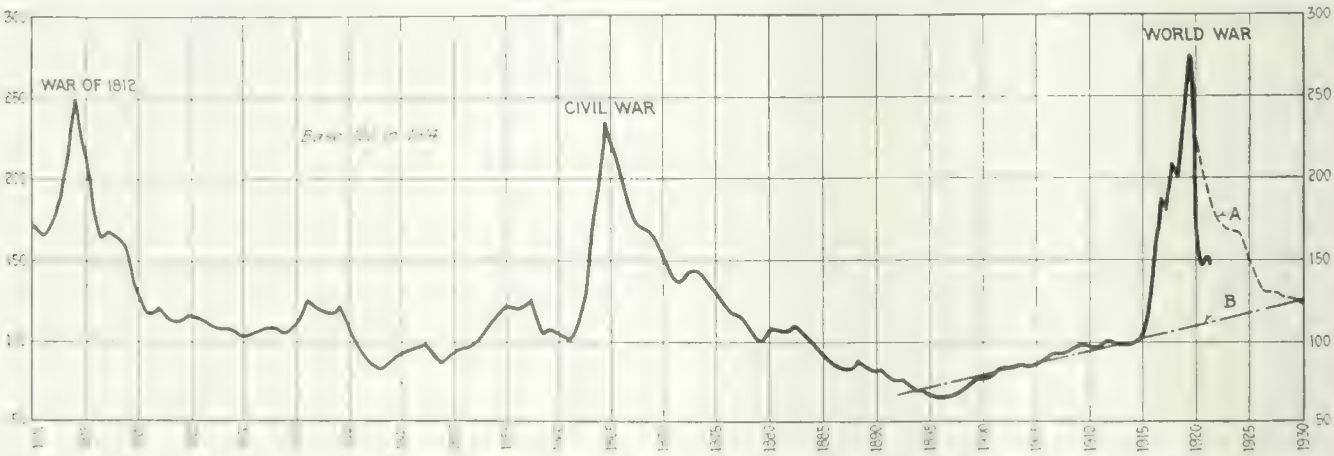
"To compare the two previous after-war periods with the present time, a composite curve 'A' of the two previous after-war price declines has been plotted in broken lines after the world war peak. From this it can be seen that the decline in prices after the world war has been accomplished far faster than ever before and we have reached the present level of 150 four years sooner than after the two previous wars. The causes of this are numerous and there is considerable difference among students of economics as to what have been the primary causes.

"Notice also the significant increase in prices from 1900 to 1914. Would this increase have continued had there been no war? An answer to this question would necessarily be based on so many assumptions as to be practically little better than a guess. However, to show the effect of this normal increase, the line 'B' has been projected to 1930, where it intersects the broken line 'A' showing prices during the two previous after-war periods.

"The present price level of 150 is fairly stable, and a study of the present economic conditions leads to the belief that the future price course from today's level will be irregularly downward with even occasional increases over short periods.

"It is my opinion after careful consideration of all available facts, keeping in mind present economic conditions and their effect upon the preceeding after-war price trends, that it may be safely assumed that the future price trend will as a whole remain in the area formed by the converging lines 'A' and 'B'.

"It must be remembered that these are abnormal conditions and the assumptions leading to the above conclusions are based on the hope that the world will recover from its recent great illness without being stricken with further complications."



Freight Loadings Touch New High Mark

Revenue freight loadings totaled 877,856 cars for the week ending June 24, according to the American Railway Association, an increase of 17,084 cars over the week ending June 17, which held the record for car loadings up to that time. Ore and coal shipments made up the bulk of the gain with 64,284 ore cars loaded as against 53,822 for the previous week and 96,960 coal cars loaded as compared with 92,136 for the week preceding. Coke loadings totaled 9,466 cars, a gain of 164 over the previous week. Forest products totaled 64,271 cars, a gain of 189 over the week ending June 17.

SURPLUS AND SHORTAGE STATEMENT—JUNE 15TH TO 23, 1922

[illegible]	[illegible] Cars		All Box Cars		All Coal Cars		Total all Cars	
	Surplus	Shortage	Surplus	Shortage	Surplus	Shortage	Surplus	Shortage
[illegible]	[illegible]		8,428		63,880		77,198	
[illegible]	79		6,475		66,492		75,599	
[illegible]	[illegible]		312	....	....	1,522	681	1,522
[illegible]	1,704	34	5,927	858	2,629	690	12,841	1,611
[illegible]	1,091		15,148	87	2,839	25	22,512	122
[illegible]	237	98	19,794	102	22,624		54,916	202
[illegible]	727		6,493	31	2,269		11,938	31
[illegible]	4,501	132	62,577	1,078	160,733	2,237	255,685	3,488
[illegible]	440	...	28,130		1,015		35,080	
[illegible]	4,941	132	90,727	1,078	161,748	2,237	290,765	3,488
[illegible]	5,805	155	91,250	1,019	172,722	311	306,983	1,696

Business Briefs

Time loan rates unchanged over week; 4 per cent for 60@90 days, 4½ per cent for 4@6 months. Call money at 4@5 per cent as compared with 4@5½ per cent, week ending July 1.

German marks touch new low, 0.19c., July 8, as against 0.25⅝c. July 1, and 1.31c. one year ago. Sterling at $4.44¼; $4.42¼, last week; $3.66, one year ago. Francs at 7.81c.; 8.39½c., week previous and 7.82½c., year ago.

$2,500,000 in British gold received during week. First gold shipment to United States in over a year. Similar shipment now on way for like amount.

Automobile output nearly 250,000 cars in June as compared with 256,000 for May.

Petroleum output increases 12,000 bbl. in week ending July 1. Average daily production, 1,454,000 bbl. as against 1,441,350 bbl. during preceding week and 1,315,950 bbl. during corresponding week of last year.

Steel rails purchased by single railroad, amounted to 33,000 tons during 1921.

Business Failures Fewer in Second Quarter

Returns for April and May had shown an appreciable decrease in number and liabilities of failures, and the June statistics reflect a continuance of the improving tendency. As against 7,517 defaults for $218,012,365 of indebtedness during the first quarter of this year, the second quarter's reports to R. G. Dun & Co. disclose 5,867 insolvencies for $155,703,973, exclusive of banking and other fiduciary suspensions. Thus, the statistics for the latest period reveal a decline of about 22 per cent. in number of failures and a contraction of more than 28 per cent. in amount of liabilities from those of the first three months of the present year, and the June defaults—1,740 in number—mark the smallest monthly total since last October. The June indebtedness of approximately $38,000,000 is, moreover, less than that of all months back to last September.

Following table shows geographic distribution of business failures:

Section	Number 1922	Number 1921	Number 1920	Liabilities 1922
New Eng.	530	409	167	$11,544,201
Middle Atl.	1,365	975	533	62,724,759
So. Atlantic	807	571	169	15,773,943
South Cent'l	832	651	154	17,405,723
Cent'l East	1,081	672	242	28,570,655
Cent'l West	578	403	122	10,458,159
Western	180	163	73	3,657,012
Pacific	494	319	265	5,569,521
U. S.	5,867	4,163	1,725	$155,703,973
1921	4,163	.....	...	130,273,615
Alaska	2	1	.....	$29,200
1921	1	.....	...	5,000

Chicago Building Permits for June Double Those of Year Ago

Building permits issued at Chicago in June had a total value of $26,593,850 according to figures given out by Charles Bostrom, city building commissioner. This was only about $500,000 less than the high record for May. The June permits included 702 single family residences, 484 apartment buildings, 142 industrial structures and 84 miscellaneous types, a total of 1,412 as compared with 1,273 for May. Permits of June, 1921, totaled only 672 or less than half those for June 1, 1922.

Production and Materials Stocks in Nine Cities

Brick Output Nearest Normal in Two Years—No Shortage of Other Materials—Coal Situation Becoming Problem

Steel—Reports from thirty companies whose output was 87.5 per cent of the steel ingot production in 1921 produced 2,634,477 tons in June as against 2,711,141 tons for May and 1,003,406 tons during June, 1921. Despite this 3 per cent decline the tonnage for the first six months of this year was 13,499,386 compared with 9,006,855 tons for the first half of 1921. Unfilled steel tonnage for June, on the books of the United States Steel Corporation, totaled 5,635,531, a gain of 381,303 tons over the preceding month. Operations in the steel industry, generally, are proceeding at about 75 per cent of capacity. Sheets for automobile manufacture have shown marked demand during the last month. Sheet mills in the Youngstown district, during June, approached nearer 100 per cent capacity than at any time since the 1920 peak.

Lumber—An average of 345 mills reporting weekly to the National Lumber Manufacturers' Association for the four weeks ending July 1 show 831,815,725 ft. cut or a weekly average of 207,453,931 ft. b. m. as against 230,330,721 ft during the preceding four weeks. Latest figures show shipments 3 per cent, production 10 per cent and orders 15 per cent below normal.

Cement—May production according to United States Geological Survey totaled 11,176,000 bbl. which is an increase of 1,933,000 bbl. over April, 1922. Shipments increased 1,569,000 bbl., leaving stock amounting to 12,897,000 bbl. on June 1, 1922, a decrease of 1,573,000 bbl. from the preceding month.

Brick—A total of 93 firms reporting to the Common Brick Manufacturers' Association of America, as of June 1, show latest production figures at 89,000,000 with shipments reaching over 95,000,000. With shipments from the yards, during the month, greater than the number of brick produced; orders on the books for 258,000,000 and stocks on hand only 154,000,000, the coal situation becomes a real problem to the brick industry. Only one plant, however, is reported definitely closed for lack of coal.

San Francisco—Plenty of sewer pipe, cement, brick, asphalt and steel, but only fair supply of lime and hollow tile. Lumber moving rapidly and supplies of other building materials not mentioned above growing scarcer.

Denver—Brick shortage being slowly overcome. Small stocks but no serious delays in deliveries from yards. Large stocks of other materials at hand.

Minneapolis—Dealers' stocks of cement, lime, brick and hollow tile somewhat limited; loading direct from cars for delivery to jobs but no difficulty in obtaining supplies from mills on usual notice, 1@5 days. Retail lumber stocks heavier than a month ago; mills producing at normal rate. Brick supplies unusually low both in warehouses and at yards.

Detroit—Plenty of cement and common bricks; only moderate reserves of sewer pipe and hollow tile but small supply of asphalt. Lumber supply meeting demand and Michigan and Ohio mills shipping plenty of lime on short notice.

New Orleans—About 8 weeks' supply of lumber in reserve, 2 weeks' supply of cement but sufficient brick to meet building demands for one week only. All lumber mills, excepting few, disabled by high water, working full time, one mill in this district operating night and day.

Cincinnati—Heavy stocks of cement, brick and asphalt. Wood blocks also manufactured locally. One week required on shipments of granite blocks.

Atlanta—Sewer pipe deliveries take 24 hr.; hollow tile, 4 days. Plenty of brick, lumber and asphalt, 30@40 cars of cement, 40@50 cars of lime and 4@5 cars of structural steel.

Philadelphia—Sewer pipe shortage. due to coal strike, somewhat improved since last month. Active demands but sufficient supplies in asphalt, paving

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (cement, Denver, 10,000 bbl.); time required for delivery of carload lots to city job, example: (sewer pipe, Atlanta, 24 hr.); and stocks on hand in general terms, example: (common brick, New York, shortage.)

	Detroit	Minneapolis	Denver	Philadelphia	New Orleans	Atlanta	San Francisco	Cincinnati	New York
Sewer pipe	Moderate supply	....	Del. 24 hr., local, plant.	Enough; demand easing up.	....	Del. 24 hr.	Local stocks large; nearby plants.	....	Sufficient; del. prompt.
Cement	Plenty. Mills at capacity.	Del. direct from cars to job.	10,000 bbl.	Supply used as fast as del. from mill.	1,500 bbl. Using 750 bbl. per wk.	30 @ 40 cars	Heavy local stocks; quick mill del.	15,000 bbl.	Warehouses well stocked; mill del. prompt.
Lime, common and hydrated	10 @ 15 cars	Factory del. prompt.	Ample supply	Fair	....	40 @ 50 cars	Fair	....	Enough. Shortage prevented by scarcity of brick.
Common brick	Local yards furnish plenty	Stocks low	Small No delay in del. from yards	Stocks in yards used up.	500,000 or one week's supply	Plenty	Ample; yards well stocked	Several millions	Shortage.
Hollow tile	Moderate supply. Del. take several days.	Del. 24 hr. to 5 days.	Sufficient	....	....	Del. 4 days	Barely enough; shipments improving.	....	Nearby plants at capacity.
Lumber	Normal. Stocks being replaced.	Retail stocks heavier.	Large stocks	Supply being used faster than replaced.	8,000,000 ft. Using 1,500,000 ft. weekly.	Plenty	20,000,000 ft.	....	7 @ 8 wk. from mill.
Asphalt	Small supply.	....	10 cars	Plentiful	.	Sufficient	Well stocked at refineries	300 tons	Refineries near city.
Structural steel	....	....	....	....	....	4 @ 5 cars.	Good supply of shapes plates and bars.	....	Warehouse stocks heavy.

stone, lime and manila rope. Stocks in brick yards exhausted and cement demand using supply as fast as delivered to dealers. Sand gravel and crushed stone moving briskly with pits and quarries taxed to limit.

New York—Brick shortage continues; Hudson River plants working at maximum capacity; Hackensack, Raritan and other districts supplying New York have orders booked for twice as many brick as can be produced. No scarcity of lime but brick shortage alone has enabled lime supplies to hold out. Lumber mill shipments slower.

REPORT ON COMMON BRICK FROM 93 YARDS AS OF JUNE 1, 1922

Dist. No.	Including States of	No. of firms reporting	Plants closed down	Burned brick on hand	Unburned brick on hand	Orders on books	Price Per Thousand at brickyard
1.	N. Y., New England	8	3	4,690,000	3,609,000	4,210,000	$13.00 to $18.00
2.	Pa., N. J., Md., D. C., Del.	9	2	13,840,000	4,841,000	32,088,000	12.00 to 16.00
3.	Va., N. C., S. C., Ga., Fla.	5	1	2,466,000	1,346,000	3,850,000	11.00 to 16.00
4.	Mich., Ohio, W. Va.	7	0	2,762,000	1,642,000	11,474,000	11.00 to 13.00
5.	Ill., Ind., Wis.	26	1	100,535,000	1,898,000	184,053,000	10.50 to 20.00
6.	Ky., Tenn., Miss., Ala., Ark., La.	14	1	7,796,000	5,825,000	6,616,000	9.00 to 14.00
7.	N. and S. Dak., Minn., Neb., Ia., Kan., Mo.	10	3	5,523,000	2,625,000	2,770,000	10.00 to 14.50
8.	Okla., Tex., N. M.	6	1	3,507,000	1,885,000	1,511,000	8.00 to 12.00
9.	Wash., Ore., Mont., Wyo., Ida., Utah, Colo.	5	2	2,412,000	382,000	250,000	13.00 to 18.00
10.	Calif., Ariz., Nev.	3	0	2,205,000	7,838,000	11,681,000	14.00 to 15.00
		93	14	145,736,000	31,891,000	258,503,000	

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of July 6; the next, on August 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$2.68	$3.65	$4.00	+$2.68	$2.86	$3.60	$3.10	$3.60	$3.75
Structural rivets, 100 lb.	3.60	4.35	5.50	3.10	3.90	4.45	4.25	3.75	6.50
Reinforcing bars, ½ in. up, 100 lb.	2.58	3.50	3.50	+2.58	2.76	3.67½	2.55	3.60	2.90
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9–5%	–46%	49.1%	53%	30.00
Cast-iron pipe, 6 in. and over, ton	+50.80	+49.00	51.50	+46.60	50.50	57.00	51.00	53.00	50.00
Concreting Material:									
Cement without bags, bbl.	2.40@2.50	+2.50	2.25	–2.05	–2.29	2.90	2.63	2.90	–2.46
Gravel, ¾ in., cu.yd.	1.75	1.85	2.25	1.80	1.50	1.75	2.25	1.10	1.50
Sand, cu.yd.	1.00	1.15	2.25	1.80	1.00	0.75	1.50	1.10	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	49.00	39.00	+39.00	+49.00	+41.00	+51.00	+31.00	22.50	47.00
Lime, finishing, hydrated, ton	–15.80@16.17	+23.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	–2.75@3.14½	+1.80	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50@24.60	11.00	11.15	11.00	+17@18	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.075	.115	.0707	+.086	.08	....	.12	.09
Hollow partition tile 4x12x12, per block	.1112	.0707	.115	.0657	....	.08	.108	.11	......
Linseed oil, raw, 5 bbl. lots, gal.	+.93	+1.00	1.07	+.98	+1.03	+1.12	1.04	.86	–1.04
Common Labor:									
Common labor, union, hour	.75	.35	....	.80	....	.50@.55	.56¼	.50@.60	....
Common labor, non-union, hour	.44@.60	.20	.25	.72½	.35@.50	.35@.50	.47½@.50	......	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — sign. For steel pipe the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars; other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at pit.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.76 cents. Bag charge is 80c per bbl. Discount of 10c. per bbl for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Steel, wrought pipe, lumber, brick and linseed oil have all shown upward price tendencies during the last two weeks, despite recent freight reductions. Cement, however, has reflected the freight decrease. Chicago quotes cement at $2.05 as against $2.07; Minneapolis, $2.29, reduced from $2.34 and Montreal, $2.46 as compared with $2.48 per bbl. Atlanta, however, quotes $2.50 as against $2.34 per bbl. Demand for principal construction materals in Atlanta is at least 75 per cent greater than a year ago. Quotations of $1.60 on structural steel, f.o.b. Pittsburgh, receding somewhat; most transactions at $1.70@$1.80 per 100 lb. for deliveries in third quarter.

Pine lumber up $1 in Dallas and $4 in Chicago; Douglas fir advanced $1 in Minneapolis, $2 in Denver and $6 per M. ft. b.m. in San Francico. Heavy lumber demand continues with mills and logging camps, in the Northwest, running two shifts and still unable to keep apace of orders.

Continued activity in the paint trade has given raw linseed oil another upward turn. Atlanta quotes advance of 6c., New York 5c., Minneapolis and Denver 4c., and Chicago 2c. per gal., in 5 bbl. lots.

Brick up $1 per M in Minneapolis.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

Volume 89 — NEW YORK, JULY 20, 1922 — Number 3

Water Power Not Fertilizer

EVIDENTLY the Senate is not to be stampeded into giving Muscle Shoals to Henry Ford. By a close, and almost strictly sectional, vote the committee has decided not to recommend the acceptance of the Ford, or any other offer. The case now goes to the entire Senate with a fair chance that it will there be debated on its merits as a water-power proposition and not decided as a fertilizer development. There will be the usual attempt to brand all opposition to Ford as the creation of the fertilizer trust but the unfair and invidious bestowal of water-power which Ford requests has been brought out clear of the fertilizer smoke screen, so that senators will at least vote with their eyes open.

Precision in City Surveying

THOUGH aphorisms are usually poor tools with which to quicken human action or interest, in reading Mr. Mitchell's article elsewhere in this issue on the value of geodetic control in city surveying one is struck with the idea that what is worth doing must be worth doing well. The accuracy of city-survey work too often is in direct proportion to the front-foot value of the city property. That means that small and perhaps inconspicuous municipalities are not very careful in establishing control stations, leaving more accurate methods to later generations. Each city engineer, however, should remember that his municipality is a potential metropolis. Use of precise methods of control for plane and topographic surveying will cost little more than slip-shod methods. From the questionnaire mentioned in the article it appears that degrees of accuracy now used are about as numerous as the cities circularized. Mr. Mitchell's plea that the first survey should be accurate and permanent ought to make city engineers see the responsibility of their jobs from a new angle.

Turning Back the Clock

BOTH railroad strike and coal strike have now carried far beyond the issues on which they were ostensibly called. The shopmen, with aid and comfort from other railroad workers, seem bent on putting the Labor Board out of business. They would rather fight with the railroads than negotiate with the Board. Mr. Jewell, their leader, gloats over the difficulties of the roads and declares that "all this means that time is with us. Every day we hold on weakens the railroads and strengthens our hand." Mr. Carroll, of the maintenance of way workers, talks of the railroads first "whipping" the shopmen, then "whipping" the maintenance workers. He attributes to the roads the "old strategy of divide and conquer." Samuel Gompers pronounces the Labor Board "a fifth wheel" and believes that direct negotiation between roads and men would be more fruitful. He waxes cynical over the idea of government restraint on violence. To listen to all this, one would scarcely realize that the wages and terms against which these men are striking have not been imposed by arbitrary railroad managements but have been arrived at after a thoroughgoing hearing by a government tribunal established for the purpose. The issue of the railroad strike, then, is whether we shall hold the gains we have made in the settlement of industrial disputes by peaceful means or whether we shall revert to the rule of violence, with the public in the role of innocent bystander.

The Trend of the Coal Strike

IN the answer of the miners' unions to President Harding's proposals for an immediate resumption of coal production, there is little indication of a desire to compromise the present differences. Their action appears to be more in line with the traditional policy of holding what they have and reaching for more. The former we find in their objection to a temporary wage revision pending a reorganization of the industry. The latter is embodied in their contention that the plan must be accepted also by the non-union properties that have been affected by the strike. Such a condition would be an indirect, but none the less effective, means of extending union influence into fields from which it has hitherto been barred. The proposals having been rejected by the unions, a majority of the operators express a willingness to accept them; but the division of their answer on a district basis as well as the tenor of their statements indicate extreme reluctance to abandon the principle of district, as opposed to general, negotiation. And so, whatever may be the intentions of the several parties to the controversy, it looks just now as though they will succeed in throwing the coal industry into the lap of the government.

Return Flow in Irrigation

THE change in irrigation from the crude rule-of-thumb methods of the pioneer to the careful engineering design and operation of the present day is notable. Much of this change is an incident of the progress that comes with the settlement of new country and the growth in experience and in available capital. State engineering departments, the more progressive and public minded irrigation companies, agricultural experiment stations, the United States Department of Agriculture, and perhaps, greatest of all, the United States Reclamation Service, have all had their part in putting irrigation on a scientific basis. Of the many lines of engineering study that have been carried on one of the most significant has been concerned with the return flow of water from irrigated lands to the streams for possible re-use. The review of such studies by Mr. Meeker elsewhere in this issue will repay study. Among other things, it shows that half or more of the return

flow occurs during the irrigation season and is available for re-use. This sometimes requires artificial drainage, which is now so large a factor in successful irrigation. With far more land needing water than there is water for the land, and in view of the relatively small portion of a given diversion that gets to the irrigated area, as Mr. Meeker points out, the economic importance of any study that will lead to the beneficial use and re-use of every possible drop of water is evident. Return flow and similar studies deserve encouragement and their results should be given wide publicity.

Logical Fire Fighting

WORK started by the Chamber of Commerce of the United States to fight fire dangers and bring about a reduction of fire losses, as noted in the news pages, is a logical and effective step toward dealing with fires. It enlists for the task of fire-fighting those people on whom the loss falls, and who therefore are most deeply concerned, namely, the business men of the country. *Fire losses are paid by the public, not by the fire-insurance companies*, and the more thoroughly this fact is hammered into the consciousness of everybody and its full significance is grasped, the more progress can we make toward wiping out the unnecessary fire loss. Work of the utmost value has been done by the Fire Underwriters, the National Fire Protection Association and other organizations of the insurance people, but such work is always at long range and cannot reach the chief evils directly. Its effect is therefore limited, and often in absurd disproportion to the effort applied and to the value of the results that might be obtained. Work under these conditions will naturally use means that are sometimes too weak, sometimes too severe, as important voices in the electrical field have lately urged. But where the work is taken in hand directly by those whose pocketbook is affected, namely by the insured—that is, by the public—each item of effort will have its proper measure of effect, and the measures adopted in the campaign may be most fitted fairly to the particular needs of the situation to which they apply. The move of the Chamber is to be welcomed as a definite promise of progress in fire fighting. It will have the support of every medium of public information and opinion in the country.

Amateur River Control

WHEN the editor of the *Saturday Evening Post* read the page proof of Harris Dickson's story of the Mississippi flood fight in last week's *Post* he must have overlooked the following sentences—"In this sweet and gentle springtime old folks discuss the levees, and a young man's fancy lightly turns to thoughts of river control. Behind receding waters the usual crop of crossroad theorists is sure to germinate. Each one presents a sizzling panacea, and writes a piece to the editor. They orate at public meetings, get red in the face, and sweat like a negro under oath, seeking to convince a bunch of stupid professionals who persist in doing the wrong thing." If the editor left this bit of truetalk in on purpose it must be in testimony of his conversion from his rather hysterical state when he wrote the editorial in his issue of June 10 entitled "Our Runaway River." That editorial does not confine itself to one "sizzling panacea"; it goes the whole hog—diversion dams, reservoirs, retention basins, reforestation and contour plowing—but worst of all intimates that through malevolent conspiracy or dense ignorance the engineering profession has prevented the application of these obvious remedies. If the editor will read, among other things, Col. Townsend's admirable paper "Control of River Floods" before the Drainage Congress at St. Louis in 1913, he will find that his cure-alls have all been examined, evaluated and, as major remedies, rejected by men who have spent a life-time in expert study of the problem. Unless the amateur in so important a national issue is prepared to refute the expert by book and verse his vague generalizations in opposition become ridiculous, though when backed by the wide circulation and responsibility of a national journal they are dangerous. The editor of the *Saturday Evening Post* owes the engineering profession an apology.

Bridge versus Tunnel

A MOST interesting controversy is now in progress in the region surrounding Newark Bay, one of the lateral branches of New York Harbor. Since early days the bay and its entering streams have been crossed by bridges, forming indispensable traffic links between New York and other Hudson River communities and the country to the west. Recently a determined effort has been made toward the ultimate clearing away of these bridges, so that unobstructed navigation space may be available for the commercial exploitation of the bay shores. Newark interests chiefly are back of this movement, with considerable backing from the New Jersey Board of Commerce and Navigation, which has strong Newark representation. The original point of attack was the proposal of the Central Railroad of New Jersey to renew its bridge between Bayonne and Elizabeth, at the mouth of the bay, a long timber trestle with double bascule draw. Determined opposition was made to this proposal from the first, and the Newark interests now demand that a tunnel be constructed in place of the bridge crossing, though the cost of a tunnel would be prodigious, and no showing has yet been made that commensurate economic advantages would be obtained.

A second opportunity for urging the replacement of a bridge by a tunnel came within the past month through the destruction of the Hackensack River drawbridge on the Lincoln Highway, just above the head of the bay, and such replacement is now under consideration. The active argument in such cases is always borne by interests with a direct financial concern, but the real questions at issue relate broadly to the ultimate public good, and lie beyond the reach of narrow considerations based on local or personal advantage.

Before any valid conclusion can be formed, the relative rights of navigation and of land traffic require to be appraised. Since such appraisal calls for intimate knowledge of the conditions and a far-seeing view of future development, it would be of greatest value if the War Department, which is charged with the final decision in at least one of these cases, seizes the occasion to enter into a thorough study of the conflicting claims of land and water traffic, especially in those most contentious cases where the land traffic is real and the water traffic is largely speculative. The conflict between the two is increasing at many points throughout the country, and the old principle that navigation rights

are paramount, though outlived by events, serves only as a disturbing factor. It is time that the basic principles of adjusting the two kinds of traffic were established; and in view of the many disturbing local elements that becloud each individual case, it would be best if they could be formulated in such general terms that they might serve as a guide in shaping the decision in any individual case, present and future.

The Making of Definitions

IN all probability the greater part of the engineering profession and its allied businesses consider the making of definitions trifling sort of work for men who are designing and building the world's structures and machines. There are dictionaries and encyclopedias where things are defined and when these authorities fail, as they so often do in engineering matters, there is the common acceptance of the term to fall back on. Why waste valuable time trying to torture a lot of words into defining what another word means? Leave that to the philologist in his study.

Fortunately there are a certain number of engineers who appreciate the necessity for precise and authoritative definitions, who have had enough experience in contract interpretation and with judicial inquisitiveness to realize that so far as possible every word the engineer uses in his work should have an unmistakable meaning and that groups of qualified engineers should put on record such accepted meanings, or lacking a general acceptance, should set forth a majority understanding of the word in the hope that this will gradually become unanimous. These men are in the various technical societies, which pretty generally have appointed nomenclature committees for this purpose. Such committees are doing a useful and difficult work, but it is doubtful if either its utility or its difficulty are properly appreciated.

As an instance there is recalled the recent deliberations of a committee on the definition of so simple a material as sand. After much discussion there was evolved the definition that sand "is the loose granular product resulting from the natural disintegration or mechanical reduction of rock," which seemed to take care of the appearance, composition and source and to cover the various interpretations of sand in the different arts. Outside experts called in immediately began to raise questions. What is a grain? What is rock? Is crushed slag sand? Under this definition, purposely written so as to include the mechanically reduced product known as sand in foundry practice, would not a concrete engineer be required to specify "natural" sand if he had objections to the use of crusher reduced rock as sand? Thus it appeared that sand is not easy to define but that at the same time its exact meaning might well become a matter of the greatest importance.

In some fields the necessity for definition becomes more a question of a nice precision than of technical or possibly financial importance. For example there is unnecessary confusion of terms in river and shore protection work. Jetty, we think, is properly applied only to a roughly paralleling current control structure at the mouth of a river. Yet it is variously applied to walls built out from the shore at or near a right angle, a structure which properly should be called a groin when built into a currentless lake or ocean and a spur dike or diversion dam or wing wall in a river; it is even sometimes applied to a mole or breakwater, which serve quite different purposes. There is a whole galaxy of words in this field to which meanings should be pinned down. Just what is a dike and how does it differ from a levee? What would you call an earth-fill built across a reservoir to permit the emptying of a part of the basin at a time?

Questions such as these are somewhat more than academic. To settle them requires a wide acquaintance with the field and a knowledge of the mechanics of language. It will not do, for instance, to define a certain kind of cement as "a cementitious substance which etc., etc.," as did a committee of a leading technical society some years ago. And as any one who has ever served on a nomenclature committee knows, difference of opinion as to well known words is astounding. There should be a better appreciation of the necessity for consolidating such opinion and a greater effort made to perpetuate such definitions as are accepted by those who are engaged in formulating them.

Must We Stick to the Wheelbarrow?

THE two papers presented to the American Society for Testing Materials and abstracted on another page are merely an indication of the amount of study now being given to proper methods of proportioning concrete. Not only are many laboratories in the midst of extended tests, either self-initiated or as a part of committee study, but concrete contractors are beginning to appreciate that something better than the old straight volumetric proportioning will increase both economy and safety and are making experiments on their own account. There still remains an undercurrent of feeling—mostly among those who pride themselves on being called "practical men"—that all of this study is fancy work and that the good old 1:2:4 mix is what the concrete man will put in, no matter how many odd decimal places the laboratory adds to the figures in the proportions.

The wheelbarrow, some of these men say, is the natural and foreordained unit of measure for aggregate and the wheelbarrow cannot possible be marked or manipulated so that a batch will be fed, say, 1.732 parts of sand and 4.351 parts of stone. Some few theoretical concrete people may use weighing machines or measuring boxes, but the line of man-pushed wheelbarrows will continue to grace every real concrete job so that there is no use suggesting any method which will not lend itself to that ancient and useful vehicle.

This is a reactionary view. Doubtless much of the concrete put in today is being proportioned in wheelbarrows; but so, too, is much of it being mixed too wet or too short a time or with insufficient cement and unsuitable aggregate. Whatever is is not necessarily right. If there were any insurmountable difficulty in using measuring boxes or hoppers or even weighing machines, a continuation of the variable wheelbarrow standard might be continued and improvement in quality of concrete sought elsewhere, but thousands of yards of good concrete placed by reputable concerns cheaper and easier than with wheelbarrows are testimony to the possibility of using the apparently complicated decimal mix. Trade practices are not immutable, as the study of any trade will show. Education can do much to bring about changes, especially when the old methods have little to recommend them except tradition.

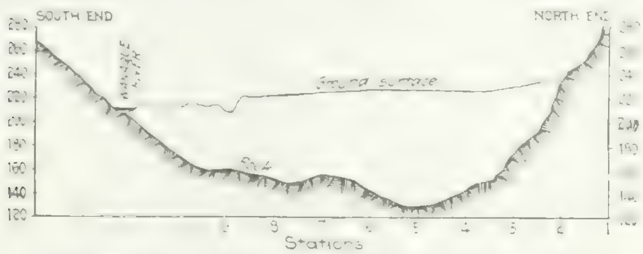
Core-Wall Construction in Deep Trench at Wanaque Dam

Maximum Section 20 x 90 Ft.—Sheeted with Two Lengths of 50-Ft. Steel Sheet Piles—Trenching and Concreting Plant and Methods Described

By Arthur H. Pratt

Chief Engineer North Jersey District Water Supply Commission, Newark, N. J.

A CORE-WALL trench only 20 ft. wide and at its maximum section 90 ft. deep, has been successfully constructed for nearly 900 ft. across the valley to be closed by the Wanaque Dam in northern New Jersey. With the exception of two accidents, neither of which caused much damage structurally but which, unfortunately, caused the death of workmen, there were no difficulties in excavating the trench or in concreting the core-wall which were not successfully handled by the methods employed. These were to drive full-depth steel-pile sheeting and excavate between the walls, which were braced apart with timber as the trench deepened, and then to fill between the sheeting with concrete until



LONGITUDINAL PROFILE OF WANAQUE DAM SITE

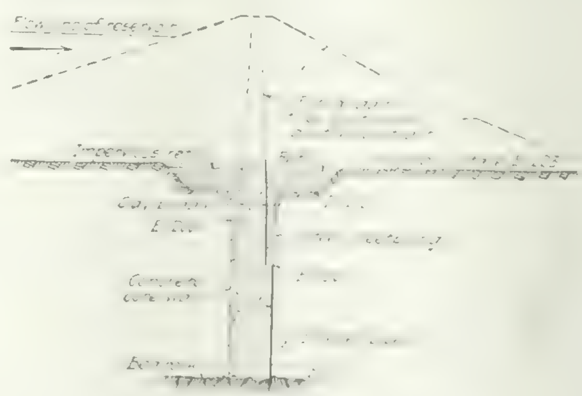
near the surface where the wall was thinned down and was concreted between forms. The unusual task was driving the long sheet-piles and supporting the high walls during excavation and concrete construction.

General Description—The Wanaque Dam is being constructed to impound water for Newark, N. J., and neighboring municipalities. The reservoir is about 25 miles from Newark, will be about 6 miles long and will store not less than 11,000 million gallons, giving a yield of some 50,000,000 gal. daily from the proposed first development, though greater storage can be provided.

The site of the dam is across a valley about 1,500 ft. wide which it is proposed to close by means of an earth embankment having a concrete core-wall extending to bedrock. This rock, a gneiss, outcrops on both hillsides but at the bottom of the valley dips to about 100 ft. below the surface. The overburden is sand and gravel, and of course bears an enormous quantity of water. The present channel of the Wanaque River crosses the site of the dam near the south end and the river bed is partly on the ledge rock which gradually dips away from the river to the deepest place near the middle of the valley. As already stated, the method adopted to construct the core-wall across the valley was to excavate a sheeted trench and then fill it with concrete. This trench is sheeted with Lackawanna arch-web, 35-lb. steel piling braced with timber. Previous to putting down the sheeted trench, a stretch of open cut, with sloped sides, was taken out with a steam shovel, giving a level path upon which to erect the frame for guiding the piling and for working the two pile-driving rigs, one on each side of the trench. These rigs have an A-frame 75 ft. high, with an extension to a total height of 92 ft., giving a clearance sufficient to handle and mesh one 50-ft. pile into another when the latter has been driven about 10 ft. Each rig is equipped with a Vulcan No. 10 steam hammer and is mounted on skids which slide on sills laid normal with the trench.

Pile-Driving Methods—First a portable guide frame 48 ft. long made of 12 x 12-in timbers was set up over the deepest part of the trench. This frame was constructed so that it could be adjusted to various widths. The aim originally was to obtain a trench 20 ft. wide at the bottom. As there was no experience upon which to determine the probable deviation of sheeting for such deep driving, the trench was started with the guide frame set to a width of 22 ft. After the piling was driven, the average top width was found to be actually 21.5 ft. The deviation from vertical before striking rock was found to be about 6 in. for each wall of piling, sometimes wider and sometimes narrower than the width at the top. On top of the rock the slope of the ledge surface forced the piling out of line so that the narrowest trench was 18.6 ft. and the widest was 24.4 ft.

A wall of 50-ft. steel piling was set up on each side of the guide-frame and driven into the ground a few

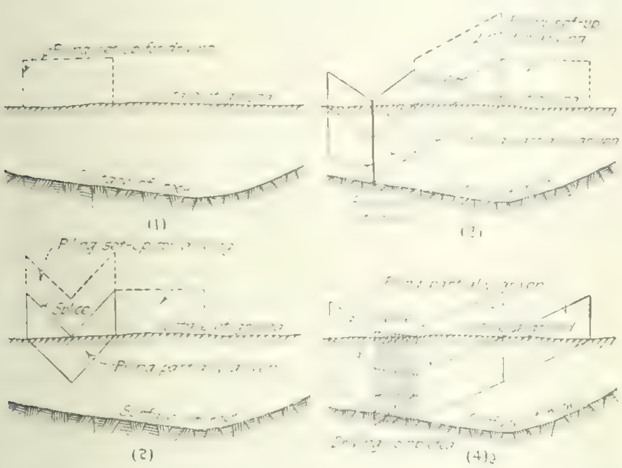


SECTION OF DAM AT MAXIMUM CORE-WALL DEPTH

feet so as to hold the toe in place. Extreme care was exercised for the first set to have the piling true and plumb in both planes. This precaution has been found to be very important as the first piles driven serve as pilots for the succeeding piles. Succeeding frames were, however, also set up very carefully. After the first wall of piling was erected driving was begun on a set of three piles at the middle of the frame. When the first three piles were driven a few feet the adjacent three on each side were driven and so on, the rule being in general to drive no pile more than 4 ft. in advance of its neighbor. This method was continued until the middle pile of the set was down with its

top to the surface of the ground, the bottoms of the adjoining piles then being in staggered diagonal lines to the surface of the ground. The frame was then moved ahead and another frame-full of piling was set up adjoining the first. Then driving was resumed until the new set and adjoining members of the first set were down to the surface of the ground except that the end piles were always left stepped-up in approximately 4 ft. steps.

As required, additional lengths of piling were spliced on top of the lower set by means of a 7-in. channel and a ⅜-in. x 6½-in. plate, bolt-holes to fit being previously punched in the ends of the piles. Driving on the spliced piles was suspended on each driving set when it had preceded its neighboring pile by 4 ft. In this manner, by gradually working the wall down in a



SEQUENCE OF OPERATIONS DRIVING STEEL SHEETING

slanting line, the bottom of the steel sheeting finally intersected the line of rising rock. By this method, while the first frame was set up over the deepest point, the first pile to strike rock was some 50-ft. to the south. Driving to rock continued then until the rock outcrop at the north end of the dam was reached.

The lengths of piles to be driven were predetermined by scale from the rock profile developed by the original borings. While the actual profile checked out as nearly as could be expected from the borings, still the rock bed was very uneven and it was later found desirable to make careful soundings, with the pile-driving rig and a steel rail, on the line of piling to determine the appropriate lengths of piles more accurately in advance. After the sheeting had been extended to the north end, the pile-driving rigs were moved to the other end of the walls of piling, the frame was set up and the same methods used extending the sheeting toward the south end of the dam. When possible sets of three piles were driven at one time but when the penetration became difficult two piles were driven and finally for the deepest part only one pile was driven at a time. The maximum length of penetration was 84 ft. and the slowest driving in that vicinity was some 90 blows to the inch.

A typical gang consisted of 1 foreman, 1 pile-driver operator and 6 pile-driver men for each pile driver. Two rigs were run under one general foreman and high pressure steam was supplied from a central plant so that a fireman was not usually employed with the driving rig. Pile-driving progress for two rigs is shown in Table I.

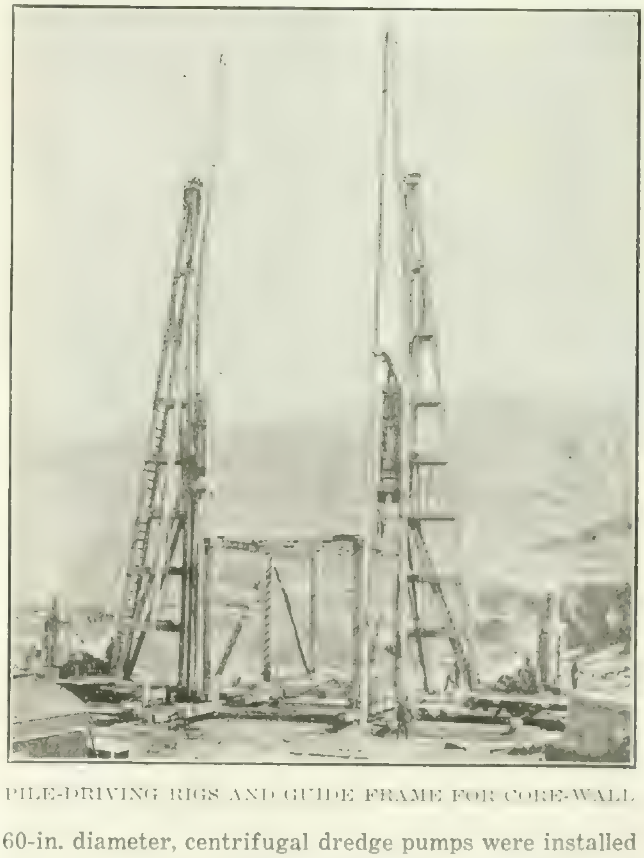
Method of Excavation—As soon as the driving rigs were moved to the southerly stretch, excavation at the north end was begun with clamshell buckets operated

TABLE I—PROGRESS OF DRIVING OF STEEL SHEET-PILING

Month	Sq Ft	Month	Sq.Ft
April, 1921	5,600	November	900
May	6,500	December	200
June	9,200	January, 1922	100
July	14,700	February	15,800
August	5,200	March	6,000
September	6,600	April	9,900
October	12,800	May	6,400
		Total	99,900

from stiff-leg derricks running on a track on top of the west bank. The excavated material was hauled directly to the downstream dam embankment when possible.

As fast as the trench was excavated it was supported with 12 x 12-in. braces in bays 10 ft. on centers and wales and braces spaced 6 ft. apart vertically for the upper 32 ft. of the trench. Below this the spacing was reduced to 3 ft. vertically and subsequently altered to double sets 6 ft. apart. Rangers 14 x 14-in. and 12 x 14-in. braces were used for the lower section of the trench. Ground water was encountered at once and pumping began after the installation of the top set of waling and bracing. Two 8-in. discharge, Morris Machine Co.,



PILE-DRIVING RIGS AND GUIDE FRAME FOR CORE-WALL

60-in. diameter, centrifugal dredge pumps were installed and dredged a considerable yardage of sand and gravel out of the trench, depositing it on the downstream dam embankment, besides pumping water. The total pumping equipment used on the job in addition to the dredge pumps was as follows: Four No. 9 Pulsometers; two 5-in. Emersons; two Lawrence 5-in. electric centrifugals and one Worthington electric 100-hp. 6-in. discharge, centrifugal. The quantities of water pumped are given in Table II.

[illegible]

[illegible] 1921	[illegible]	[illegible]	85.8
[illegible]	[illegible]	[illegible]	90.5
[illegible]	[illegible]	[illegible] 1922	[illegible]
June	3.2	February	[illegible]
[illegible]	[illegible]	[illegible]	120.3
[illegible]	[illegible]	[illegible]	115.8
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

Due to the porosity of the material and the low rainfall, the ground water level was very considerably lowered during the fall and winter of 1921-22. In general it remained about 20 ft. above the water level in the trench. The result of this lowering of water level was appreciably to reduce the pressure on the timber bracing. After a few timber sets had been put in and the trench excavated about 40 ft. deep the bracing began to show strain; one wale cracked longitudinally in about the middle, some of the bracing cut into the wales as much as ½ in. and some of the braces split at the ends. The use of iron bearing plates at the ends of the braces had been proposed and a closer vertical spacing was considered, but the only change actually made was to substitute oak for pine bearing plates at the ends of the braces and to frame the timber with extreme care to be sure of a bearing over the entire 144 sq.in. section.

TIMBER BRACING BETWEEN TRENCH WALLS

As the trench was deepened the ground water dropped and the pressures have apparently never again reached those which obtained in the more shallow trench. Most of the braces when removed were sawed and cut out without great difficulty and some could be pulled out with a cable from a derrick hoisting engine.

Accidents Due to Cave-In—As the excavation reached the bed rock beginning at the north end, the condition of the contact of the steel piling with the ledge was inspected with considerable interest. In general this contact was found to be most satisfactory but in a few places the piling had encountered rock fragments near the bottom and had been twisted out of its interlock. There were a few piles that had been overdriven and "fishhooked." With the pressure of ground water of about 20 ft. and a considerable flow under the piling at the bottom some apprehension was felt as to the certainty of the bond between piling and rock so that a small pile hammer was rigged on a derrick set upon the berm of the sloped excavation for the purpose of redriving any piles not driven to the rock.

On Nov. 2, 1921, absolutely without warning, a cave-in occurred about 200 ft. from the north end of the core-wall and about 8 ft. outside of the sheeting. A hole said by eye witnesses to be about 5 ft. in diameter and 12 ft. deep opened up under the feet of several mechanics who were working under the new derrick rig and one man was submerged. It was necessary to move the rig out of the way before workmen could dig for the man and soon after digging began it was found that sheeting would be necessary to hold the ground to reach where he might be. A temporary sheeted wall was put down and this was later inclosed by a framed timber shaft but all to no avail and the body was not recovered for several days and not until an 11-ft. square shaft of 35-ft. steel sheeting was driven inside the timber set put down after the temporary set. The body was finally recovered at a depth of 32 ft., about 30 ft. above rock.

After this occurrence the driving rigs were pulled back and all piles between which any excavation had been made were redriven to insure a close contact with the rock. This redriving resulted in an additional penetration of generally from 6 in. to 1.5 ft. though a few single piles were driven as much as 3 ft. and one was driven an additional 11 ft. Some did not budge upon redriving. The completed excavation indicates a satisfactory contact of piling with the rock. In a few places where it was not good special precautions were used such as piling sand bags; some bent and torn piling was burned off. In one especially bad place a short set of additional piling was driven at the bottom of the trench inside of the first set.

Method of Concreting Core-Wall—As soon as the earth was cleared away from the northerly end of the trench, the concreting of the core-wall was begun. Aggregate is obtained from a gravel bank about one-half-mile away from the core wall on the opposite side of the river and located on a terrace about 35 ft. above river level. The material is excavated by means of a 40-ton steam shovel, hauled to and run through a crusher and a revolving screen. The portion of the output of the screening plant which can be used at once is hauled directly to the concrete mixer and the remainder is stored in the excavated part of the pit for future use. There is about 50 per cent of excess sand in the pit which has to be wasted. The concrete mixing plant is located 300 ft. from the core-wall trench and consists of aggregate storage piles feeding into bins by a derrick and two Ransome, size 63 mixers. Mixed concrete mostly proportioned 1 : 2½ : 5 is deposited in bottom-dump buckets which are hauled to the core-wall trench on narrow-gage flat cars and then transferred by stiff-leg derricks on the west bank to the concrete forms. In the bottom of the trench on account of the

IN TRENCH BOTTOM CONTACT OF PILES WITH ROCK

interference of timbering, concrete was placed through hoppers feeding into a vertical 10-in. steel pipe.

Concreting was begun at the shallow portion of the excavation at the north end and proceeded southward as the trench was deepened. In the first part of the work the water in the bottom was handled with no difficulty by means of blind drains or pipes on the sides of the trench next to the sheeting, but as the deeper portion of the trench was reached the water increased in quantity and began to interfere with placing concrete. In the deep trench the ground water back of the sheeting began to leak through and flow onto the concrete up to a level some 20 ft. above the bottom of the trench.

To obviate this trouble holes were burned in the sheeting near the bottom and 2-in. pipes, 3 or 4 ft. long, pointed and perforated were driven into the earth. These acted like well points and drained the water away from the back of the piling so that the flow into the trench was largely confined to these bleeder pipes and was easily controlled. The bleeders were also useful in holding the ground water level down so that there was no difficulty in placing the second layer of concrete. For the concrete in the deepest section additional precautions were used. The concrete was placed in short stretches—10 or 20 ft. long—and first a concrete bulkhead about 6 in. wide and 2 ft. high was built on either

UPPER PART OF CORE-WALL UNDER CONSTRUCTION

side about 2 ft. from the sheeting. Back of this wall a blind drain or pipe—sometimes connected with the bleeder pipes—carried the water ahead. Between these bulkheads concrete could be placed in the dry and afterwards the space back of the bulkheads was concreted—blind drains and drain pipes being cut off periodically.

Concreting was carried on from the north end of the trench towards the middle until the deepest point in the excavation was reached, Sta. 5 + 00, where the principal pumping plant was located. Operations were then undertaken part way across the valley near Sta. 7 + 50 at a point where there was a natural sump in the rock. Here another pump was installed and operations by the same methods as used before continued in the opposite direction until the gap between the new pump and the main pumping plant was filled. Then the closure at the deep place was undertaken, the space between the finished sections of core-wall being about 40 ft. Parapet walls 6 in. wide were built longitudinally across this stretch about 2 ft. inside of the sheeting and the water which came underneath the piling or through bleeder pipes was concentrated on either side between the parapet and the steel piling, leaving the center clear and dry to be filled with concrete. When the center wall had been carried up about 6 ft., the spaces between the parapets and the steel piling were filled with rock fragments and the top was sealed over with concrete from one wall of steel piling to the other leaving vertical steel pipes built into the concrete for pump suctions and float wells. The pumps are arranged in three sets, one having its suction on the upstream side, the second on the downstream side and the third so that it can be switched to either side when one set of pumps of the three is being raised. By this means, alternately raising one pump at a time and concreting under it and building the suction pipes up, the closure in the deep section is being accomplished. Meanwhile concreting is proceeding at the river end of the trench where the rock is not so deep.

The quantity of water at the sump at Sta. 8 + 00 is about 600 g.p.m., while at the date of this writing the quantity of water in the deep sump is about 1800 g.p.m. At the present progress of concreting it is apparent that the rest of the trench will be closed before the deep section can be finished so that the pump suction pipes will probably be extended upward to the river level and when pumping stops the suction pipes and pump suction chambers which were filled with broken stone will all be grouted. In any event there is a tight concrete wall at least 10 ft. thick between the two sets of suction pipes.

The refill on the upstream side of impervious rolled material and on the downstream side of sand and gravel —probably placed by hydraulicking—will complete the present contract. A contract for the remainder of the dam will follow.

Personnel—The North Jersey District Water Supply Commission consists of Laurent J. Tonnele, chairman; Wood McKee, Obadiah C. Bogardus and Thomas L. Raymond. Morris R. Sherrerd is consulting engineer; Arthur H. Pratt, chief engineer; Neil C. Holdredge, assistant chief engineer in charge of construction and Arthur L. Sherman, designing engineer. The contractor, W. H. Gahagan, Inc., Walter H. Gahagan, president, is represented on the work by Ralph C. Young, superintendent and H. B. Wheatcroft, assistant superintendent. J. Roy Horton of Buffalo was subcontractor for the steel sheet-piling work.

Plant Inventories Offer Field for Structural Engineer

Strong Need for Adequate Data on Factory Properties and Equipment — Detailed Methods on How Best to Present Accurate Picture

By Francis W. Wilson
Wilson Engineering Corp., Hanover, Mass.

In PERIODS of industrial depression when construction is at low ebb engineers should give attention to the possibilities of income from other sources. The preparation of neatly-executed, clearly-expressed inventories of buildings and equipment for existing factories or industrial plants offers an extensive field for the employment of structural engineers. It is true that there are large concerns specializing in this line of work, but even a hasty glance at their methods would be sufficient to suggest to a structural engineer opportunities for improvement.

Not that these concerns do not do their work in a thorough manner, but generally their scheme of recording the information is largely clerical. So far as structures are concerned a mere listing of material is vague, whereas photographs and drawings showing the construction are more valuable and convincing.

For example, on one such inventory the writer noted that wooden roof trusses were described only by a bill of material. The actual construction of the roof trusses could not even be surmised from this information. A simple line drawing of the trusses with the sizes of material marked on each member would have been much more enlightening. However, it must not be assumed that inventories prepared by concerns who make such work their sole business entirely neglect the value of drawings as a means of recording the information.

Usually floor plans of the buildings are prepared and these show locations of machine tools, shafting and other items. Such drawings, however, are, as a rule, lacking in completeness in indicating construction features.

The set of blueprints furnished with the usual plant inventory is (in all cases that I have personally observed) fastened together by clips, and rolled up along with typewritten schedules and information covering the listing and description of other items of the buildings and contents. Such a system is lacking in clearness, accessibility, and permanence.

Keep in mind the fact that there is nothing which so quickly or clearly conveys an impression, as a "picture" of an object. Remember that the factory owner who employs you to prepare such an inventory will take a pride in it, and tell others about it, if he can without mental effort, see on the pages of a book, his entire plant spread before him, page by page, in "pictures."

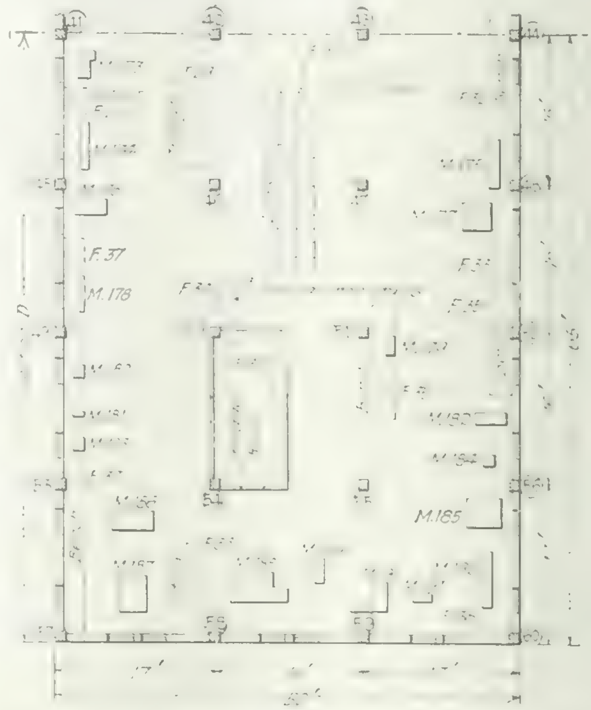
To many business men blueprints are expressionless and mysterious, but with records of the kind described here, a factory owner will delight in consulting them frequently because it is easy to take the book from the safe and turn to the pages illustrating any portion of the plant which he desires to study.

As to the demand for such inventories there is practically none, but there is a great *need* for up-to-the-minute data of the right kind. The demand must be *created.*

Why Inventories are Valuable—There are at least four good reasons why a manufacturer finds a plant inventory valuable, and worth much more than its cost. Briefly stated, these are:

(a) In case of a destructive fire he can show the insurance company convincing data as to just what has been destroyed.

(b) It furnishes reliable data on which to base the proper amount of insurance to be carried by the factory owner.



CHARACTERISTIC PLAN SHOWING ALL ITEMS MARKED

(c) It supplies a basis for obtaining bank loans in case improvements requiring additional capital are contemplated.

(d) Plans drawn to scale, showing the grouping of machines, the relative position of stock, the installation of apparatus, etc., provide the manufacturer with an opportunity to study the efficiency of his producing plant as a whole, or in its various units.

Field for Plant Inventories—The most fertile field for securing work in this line is naturally in plants where the buildings are of cheap wooden construction. It is there that an engineer will generally find the owner an attentive listener as he unfolds the details of the proposed book of data.

The following description is not supposed to represent the last word in the preparation of such inventories. Any bright structural engineer may see many opportunities to improve on these suggestions, both as to methods of obtaining the data, and as to the manner of recording it.

Method of Procedure—Sometimes the owner has a set of plans and specifications for the building as originally constructed. If so, they will materially reduce the labor of preparing the inventory, but do not accept these old plans as correctly representing the buildings as they exist at the time your work starts.

You will generally find that there have been many changes. Perhaps a stock room has been partitioned off in one corner, the offices have been moved into another building, a new loading platform has been added, another elevator has been installed, etc. After a matter of ten or fifteen years factory buildings have often grown away from the original plans until they agree with them only in a general way. Take nothing for granted. Compare every detail with the plans (when there are plans) and note all alterations, additions, and new features.

Frequently you will find that the owner employed no mill architect, and had no plans prepared for his buildings. Some "builder" perhaps made some rough drawings at the time of construction, but these were never seen after the completion of the work. In that case, it is necessary to prepare a set of floor plans of the buildings, made from actual measurements. No elevations need be made, for photographs will better tell the story. A few cross-sections are necessary in order to show story heights, and other features which cannot be clearly shown on plans.

The first thing to prepare is a block plan of the entire plant. This should show spur tracks, loading platforms, the position and dimensions of buildings, loading cranes, foot-bridges between buildings, stack, stock racks, tank towers, and all features which can be indicated on a small scale block plan.

Next, decide on the size of the book in which the complete inventory will be bound. Data of this kind simply rolled up like a set of drawings, and held together only by clips are in very undesirable form. A sheet can be too easily removed, and often will not be replaced. Decide on a uniform size of sheet, and when the information is complete have the loose leaves neatly and securely bound. The size selected for the pages of the book will depend somewhat on the dimensions of the individual buildings, and on the scale to be used for floor plans. A scale of $\frac{1}{8}$ in. = 1 ft. is desirable for all the plans.

A long narrow building can be divided into two or more sections when it comes to making the floor plans. These sections should be shown on the block plan, and clearly designated by letters or figures.

Notes and Sketches—A good method of making notes and sketches embodying information which must be collected on each floor of the factory is to have a plan of the floor on which this could be marked and sketched, preliminary to representing it on the finished plan. All the information cannot be sketched on any *one* plan of the floor under consideration without entailing undue confusion in the notes. To do this quickly and cheaply, resort is had to the hektograph. Hektograph copies can be quickly and cheaply made and afford the white ground on which to make sketches and notes.

The number of hektograph copies of the floor plans or sections into which a floor is divided will depend on the nature of the building and contents, but start out with enough of each. You will need one plan to show the floor framing; one for marking the location and size of machines; one for position and size of shafting; one for steam-heating pipes, coils and radiators; one for sprinkler pipes and heads; one for vent ducts; one for electric wiring and lights; one for plumbing pipes and fixtures, etc. Use one of these hektographed plans for each class of information.

In preparing hektograph plans, number each column, show partitions, and location of all windows, doors, location of elevator, etc. These features will serve as a basis from which to locate the other items, such as machinery, equipment, etc. Especially convenient in this respect are the numbered columns. Assign each wall and interior column a separate number, as you might on a steel erection plan. Then in the building, while working on any particular floor collecting the notes, tag certain columns with the number assigned to them, so that you can quickly identify locations on the floor with your working plan.

The Finished Book—In the finished book of data there must be one set of plans devoted to framing and floor and roof construction and another showing the location of each machine on the floor. By using different colored inks it is possible to combine the information relating to a number of items of equipment on a single set of floor plans.

Blueprints are not suitable for this work because water colors and colored inks cannot be used. The drawings on which the completed record is shown should be black-line prints on a good quality of strong white paper which will take water-coloring satisfactorily.

The black-line prints should have a border line of uniform dimensions and at the left hand side of the sheet there should be a margin outside of the border line to allow for binding.

The illustration herewith shows a small portion of a factory floor and the manner of indicating the position of machine tools and other fixtures on the floor. Machine tools represented in plan would have in many cases irregular outlines, but it is sufficient to represent them by rectangles of sufficient size to include extreme plan dimensions.

After all machines have been located and their approximate sizes and true positions shown on the floor plans, then, starting with the basement, or first floor plan, as the case may be, number each machine tool or piece of mechanism consecutively. Continue the numbering on each successive floor to the top of building.

Obtain from the factory owner the name, name of maker, maker's number (or model number), and the purchase price of each piece of machinery. The date of its purchase is also important. These data can all be recorded in a list on tracings of the size adopted, and black-line prints made from them.

Data on machinery are the only data in the inventory which the structural engineer is in no position to verify. The factory owner's books, cancelled checks, and receipted bills should be all the evidence necessary to substantiate the reliability of this schedule.

On the floor plan showing the location and numbers of the machines it is well also to show the shafting which is located in that particular story of the building. This can be done by heavy red lines on which, marked in red ink, the diameters of shafting can be stated. On the same floor plan locate all fixtures, such as

benches, racks, troughs, shelves, lockers, etc. In order that such fixtures may not be confused with the machinery draw the outlines of machines in solid lines and the outlines of fixtures in dotted lines (see illustration on p. 96). Also to make this distinction plainer, color machines and fixtures with different tints.

Each floor plan contains three separate sets of numbers applying to different kinds of items. The columns are numbered, the machines are numbered, and the fixtures are numbered. In order that these numbers cannot be confused enclose column numbers in small circles; prefix the numbers assigned to machines by the letter "M"; and prefix the numbers assigned to fixtures by "F."

All fixtures, as well as partitions, stairs and minor structural features, must be fully described, and the description supplemented by drawings whenever necessary. These descriptions can be typewritten. Use sheets of such size that either two or four of them can be blue-printed on a single page.

If the buildings contain a number of partitions it is well to also number them as "P—5," "P—6," etc.

It is not especially important what colors are selected to represent different materials or items so long as the plans indicate clearly what each color represents. For instance, yellow is appropriate for wood shown in cross-section; gray for concrete; red for brick; and blue or green for shading the rectangles which represent machines.

Photographs of the exterior of the buildings should be 8 in. x 10 in. in size. Enough should be taken to show, if possible, each side of each building. Underneath the photographs state in lettering which building is shown and give the approximate location from which the photograph was taken.

Estimates and Costs—It is assumed that any structural engineer worthy of that title is a careful, accurate estimator; fully competent to prepare a reliable estimate of the quantities of material contained in any ordinary structure or building.

After preparing an estimate of the quantities of material of the various classes included in the buildings, the matter of costs becomes important. There are several good books on estimating which give the "cost" in hours of labor for various items of building construction. Data of that kind are quite valuable for this purpose since it is an easy matter to find the hourly rate charged in the various trades. Any dealer in building supplies can furnish data as to costs of all ordinary materials.

As to the cost of equipment items, such as plumbing, heating, lighting, ventilating, sprinklers, elevators, etc., there are reasonably close methods of approximating the costs of all except possibly ventilating equipment and elevators. Concerns specializing in those lines can be consulted.

Of great importance to the clearance of the whole is a very complete, well-arranged index. In the index, under the heading "Machines," or "Machine Tools," the entire list of numbers assigned to them should appear and corresponding to each number should be the pages on which the item is shown or referred to. The same applies to the list of fixtures.

On the first page of the book it is well for the structural engineer who has compiled the data to execute a sworn affadavit as to their careful preparation and as to their verity. In any such affadavit the engineer should state any reservations which may be necessary, such as the description and cost of machinery supplied by the factory owner or by his employees.

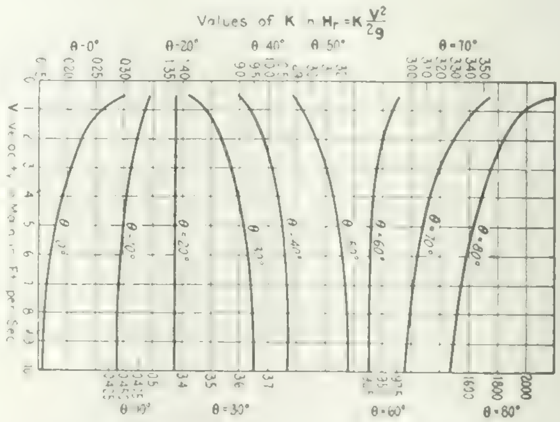
In the foregoing it has been the intention to call attention to a legitimate field for structural engineers, and give in a generalized manner suggestions as to methods which will appeal to the plant owners. Each individual who undertakes work of this kind will discover for himself labor-saving methods of acquiring and recording the information, and if he continues in such work for any length of time he will soon have at hand a vast amount of ready information as to costs which will prove of great value on subsequent work.

Losses in 6-Inch Butterfly Valve Varies Materially with Velocity

By W. S. Pardoe

Professor of Hydraulic Engineering, University of Pennsylvania, Philadelphia

RECENT experiments on the loss of head in a 6-in. butterfly valve indicate that the value of K in $h_f = K\frac{V^2}{2g}$ is not constant for a given value of θ but varies materially with the velocity in the pipe. The valve used was $\frac{1}{8}$ in. thick with a $\frac{5}{8}$-in. shaft as pivot. The angle θ is the angle between the valve and the axis of the pipe.



LOSSES OF HEAD IN 6-IN. BUTTERFLY VALVE
Tests show that K varies material for different positions of valve represented by angle θ

The exponential expressions for the lost head h_f are as follows:

Angle θ	
0	$h_f = 0.00405V^{1.7[illegible]}$
10	$h_f = 0.00755V^{1.97}$
20	$h_f =$ [illegible]
30	$h_f =$ [illegible]
40	$h_f =$ [illegible]
50	$h_f = 0.45V^{2.00}$
60	$h_f =$ 1.50[illegible]
70	$h_f =$ [illegible]
80	$h_f =$ 30.6[illegible]

As the exponents vary from 2.00 except in the case of θ equal 20° the values of K will vary. This is shown in the accompanying curve. The values at 3 ft. per second do not vary materially from those of Weisbach, published in Merriman's "Hydraulics."

North Carolina Top-Soil Road Theory and Practice

Top-Soil Roads and Paved-Road Subgrades Conditioned to Carry Traffic Until Slab Is Laid

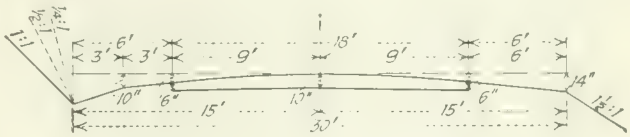
TOP-SOIL road construction, rationally developed, is rapidly giving North Carolina a system of improved highways reaching into every part of the state. These highways are in good condition 11½ months of the year; they are economically durable for a traffic of between 400 and 800 vehicles per day; they cost about $7,000 per mile to construct; they are maintained for about $400 per mile per year, and by resurfacing at a cost of about $135 per mile, say once in three years, they can be virtually renewed. When at last the traffic capacity of these top-soil roads is exceeded at somewhere between 400 and 800 vehicles per day, they provide remarkably good foundations for pavements of a hard-surface type.

Top-soil roads are an old type of construction in several Southern states. They have been constructed and maintained with all degrees of perfection but the work has been inferior perhaps more often than good. This has been particularly true of maintenance. Construction while frequently good has never been on a rational basis. When good it has been so because of a fortuitous combination of good local material and a builder experienced, or especially lucky, in selecting and working the material. If good the roads have demonstrated their ability to carry a moderate traffic nearly the full year at a moderate charge for construction and maintenance. Therefore, as employed in North Carolina, the top-soil road is a new development merely in the respect that certainty of good quality is being sought by rational construction and maintenance and that the type has been assigned a definite economic position in a balanced road system.

In North Carolina as in most states of large area and comparatively unimproved highways, the problem of road improvement has been to provide low-cost transportation as quickly as possible. The conditions, briefly stated, were: A law had been enacted providing for a system of state highways and investing control of the improvement of these highways in a state highway commission. A bond issue of $50,000,000 for highway improvement had been voted by the people and made available by the state legislature. Behind these actions was the expectation of the people that highway improvement would be realized quickly in a state-wide way.

To meet the expectation of immediate results, maintenance of existing roads was undertaken first. A state system of 5,500 miles was taken over and in four months was put under intensive patrol maintenance. In instances, this maintenance amounted to a substantial step toward reconstruction. The favorable effects were immediate. Attention was then turned to major improvement by new construction. The economic principle laid down for new construction was to adapt the road structure to the traffic conditions. Therefore in the industrial districts and between the large cities, paved roads were planned; in the farming country and between small towns permanent grades and structures, with wearing surfaces of selected materials, were planned, and in more remote districts it was planned to widen and drain the mountain trails and shape them up toward permanent grade and surfacing. In each kind of inferior road the work was designed to be a step toward a final hard-paved structure. Progressive construction was then the corollary of the principle of adapting the road structure to the traffic conditions.

In the classification indicated, top-soil roads are paved-road subgrades which are being kept in condition —by being constructed of selected materials and intensively maintained—to carry traffic until it is convenient and economical to put on the pavement slab. They are subgrade highways. As constructed they are in every respect a paved road lacking the paving slab. Location, profiles, dimensions, road bed, signs, drainage structures are final and permanent as if a hard pavement were to be built. The top-soil surfacing is the only task special to the type of road. The cost of



STANDARD TOP-SOIL ROAD SECTION

TYPICAL TOP-SOIL ROAD

this is practically only the cost of materials, which is $800 to $900 per mile, since the labor of placing is not greatly more than would be required to complete the subgrade for hard paving.

Top-soil is a disintegrated granitic rock from which the fine material has leached, leaving about 60 to 70 per cent grit and 40 to 30 per cent clayey residue not removed by leaching. It may be defined as a natural sand-clay. Besides the capacity for welding together into a mass of great hardness and strength, top-soil has the excellent qualities that it does not change volume with change of moisture content and that its capillarity is very low.

Generally top-soil is secured from tilled fields, but it exists in other places where natural conditions have induced a leaching action. Its occurrence in tilled fields is common of course because leaching has been activated by repeated upturnings of the soil in cultivation. The occurrence is in spots where leaching has been most active as on cultivated side hills. Its depth is usually 6 to 8 in. It is found in patches widely distributed but scattered. A tilled field may contain several patches of top-soil intermingled with areas of soil of the same origin but not leached or partially leached. The deposits are selected by visual inspection by men trained by experience to tell the best conditioned material.

Selection of top-soil requires to be put on a rational

basis. There is little difficulty in determining the most perfect material but as the quality shades off into soil of no value the selection by inspection is more difficult and the result is often in error. Studies are now in progress by the Division of Tests and Investigations to develop a qualitative field-test for top-soil. It appears from the results so far obtained that a combination slaking, shrinkage and strength test may be found practicable to make and reasonably determinative.

Top-soil packs down hard under traffic and assumes remarkable strength when dry. The roads fail by wear from the surface. Until recently, attempts to hold the surface by bituminous treatment have not succeeded. The light oils lack the binding qualities needed and the heavy oils form a mat which peels off. Experimental construction undertaken last year and being continued this year, indicates a possibility of developing a bituminous covering which will stay put. The process is to surface-scarify the old top-soil and then roll into it a single layer of broken stone about 2 in. in size. On this is spread enough top-soil to fill in the stone and slightly cover it. When the top-soil carpet has been worked by traffic well into the stone the surface is given a good dose of heavy oil. The stone furnishes an anchorage for the oil and it clings and wears remarkably well.

Maintenance is an essential factor in top-soil road theory and practice in North Carolina. Methods and equipment are ordinary. Dragging is the usual process. But it is essential that the maintenance shall be constant and conscientious. Faults must be remedied when they begin to show. Besides the rutting, which is characteristic of all earth type roads, corrugation and dusting are the principal surface effects of travel. Dry dragging has been found the best remedy for corrugation. Dust laying applications have the same action and efficiency, about, as on the more familiar gravel roads of the North. With the full perfection of a method of oil treatment as described in a preceding paragraph, the dusting problem will be solved.

German Technical Journals and High Printing Costs

High printing costs are having a seriously restrictive effect on the publication of technical and scientific periodicals in Germany, according to a note in the April 26 issue of *V D I Nachrichten,* the news edition of the *Zeitschrift des Vereines deutcher Ingenieure.* The figures in the case stands thus: Paper costs have risen from the 1914-1916 price of 0.38 M per kg. to 20 M per kg.; but the present price, which is about sixty times the pre-war price, applies to a lower grade of paper, and for equal grades the ratio would be about 100. Composing and press-room costs have multiplied by nearly thirty times. The cost in both instances rose only gradually up to the beginning of 1920, reaching three to five times the pre-war figures; then a very rapid rise set in, culminating in the summer of 1920, after which there was a stationary or slightly receding period, until in the fall of 1921 a new rise set in, at greatly intensified rate, the cost having more than tripled since that time. In the meantime, says the note, the subscription price of the journal has increased only fivefold. Considerably increased subscription prices are in prospect, and in addition the note forecasts increased rigor of selection of matter accepted for publication.

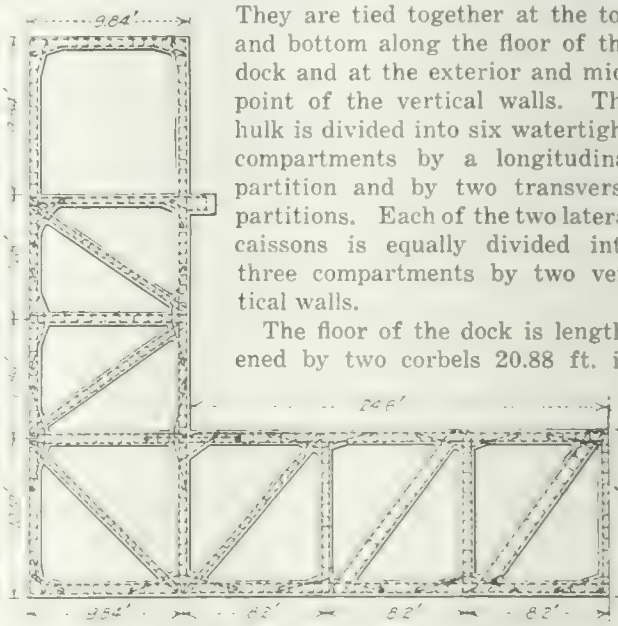
Large Concrete Floating Dry Dock Recently Launched at Triest

ONE of the largest reinforced-concrete dry docks recently completed has just been launched in Triest on the Adriatic Sea. The dock is designed for use by the port of Triest and for ships in the Adriatic Sea service only. The dock will accommodate vessels up to 2,000 tons displacement.

The principal dimensions of the dock are as follows:

	Feet
Length of hull	171
Total length, including corbels.	210
Interior width	49
Useful width	44
Out-to-out width	69
Interior height	23
Total height ..	34
Maximum draft	16.4

The steel framing of the dock is composed of U-shape sections built up of latticed girders and set transversely 3.35 ft. on centers, there being fifty such sections.



HALF SECTION OF STEEL FRAMING

These steel U-shape sections were built up of medium steel plates spaced at 3.35-ft. centers. The odd-foot dimensions shown are due to reduction from meters to feet.

They are tied together at the top and bottom along the floor of the dock and at the exterior and midpoint of the vertical walls. The hulk is divided into six watertight compartments by a longitudinal partition and by two transverse partitions. Each of the two lateral caissons is equally divided into three compartments by two vertical walls.

The floor of the dock is lengthened by two corbels 20.88 ft. in length which extend the useful length of the dock and facilitate receipt and delivery of material. Each of the two lateral caissons is 9.84 ft. wide.

Caissons are dewatered for floating the dock by three centrifugal pumps placed in the lower compartments of lateral caissons. Water is discharged through pipes into a longitudinal trench running the entire length of the dock in the center. Electric motors operate the pumps and are set in the upper compartments of the lateral caissons being connected to the pumps by vertical shafts.

The total volume of concrete used in the dock approximated 575 cu.m. This volume corresponded to a total thickness of concrete over the steel of 2.5 ft. The weight of the dock, including its machinery, is 1,700 tons. The dock is equipped with four three-ton cranes.

The impermeability of the concrete surface was effected merely by troweling over the entire surface with a cement mortar of a mixture of one part of cement to three of sand. This cement mortar was laid to a thickness of 15 mm.

Material contained in this article was taken from a recent issue of *Le Genie Civil.*

The Value of Geodetic Control in City Survey Work

One Triangulation Should Serve Most Exacting Demands—Accuracy and Permanence Invaluable—Survey Standards That Should Be Maintained

BY HUGH C. MITCHELL
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RESULTS of a questionnaire circulated some months ago among city engineers by the U. S. Coast and Geodetic Survey indciate that few engineers are using either geodetic methods or control in city survey work. Total replies to the questionnaire numbered 216. Twenty engineers stated that they were using geodetic methods and twenty-four that they were using geodetic control. The control used consisted usually of precise-level bench marks established by one of the federal surveys. A few engineers had made use of precise triangulation control.

An appreciation of the accuracy attained through the use of geodetic methods and control elicited from several engineers strong endorsements of its use, and from others came simply expressions of a need for more accurate and standard methods in making city surveys.

The need for greater permanency in the engineering personnel was indicated in a number of ways by the replies from various engineers. Rapidly-shifting personnel is a strong argument for standardization of survey methods. If surveys were standardized, how easily the incoming engineer could take hold of his work, and how great would be the saving to the taxpayer, both through having full and efficient service on the part of an important public official and through the possession of accurate data for its engineering and surety work.

In one town, having a population of some 16,000, the questionnaire was delivered to the chairman of the committee on streets who returned it with the note that "we do not employ an engineer regularly. This was delivered at my house and of course is nearly all latin to me but nevertheless deserves acknowledgment." It will be a busy engineer who eventually takes up the work of a city which has attained the size of this one and has no definite engineering service.

Two general conclusions may be drawn from the great variety of answers received to the questionnaire. One is that there exist now no exact and adequate standards of accuracy in city survey work, and the other is the emphatic need of such standards. It is the belief of the writer that through standardization of instruments and utilization of geodetic methods and control will come accuracy and economy, not only in city but in all survey work.

Realization of the need for accurate control for city work will doubtless lead the engineer to ask: "Of what use to me are geodetic methods and control? What constitutes acceptable geodetic control? How am I to obtain it?

While geodetic control may be used for cadastral, topographic and underground surveys, as well as for other surveys of special character, its value is greatest where greatest accuracy is required. In most cities this is probably in connection with cadastral surveys. For a small scale topographic survey of a city or even for a large-scale map of a small area, the ordinary methods of plane surveying will usually prove sufficiently accurate. But as the area is extended and the accuracy required is increased more precise methods are demanded, until finally the methods and formulas of geodetic surveying are required. Slowly the larger cities of our country are coming to realize this fact, but it is proving a difficult matter to get away from the old rule of letting the immediate purpose of the survey determine the accuracy required. But why make a rough survey of a region, when in a few days or a few months a precise survey, needed for some other purpose, will be made? Why not make the complete and precise survey in the first place and use it for all purposes? If reasons why this is not feasible exist, why not at least execute the control, and make it of such character as will serve *all* surveys? If triangulation is executed of sufficient accuracy to serve as control for cadastral surveys it will generally be suitable as control for all surveys. The character of the instruments needed for precise triangulation, the unique professional training required for its execution as well as for least-squares adjustment, without which final results may not be had: *all* dictate that but *one triangulation of a city should be made*, and that should be of an accuracy which will serve the most exacting demands.

The value of geodetic methods and control in city survey work may be grouped under two general heads: *Accuracy* and *permanency* of results.

Accuracy—The triangulation of Greater New York (1903-8) had an accuracy of 1 part in 25,000 for length of line. This was the accuracy sought; had a greater accuracy been desired at that time, it could probably have been obtained. Subsequent triangulation work has shown that greater accuracy should have been sought. The methods of triangulation surveying have now been so standardized that it is possible to obtain any reasonable specified accuracy. Traverse may be run with nearly the same linear accuracy as the triangulation base line, but triangulation is required to control a traverse survey, to prevent an accumulation of errors in azimuth, which produce errors in position.

It is true also of the level survey that where accuracy is required in the survey over a large area, the use of geodetic instruments and methods will prevent the accumulation of errors which ordinary methods might permit.

Permanency—There is but *one* point at the intersection of any given parallel and any given meridian on a specified datum. A survey point, if determined on a standard geodetic datum, has as witness marks all the other survey points whose positions are known on that datum. Thus in the case of the triangulations of Cincinnati and of New York City, both of which are connected directly to the great triangulation net of the United States, each point in the city survey has as

witness marks—the 20,000-odd triangulation stations of that net.

A small charge of dynamite or an ill-considered excavation may destroy a monument but the point it occupied can readily be re-determined from other triangulation stations of the same system. It may interest the engineer to look at a simple example of how destroyed stations are re-established. In the Coast and Geodetic Survey, where triangulation starts from an arc already in existence, it is the practice always to recover three stations of the older work, usually a triangle, and by re-observing the angles of this triangle, prove the recovery of the original stations. Three such stations, forming a triangle, were recovered some years ago at the junction of a new arc of precise triangulation with one which had been executed some four years earlier. Two of the angles of the triangle were re-measured with standard accuracy, the third was concluded. The triangle was solved using the new observations, and the results being compared with the original lengths of sides gave discrepancies which amounted in proportional parts to 1 in 434,000 and 1 in 868,000.

Standards for the Survey—As a rule no general survey calls for greater accuracy than does the cadastral survey, which requires an accuracy which should be a function of the future reasonable value of the property surveyed. If geodetic control is executed which will serve the needs of the cadastral survey, the control demands of all surveys will be met. In New York City an accuracy in triangulation approaching 1 part in 100,000 is now believed desirable. Cities of the second class would probably require triangulation of an accuracy around 1 part in 50,000, while other cities for which a geodetic survey might be proposed would find 1 part in 25,000 satisfactory.

Specifications for the Survey—The triangulation should be controlled by at least two base lines: a line brought in from the triangulation net of the country, and a measured line. These two lines should be so situated as to include the major portion of the triangulation between them. It should be possible to compute any line of the triangulation from at least two bases, thus making it possible to determine its accuracy. The bases measured should have an accuracy of at least 1 part in 500,000. This accuracy can be obtained by ordinary base line methods, using *invar* tapes, which must be standardized immediately before and after the measurement of the base line or lines. The tapes must be used on the base in exactly the same manner as they were used in the standardization; that is, same tension, number of supports, etc. A base line can be measured with the required accuracy on any grade up to 10 per cent, and a small creek or gulley, if less than one tape length (50 meters) in width will offer no obstacle to the measurement.

An angle may be introduced into a measured base line if proper care is had in measuring the angle. Offsets are sometimes required; they should be measured from *one* line projected through for the entire length of the base. It seldom will be feasible to occupy with a theodolite the ends of the measured line, but signals must be placed close by for that purpose. If the measured line and the line connecting the triangulation signals are made sides of a very flat quadrilateral in which all the angles are measured, the transfer of length will be made with no appreciable loss of accuracy. Lengths should be carried ahead through overlapping quadrilaterals.

Accuracy of Triangulation—The accuracy of the triangulation is determined by three main factors: the frequency and accuracy of the base lines; the shape of the figures through which the lengths are carried; and the quality of the observations of horizontal angles. The shape of the figures will determine where bases should be inserted to maintain a desired accuracy.

For an accuracy of 1 part in 25,000, which is the minimum standard for the precise triangulation of the federal survey, the angles are measured with 16 positions of a direction instrument reading to one or two seconds, or if a repeating theodolite of proper size is used (10-in. circle read by verniers 3 sec. to 5 sec. of arc), then five sets are taken on each angle. A set consists of six measures of the angle with the telescope direct, and six of its explement, telescope reversed. The only condition introduced is that the horizon be closed.

Triangulation of this accuracy exceeds the requirements for the control of a topographic survey on a scale of 200 ft. to the inch, a scale which is considered desirable for general city planning. On an underground survey, if mapped 40 ft. to the inch, the plotting unit of one-eightieth inch represents ½ ft. on the ground, and if the triangulation stations are two miles apart, the possible error in that distance will be 0.4 ft. or 0.01 in. on scale.

For the topographic survey the traverse need be only of an accuracy and a frequency which the scale of the map dictates, though even for traverse it may be found economical to execute only the most accurate type and use it for all dependent surveys. If this can not be done the topographic map will require traverses every half mile, with stations placed every 1,000 ft., and an accuracy of 1 part in 5,000 to 10,000.

The cadastral survey requires traverse of the same accuracy as the triangulation and should determine stations at every street intersection. The cadastral marks should be placed within the protection of the curb, in such position as to be reasonably safe from destruction in the construction of buildings or of streets. Since the traverse stations are to be considered temporary, the cadastral points must be susceptible of occupation with an instrument and contiguous ones must be intervisible.

Least-Squares Adjustment—In computing the triangulation it must be remembered that while values for lengths and angles may be obtained which will satisfy the demands of such surveys as the topographic, the most probable values for those quantities and the ones which are to be considered final can be obtained only *through a least-squares adjustment.* In a cadastral survey this is a most essential operation.

Marking Stations—While a triangulation station, if destroyed, can be replaced, one must not overlook the fact that such replacement is necessarily an expensive operation, and the station should therefore be preserved, as far as can economically be done, by physical marks. A sufficient number of stations should be established in open ground to render it unnecessary to carry a new triangulation more than two or three triangles to replace lost stations. The ground mark for such a station should be monumental in character, and the ground it occupies should be owned in fee by the city.

Precise Levels—The precise levels can best be run using the type of level which two decades of use in the U. S. Coast and Geodetic Survey have proved most satisfactory. Its essential qualities are: (1) That the observer is able to hold the bubble in the middle of its tube while he reads three lines of the diaphragm as seen projected against the level rod; (2) constancy of temperature conditions in the instrument through the use of invar; (3) control over the adjustment; and (4) the determination of the collimation error. Invar, which has a very small coefficient of expansion, is also used for rod faces. The use of a target in leveling is to be avoided, except where the width of a river crossing makes one necessary. Even where a wye level is used, the writer believes that the use of self-reading rods of standardized length, equalizing the lengths of foresights and backsights as each station, and the reading of three wires on the rod, will tend to give both increased speed and accuracy.

Bench Marks—A splendid arrangement of bench marks is to place them in pairs, as was done in the survey of Cincinnati. The two marks of a pair should be placed close enough together to be connected in one or two set-ups of the level instrument, yet so placed as not to be subject to the same destroying agencies. Where marks are placed on buildings, only such buildings as are apt to remain a long time, and such parts of those buildings as will not be affected by ordinary remodeling, should be used. Ground marks should be protected against traffic, vandalism and frost.

The criterion for precise levels is an agreement between two runnings over a section between bench marks on 4 mm. times the square root of the length of the section in kilometers (or 0.017 feet times the square root of the length of the section in miles). The two runnings of a section are made in different directions and on different days.

Advisory Committee on Treasury Water Standards

An advisory committee on official standards for water supplies on railway trains and on vessels engaged in interstate commerce has been created by the Public Health Service and is announced in detail in *Public Health Reports* for June 16, 1922. The function of the committee is "to review the present Treasury Department's standard for drinking water on interstate common carriers and to recommend a standard, or standards, based on recommended specific methods of laboratory analysis and field surveys, which will be applicable to all classes of water supplies coming within the supervision of the interstate quarantine regulations of the United States." The committee numbers 42 members, including Dr. A. J. McLaughlin, assistant surgeon-general as chairman, and five others connected with the United States Public Health Service, among which are two associate sanitary engineers. The Department of Agriculture, Commerce, Interior, Navy, and War each has a representative on the committee. Eleven scientific associations are represented by one member each. These include the American Society of Civil Engineers, American Public Health Association, American Water Works Association, American Chemical Society, and the Society of American Bacteriologists, and there are nineteen "sanitarians" on the committee. Among these are some of the most noted engineers, chemists, and bacteriologists in the country, including men in private practice.

Proposed Road on Mexican Border Would Involve Treaty

"In the southeast corner of California a chain of sand-hills 50 miles long and 7 miles wide constitutes a barrier to the construction of an adequate interstate highway connecting El Centro and Yuma, Ariz.," according to a bulletin issued by the California highway commission. "The hills are constantly on the move and during one of the high winds which are prevalent at certain seasons of the year would bury past economical reclamation any permanent type of paved highway. At the present time the sand-hills are bridged by a plank road built in sections which can be moved or abandoned to accommodate the drift of the sand." The construction of this road was described in *Engineering News-Record*, July 29, 1916, p. 131.

With the co-operation of Mexican officials from Lower California, the bulletin continues, the California commission made a reconnoissance survey and found that the sand-hills end a short distance south of the international line and that the drift is all northward, so that

A ROAD THROUGH THE SILT OF THE COLORADO VALLEY

a road located on the Mexican side for about 14 miles would entirely escape the sand menace. Before such a road could be built, an international treaty would have to be negotiated and arrangement would also have to be made for special financing as funds now available could not be expended outside the state boundaries. State legal authorities have advised the highway commission however, that funds for the construction of a 14-mile section of highway through Mexican territory could be had by special act of the state legislature and that motor vehicle department funds could be used for the maintenance of such a highway providing treaty arrangements are made with Mexico neutralizing the highway zone and vesting the control of the highway

construction and maintenance in the California highway commission. Mexican officials are believed to be friendly to the plan.

As an example of the kind of country through which such a road must go the accompanying view is given. This was taken last year by a member of the staff of *Engineering News-Record* in Mexico, about ten miles south of the line at Calexico and is remembered by him as the worst piece of road on the continent.

Anchored Bulkheads Across Slips on Chicago River

Fill in Large Slips To Be Retained by Bulkheads in Deep Water at Dock Line and Tied to Pile-Bent Anchorage

IN PREPARING to fill several old slips opening from the Chicago River and Lake Michigan the Illinois Central R.R. was faced with the necessity of providing some form of anchorage for the bulkheads which will close the mouths of the slips, since there is no solid ground behind them to which anchors could be fastened. The maximum height of fill will be about 32 ft. and the slips are 144 to 186 ft. in width. The bulkhead construction consists of a single line of Wakefield triple-lap wood sheet piling and an outside row of round piles spaced 4 ft. c. to c., with three lines of waling timbers between the piles and sheeting and two on the outside of the piles, as shown in Fig. 1.

Across each slip will be placed two rows of piles for the anchorage, with anchor timbers behind the piles and with an inclined brace pile to each vertical pile, as shown. The head of each pile in the first row will be tied to the foot of the corresponding pile in the second row by a $1\frac{3}{8}$-in. loop-end rod. The upper end of this rod will be attached to a stirrup or yoke around the heads of both vertical and brace piles and the lower end will be attached to a threaded rod passed through the rear pile. The minimum penetration is to be 15 ft. for vertical piles and 20 ft. for brace piles. Details of construction are shown in Fig. 2.

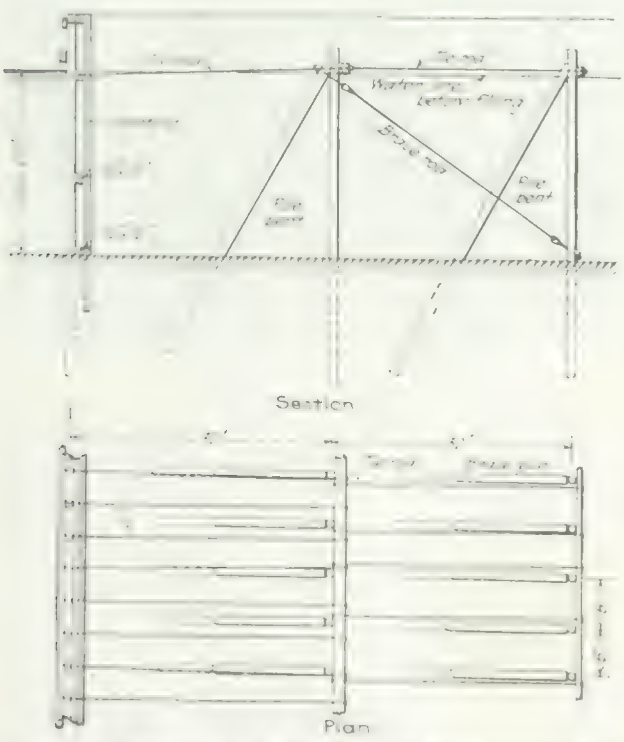


FIG. 1. [illegible] PILE ANCHORAGE [illegible] BULKHEADS

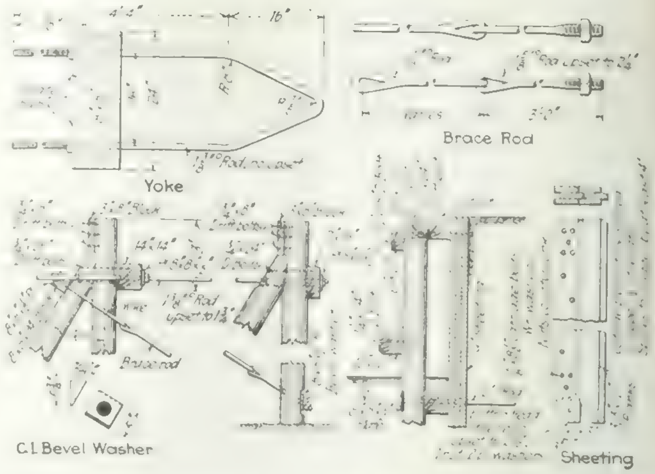


FIG. 2 DETAILS OF PILE BENT ANCHORAGE

Through each bulkhead pile will extend a 2-in. tie-rod with a button-head and bearing on a $\frac{1}{2}$-in. plate 8 x 8 in. The rear end of the rod will be held by a nut and washer at the back of the waling timber on the first row of anchor piles. Other tie-rods, $1\frac{3}{8}$-in. in diameter, with both ends threaded, will connect the two rows of braced piles. In order to prevent undue pressure, the filling for a distance of 60 ft. back from the face of the bulkhead will be made of stable material. This will also enable the anchor bents to be relied upon as deadmen embedded in the fill. No cinders or lime are to be used within 175 ft. of the bulkhead, as these materials might result in excessively rapid corrosion of the steel rods.

It is estimated that this bulkhead will cost considerably less than the usual construction consisting of a double row of piles with rock filling between them. Further, since it is probable that the railway company will erect buildings along the water front, the rock filling of such a bulkhead would interfere with future foundation work. This filling of the slips is a preliminary step in the large scheme of railway terminal development at Chicago by the Illinois Central R.R. The bulkhead design was prepared by C. H. Mottier, office engineer, under the direction of D. J. Brumley, chief engineer of Chicago terminal improvements, Illinois Central R.R.

Limitations of Land Drainage by Wells

Land drainage by wells driven through impermeable strata to porous soil or open rock, as practiced to some extent in the central states and in Florida, is of limited efficiency and relatively high cost, according to a statement of the U. S. Bureau of Public Roads. Of 73 wells investigated in the north-central states 42 were considered unsatisfactory, 23 of doubtful value and only eight satisfactory. Of wells carefully located and driven to porous limestone about 75 per cent have proved successful. The cost of drainage by wells has ranged from \$90 to \$200 per acre drained, indicating the average for outlets in organized drainage districts.

Return-Flow Water From Irrigation Developments

About 50 per Cent of Water Diverted Is Source of Return Flow—Statistics of Colorado Valleys Indicate 1 Acre-Foot per Acre Recoverable, Maximum in Summer and Fall

By R. I. Meeker
Irrigation Engineer, Denver, Colo.

Since a surprisingly small amount of water is consumed or needed compared with the quantities diverted, any salvage or return that can be made extends by that much valuable contiguous territory. The increasing volume of return flow or seepage water from irrigation, the growing importance of such waters in an economic way, their relation to volumes diverted and acreage irrigated and the dearth of recent data in current engineering literature have prompted this article. It is hoped that its publication will induce the compilation and publication by engineers of facts and a discussion of similar data coming under their observation in other irrigated areas. Advances of a 10-year period in irrigation history and the engineering world generally are so great that there is a lag between accomplishment and the dissemination of recorded progress.

Application of water to land in the arid states has wrought wide changes in river flow in the irrigated areas. It is common history in the older irrigated valleys that natural stream flow, after heavy depletion or reduction by canal diversions for irrigation, increases in volume through the irrigated areas; also that dry tributary channels frequently become live streams and low-lying areas waterlogged and swampy. The explanation is summed up in four words "return water from irrigation." Further tangible evidence of increase is found in a constantly enlarged acreage watered under old ditches and from junior ditches, whose water supply was considered precarious or "flood right" in character at the time of construction.

Attention is directed to general changes in stream flow due to the settlement of the arid West. Such changes are a matter of common observation among the older residents, and while precise data of flow variation may not be cited, the attendant effects are evident and form a crude measure of the tendencies resulting from artificial causes.

Before the advent of western civilization, as recently as 1860, stream flow in the West was regulated to some extent (excluding seasonal variation) by natural conditions of an excellent forest cover in the mountainous area and a heavy grass carpet in both mountain and plain areas. While spring floods occurred from melting snows and other floods from summer rains, their peak variations and erosive effects were undoubtedly much less than at present. The natural and profuse carpet of vegetation retarded run-off, increased absorption in transit and delayed immediate appearance in main river channels. Over-grazing of the grass cover in plain, plateau and mountain areas is placed first in importance as a cause of the change in stream flow and erosion, with forest denudation by axe and fire second. Two phases of irrigation offset these destructive tendencies; (1) reduced flood flows from canal diversions and reservoir impounding, and (2) return flow from underground soil reservoirs of the irrigated areas. The general net result to the lower portions of river basins where irrigation is extensive is a better equalized river and reduced flood flows. The streams of the more arid Southwest are generally exceptions to the above statement because irrigated areas are small and reservoir capacity negligible. On such streams peak or flood flows are more acute and more frequent than formerly.

Economic Value—Irrigation history is replete with optimism of human nature as expressed in the construction of ditches whose available water supply was doubtful in character or undetermined. Early prediction was that such ditches would have a poor water supply, an increasingly inferior water supply, or ultimately no water supply. The compensation effect of return flow has saved many a wild or ill-advised effort in ditch construction from failure and turned it to success. The extension of the irrigated area and its depth of penetration into the surrounding arid land has been the surprise of pioneer engineers, and the results have exceeded the anticipation of the most sanguine residents in several irrigated valleys. Several communities whose former water status was uncertain and precarious have become prosperous and their water rights are now rated first class. Seepage water has been a big factor in the development of the South Platte Valley. Perhaps no area is more typical or better illustrative of the beneficial and healing effects of return waters from irrigation than the lower South Platte River area in Colorado between the towns of Fort Morgan and Julesburg, a distance of 100 miles. The present assessed valuation of the irrigated land of the lower South Platte Valley is over $10,000,000, the area irrigated being 180,000 acres. The average return flow of the river section is 500 sec.-ft. or 360,000 acre-ft. annually. Without seepage water this area would have only a flood-water supply and its economic importance would shrink at least one-half or probably from $40,000,000 to $20,000,000.

Seepage or return waters have attained such volume on the U. S. Reclamation Service projects that the Federal Government now makes specific claim for such waters on the various projects. On the North Platte Project in Wyoming and Nebraska, the Shoshone Project in Wyoming, and others, the volume and value of such waters is so great that litigation has resulted.

Source of Return Flow—In the process of conveying water to land in unlined canals and its application to crop production there are excessive losses. Roughly they may be tabulated as follows:

	Range, Per Cent	Average,* Per Cent
Conveyance or seepage losses by deep percolation in transit through canals and laterals ...	[illegible]–50	[illegible]
Field losses by deep percolation and surface waste [illegible]	[illegible]–20	[illegible]
Evaporation losses from canal water, saturated ground surface and irrigated fields	10–30	20
Plant evaporation or transpiration (actual water consumption)...	20–40	30

* Mean of 21 U. S. Reclamation Service projects, 7 years' record 1912 to 1919 inclusive.

From the foregoing table it is evident that the plant consumption of water is, roughly, only from one-fifth to one-third of the water diverted at the river headgate; also it is evident that (excluding lined canals)

deep percolation losses in canal, lateral and field, amount to 50 per cent of the water diverted. Probably 50 per cent is a general figure for large areas and varied conditions. Where water is scarce and application is made with good husbandry these figures are reduced, and where water is plentiful and used lavishly they should be increased. It should also be understood that soil texture is a large factor in changing the above-mentioned percentage. It is, therefore, evident that 50 per cent or more of the water diverted at the river is available as a source to return flow.

Underground Soil Reservoirs—Ordinary soil is porous, the voids ranging from 30 to 40 per cent. Each acre of saturated soil in irrigated areas will, therefore, reservoir 1 acre-ft. of underground water for each 3 ft. of depth. Unfilled underground soil reservoirs explain the heavy water consumption which occurs when irrigating new land and account for the lagging effect of return-flow waters. The magnitude of such underground reservoirs is illustrated by the Cache la Poudre in Colorado where 250,000 acres are irrigated.

Assuming the average soil depth to bedrock (shale, sandstone and marls) to be 20 ft. and the average depth to the water table to be 5 ft., there is a soil depth 7.5 ft. for underground water storage. Using a pore space of one-third, then 1 acre of surface soil would cover 5 acre-ft. of underground storage. In an area of 250,000 acres the underground reservoir would contain 1,250,000 acre-ft. The actual underground soil reservoir is more extensive because unirrigated areas lie within and adjacent to the boundaries of the irrigated tract. This means that during the 50 years of irrigation history in that valley there has been a gradual withdrawal of at least 1,500,000 acre-ft. of water from river circulation. This vast underground reservoir naturally fluctuates slightly from year to year, and in dry cycles is depleted, serving as an equalizer to river flow, but recovering during years of heavy stream flow and application.

When irrigation is first practiced in a community the water demand (per acre irrigated) on river supply is at a maximum, and practically all water diverted, except surface waste, is temporarily lost to the stream. Gradually there is a building up of an underground reservoir in from 5 to 20 years with return flow in increasing volume until eventually the return flow may approximate or exceed one-third of the total yearly diversion. It is apparent that during the irrigation history of a river there occurs a period of years when irrigation demands indicate that the limit of water supply has been reached. This condition is only temporary and later on return flow enriches river flow and permits an extension of the irrigated acreage.

Investigations on the Poudre River in Colorado show a return of close to 35 per cent of the annual average original water supply of that stream measured at entry to the plains. On the South Platte in Colorado the percentage is about 50. On the Salt and Gila Rivers in Arizona returns of 35 to 65 per cent have been measured.

History of Return Flow—Return waters from irrigation were first observed in Colorado 40 years ago, irrigation having commenced in a small way in 1860. The first known published return-flow measurements were made in 1885 on the Cache la Poudre River in Colorado between Fort Collins and Greeley. They confirmed the observations of irrigators for several years to the effect that there was an increase in river flow. Commencing in 1889 and continuing until 1915, covering a period of 32 years, seepage measurements were made annually on the Cache la Poudre River from Poudre Canyon to the mouth, 47 miles, and on the South Platte River from Platte Canyon to the Nebraska line, a distance of 235 miles. During that period seepage or return flow measurements were also extended to the important streams in the principal irrigated valleys in Colorado. Other states have conducted similar investigations. In Arizona early return-flow measurements were made on the Salt River and the Gila (see U. S. Department of Agriculture Experiment Station Bulletin 104), and in 1910 amounted to 200,000 acre-ft. During the past five years the U. S. Reclamation Service has made special investigations on some of the modern irrigation projects in connection with drainage return flow from irrigation. The conclusion from these studies and from comparisons with the natural return flow from large older irrigated areas is that the amount of water actually consumed by crops is relatively small compared with the amount diverted, and further that with efficient drainage on an irrigated project, the actual plant consumption has decidedly low limits regardless of the water applied.

Method of Measurements—The first return-flow measurements were determined by dividing a river into sections 5, 10 or 20 miles in length and measuring with current meters the section inflow (in sec.-ft.); section outflow and all intervening tributary inflows and ditch or canal diversions; the total inflow minus the total outflow gives the gain or loss. The work was conducted more as a determination of river gains or losses than total return flow of a specific irrigated area. Where pronounced returns were observed in side channels the work was extended to them. Work has usually been confined to main stream channels.

Such investigations were formerly conducted in the late summer or fall when stream flow was low or at a minimum and river measurements could be made by wading. September and October were the usual months although a few measurements have been made in the spring; rainfall was meager in the fall months, and conditions generally were more favorable to accuracy. At first it was assumed that seepage returns were more or less constant throughout the year, and the fall records were frequently taken at face value for the year. In recent years investigations on the main South Platte River by the state engineer of Colorado were made during every month of the year to determine seasonal variations and their character. More refined methods were used and greater accuracy secured than during the pioneer investigations. In 1919-20 on a 150-mile stretch of the main South Platte River continuous records by automatic water-stage registers were secured for 18 months of all section inflow, section outflow, tributary inflow and canal diversions. Some 50 recording gages were required. The seasonal variation is comparatively small and approximates the variations found in the North Platte in Nebraska where soil conditions are similar (viz., a porous, sandy soil and fair natural drainage). May appears to be the month of the minimum return, 6.5 per cent, with September the month of maximum return, 10 per cent, July having the average of 8.5 per cent of the total for the year.

It should be remembered that the return-flow investigations mentioned were usually confined to main streams and main tributaries, that return flow is frequently diverted and intercepted before it reaches the main streams; hence, the recorded data may be considered as being less than the actual return of a given area. On the other hand the measurements made in the fall months, especially on the South Platte, would show, if applied for the year period, higher results than the actual average, or a difference of about 10 per cent too much.

Summary of Tables—Table I gives general data for two areas where return waters are important factors of irrigation. In both the chief crops are alfalfa, sugar beets, grain and potatoes. The Cache la Poudre flow includes 35,000 acre-ft. trans-mountain diversions but the Platte flow is corrected for storage and trans-mountain water.

TABLE I—RÉSUMÉ OF FACTORS AFFECTING RETURN FLOW IN CACHE LA POUDRE AND SOUTH PLATTE RIVERS

Item	Cache la Poudre	South Platte
Flow, average annual, mouth canyon	375,000 acre-ft., 36 years' record	1,700,000 acre-ft.
Elevation irrigated area	5,[illegible] to 4,600 ft	5,700 to 3,500 ft.
Temperature, mean annual	47 deg. Fahr.	49 deg. Fahr.
Rainfall, mean annual	15 in. 38-yr. record	15 in.
Rainfall in growing season, Apr.-Oct	7.5 in	7.5 in.
Growing season, between frosts	150 days	155 days
Acreage irrigated, 1920	250,000	1,000,000
Years since first irrigated	50	60
Total reservoir capacity	160,000 acre-ft	1,000,000 acre-ft.
Diversion duty per acre per year	1 to 2 acre-ft.	2± acre-ft.
Consumption use per acre per year	1.25 acre-ft	1.25± acre-ft.
Return flow, annual	130,000 acre-ft.	1,000,000 acre-ft.
Water table	Stable	Approaching equilibrium
Soil conditions	Sandy loam and clay loam in small areas	Sandy loam
Nature of river channel	Narrow and rocky	Wide, sandy, shallow below Denver.

Tables II and III indicate the growth of return water covering a period of over 30 years as measured in the river channels.

Table IV gives monthly per cents of annual return both on river sections and drainage systems.

Table V gives general information and comparative data on the volume of return flow.

TABLE II. RETURN FLOW FROM CACHE LA POUDRE VALLEY
Section length 47 miles, canyon mouth to junction with South Platte

Year	Sec.-Ft.	Acre-Ft. Per Year	Acres Irrigated
1870	0	0	4,500
1880	48	35,000	10,000
1890	101	73,000	108,000
1900	110	80,000	160,000
1910	160	116,000	207,000
1915	175	126,000	246,000
1920		(est.) 130,000	250,000

* The e values approximate only.

Tables II and III are based on actual return-flow measurements of the U. S. Division of Irrigation Investigations, Colorado Agricultural College, and the State Engineer's Office of Colorado. There is a slight seasonal variation. The actual return flow of the entire irrigated area is greater because these data do not include tributary streams where ditches frequently intercept and divert return waters before they reach the parent stream.

The South Platte records are for 1920 and were continuous for a 12-months period with automatic water registers. The return during the irrigation season was 60 per cent.

The North Platte figures are a mean of three years, 1915, 1916 and 1917 and the return during the irrigation season was 59 per cent.

The Carmel record is a means of 6 years' discharge measurements at 2- to 3-week intervals from 1915 to 1920 inclusive. The return was 60 per cent during the irrigation season. A small amount of drain water was used within the district and is not included. The average annual return per acre was 1.2 acre-ft. From Jan. 1, 1915, to May 31, 1916, the measurements were made by the office of Public Roads and Rural Engineering, U. S. Department of Agriculture. From then to Dec. 31, 1920, the work was carried on by the State Engineer's Office every three weeks with daily flows interpolated on account of the regularity.

The Rio Grande record is for the year 1920. Of the total, 58 per cent of the return is in the irrigation season. Monthly measurements were made by the State Engineer's Office and gage heights taken by the Rio Grande Drainage District except during the winter, when interpolations were made from the discharge measurements.

Between Whalen, Wyo., and Bridgeport, Neb., return waters from irrigation are pronounced, and especially on the Interstate Unit of the North Platte Project of the U. S. Reclamation Service where considerable artificial drainage has been necessary to avoid water-logging.

In 1918 visible return flow from the Interstate Canal and lands irrigated from it measured in open drain at their intersection with the Tri-State Canal amounted to 150,000 acre-ft. annually from 100,000 acres of irrigated land, or 1.5 acre-ft. per acre per year.

TABLE III. RETURN FLOW FROM SOUTH PLATTE VALLEY
Section length 235 miles, Platte Canyon to Julesburg, Nebraska line

Year	Sec.-ft.	Approx. Acre-ft. Per Year	Acres Irrigated	Authority
1889	*451	326,000	421,000	Census
1899	1,026	742,000	710,000	Census
1904	1,038	750,000	685,000	1902 Census
1908	1,197	865,000	832,000	State Engineer
1913	1,129	816,000	958,000	State Engineer
1920	1,400	1,000,000	1,100,000	Census

* To Iliff only

NOTE: Measurements made in fall months except 1920 data, which are based on 12-month period with automatic registers; fall measurements applied, as yearly returns give results 10 to 15 per cent too high.

In 1918 and 1920 the return waters to the North Platte River in a 125-mile section between Whalen and Bridgeport amounted to 400,000 acre-ft. annually. The soil on the north side of the river where 75 per cent of the irrigated area lies is very sandy and porous; on the south side the soil is from a sandy loam to a clayey loam.

Progressive Increase—As to the increase in the return flow over a period of years, data from published records of the State Engineer's Office and the Colorado Agricultural College are as follows: The 235-mile stretch of the South Platte from Platte Canyon to the Nebraska line increased in return flow in the 20-year period from 1900 to 1920 from 914 sec.-ft. to 1,400 sec.-ft. Similarly in 47 miles of the Poudre from the canyon to the mouth from 1900 to 1915 the increase was from 110 sec.-ft. to 175 sec.-ft. The entire South Platte area, including both main tributaries from the foot of the mountains to the Colorado-Nebraska line from 1900 to 1910 increased from 1,201 sec.-ft. to 1,566 sec.-ft. The Arkansas River from Canyon City to the Colorado-Kansas line, 215 miles, in a 17-year period beginning in 1897 increased from 123 sec.-ft. to 547

TABLE IV. SEASONAL DRAINAGE RECOVERY OR RETURN FLOW FROM IRRIGATION

Stream or Project	Location	Acres	J	F	M	A	M	J	J	A	S	O	N	D
South Platte	70-mile lower section	90,000	7.0	7.5	7.5	7.5	6.5	8.0	8.5	9.5	10.0	9.5	9.5	8.5
North Platte	[illegible] Wyo., and Neb.	[illegible]	7.0	[illegible]	[illegible]	6.6	6.8	6.4	7.0	9.0	11.5	11.6	11.0	9.6
Carmel Drainage District	San Luis Valley, Col.	5,700	4.0	4.0	[illegible]	6.0	9.0	14.0	16.0	12.0	9.0	9.0	7.0	5.0
Rio Grande Drainage District	San Luis Valley	[illegible]	3.0	3.0	5.0	6.0	10.0	16.0	12.0	11.0	9.0	10.0	9.0	6.0

sec.-ft. The return flow in the Uncompahgre River from Bachelor to the mouth at Delta, 53 miles, in 1900 was 89 sec.-ft. and 21 years later had increased to 250 sec.-ft.

Return flow waters from irrigation along the Salt and Gila Rivers were well in evidence 15 to 20 years ago. Soil texture, slopes and narrow irrigated areas along the rivers combine to produce immediate and pronounced seepage water. In the Salt River Valley 30 per cent of return flow has been observed, and along the Upper Gila River 65 per cent. In 1900 260 sec.-ft. or about 190,000 acre-ft. annually were reported between Tempe and Gila Bend.

TABLE V. WATER RECOVERY FACTORS IN TWO DRAINAGE DISTRICTS IN THE RIO GRANDE VALLEY

Item	Carmel District	Rio Grande District
Area, acres	5,040	30,000
Area tributary to drains	5,700	......
Location	13 mi. southeast Monte Vista	9 mi. northeast Monte Vista
Completed	1914	1920
Cost	$50,000	$200,000
Drain types	15 mi. outlet ditch, 8½ mi. rect. wood conduits, 7 ft. below surface. ¼ mile apart; 10½ mi. tile.	13.1 mi. outlet ditch; 2.1 mi. covered outlet; 39.4 mi. rect. wood-conduit, laterals 1 mi. apart, 5 to 7 ft. below surface.
Character of soil	Top 24 in. sandy loam; subsoil, gravel	Top 15 to 30 in. sandy loam; subsoil coarse sand and gravel.
Elevation	7,600 ft.	7,600 ft.
Annual rainfall	8 in.	8 in.
Irrigation season	150 days	150 days
Irrigation methods	Surface in furrows	*Surface and sub-irrigation

* An alternate system of irrigation and drainage is practiced. Concrete checks with gates are located in the drainage laterals. The water table is controlled to give the effect of sub-irrigation.

Drainage Recovery—Drainage has become an important problem to most irrigation projects. In 1920 the U. S. Reclamation Service expended $996,000 on drainage in connection with its various 21 projects (see *Reclamation Record*, March, 1921, page 101).

The San Luis Valley lies on the headwaters of the Rio Grande in Southern Colorado. The Valley is an old lake bed and is consequently very flat, and has poor natural drainage. Large areas have become waterlogged and alkalied, both irrigated and unirrigated. Approximately 500,000 acres of raw and irrigated land need drainage relief in some form. Drainage districts have been organized and constructed. The following data will be of value. For the Carmel Districts there is a return of 1.2 acre-ft. per acre drained (6-year record). The duty is roughly 2 acre-ft. per acre. In the Rio Grande District just completed the return is close to 1 acre-ft. per acre drained. It should be noted that sub-soil conditions are favorable to drainage and in ordinary years is used freely.

Summary—The following paragraphs summarize the conclusions of this study:

1. Ordinarily 50 per cent of the water diverted for irrigation purposes becomes a source of return flow.

2. Annual return flows of from 35 to 65 per cent of the river flow diverted have been measured for large compact irrigated areas.

3. In the South Platte and tributary valleys in Colorado, where 1,100,000 acres are irrigated, return flow amounts to 1,000,000 acre-ft. annually.

4. In the Cache la Poudre Valley where irrigation is intensive and 250,000 acres are irrigated, the annual return flow is 130,000 acre-ft. or about 0.50 acre-ft. per acre.

5. In the North Platte Valley, Nebraska, where water is plentiful, the annual returns from 250,000 acres are 1.6 acre-ft. per acre.

6. Annual drainage returns on the two Colorado projects of 5,000 and 30,000 acres, respectively, fall close to 1 acre-ft. per acre.

7. Monthly returns throughout the year are not constant. The summer and fall months are the months of maximum return and the minimum returns occur in the winter and spring months.

8. From 50 to 60 per cent of return flow under natural or artificial drainage occurs during the irrigation season and is available for re-use.

9. Return-flow waters from irrigation in the older irrigated valleys are a large factor in water supply and have a large economic value.

Bibliography of Return Waters

Seepage or Return Water from Irrigation, by L. G. Carpenter, Bulletin 33, 1896, State Agricultural College, Fort Collins, Col.

Seepage and Return Waters, by L. G. Carpenter, Bulletin 180, 1916, parts 1, 2 and 3, Agricultural Experiment Station, Colorado Agricultural College, Fort Collins, Col.

Irrigation in Colorado, by C. W. Beach, Porter J. Preston, Bulletin 218, U. S. Department of Agriculture, Office of Experiment Stations, Washington, D. C.

Irrigation in Arizona, by R. H. Forbes, Bulletin 235, U. S. Department of Agriculture, Office of Experiment Stations, Washington, D. C.

State Engineer of Colorado, Biennial Reports, Tenth, Eleventh, Thirteenth, Fourteenth and Seventeenth.

Conveyance Losses of Water on U. S. Reclamation Service, Irrigation Projects, by E. A. Moritz, *Reclamation Record*, Vol. 12, No. 4, April, 1921, pp. 180-182

Wayne County Plants 2,200 Trees

The Wayne County, Mich., Road Commission last week observed Arbor Day by planting 800 American elm, 950 Norway maple, 125 Oriental plane, 125 red oak, 100 pin oak, 50 paper birch, and 50 mountain ash trees—a total of 2,200. Ever since the adoption of the county road system in Wayne County, the Road Commission, according to Edward N. Hines, its chairman, has repeatedly urged that the treeless condition of the highways should be remedied. Until the special session of the legislature last year, at which time a law was passed making it possible to plant trees, nothing had been done.

In making this planting the matter of the future development of pavement width, of safety, as well as that of beauty, have all been taken into consideration. The trees are placed in rows 32 ft. from the center line of the pavement except in a few cases where they were planted to conform to trees already growing. This method of planting allows for a future widening of the pavement to 40 ft. and permits an additional 11 ft. for sidewalks and parking strip between pavement and trees. It gives a clear and safe view to auto drivers.

A survey of the entire county is being made, to provide a definite, systematic, continuing plan towards which to work as funds become available for roadside tree-planting and decoration and in time, Wayne County's 350 miles of concrete roads will not only be useful, but ornamental transportation mediums.

Some New Tests on Proportioning Mortar and Concrete

AT THE annual meeting of the American Society for Testing Materials at Atlantic City, June 27-30, two papers were presented giving experimental data on some recent investigations into the proportioning of mortars and concrete. The first, entitled "Relation Between Voids and Plasticity of Cement Mortars at Different Relative Water Content" was by Frank E. Richart and Edward E. Bauer, of the University of Illinois; the second, entitled "The Use of Excess Sand and Pit-Run Gravel in Concrete Pavements" by R. W. Crum of the Iowa State Highway Commission.

The paper by Prof. Richart and Mr. Bauer was in continuance of the study presented by Prof. A. N. Talbot, of the University of Illinois, at the meeting last year of the society (*Engineering News-Record*, July 28, 1921, p. 147); that is, the mortar-voids test is used in studying the plasticity of cement mortar. That paper gave quantitative information on the properties of various mortars, emphasized the relation between cement content, voids and strength, and described a laboratory method of determining the voids in any mortar mixture made with a given sand. The current paper studies mortars and concrete in the light of the mortar-voids theory and from the viewpoint of the laboratory. It establishes some principles regarding basic water content, relations between water content and consistency, and between strength and minimum voids.

The fundamental principles may be laid down as follows: (1) When a mixture of dry sand and cement is gaged with increasing amount of water there occurs a certain swelling or bulking of the mass such as is produced in sand alone when damped. (2) This is followed by a gradual decrease in the volume as the mixture develops cohesive properties until a point of minimum volume is reached where the mortar begins to become plastic. (3) With more water an increase in the volume is caused by the mechanical separation of the particles or dilution of the mixture by additional water. A certain definite amount of water is required to produce minimum voids and it appears that this amount of water may be used as a standard in determining the proper amount of mixing water for mortar used in test specimens. In any mortar or neat cement mixture the point of minimum voids is well defined, and it has been possible to duplicate its determination satisfactorily in repeated tests. Furthermore, the water producing minimum voids (termed in the paper the basic water content) appears to coincide quite closely with the water required by the standard Vicat test for plasticity.

Further tests showed that the water required for maximum strength and for minimum voids is in general about the same, while in some cases the maximum strength was obtained with 105 to 110 per cent of the basic water content.

A possible use of the test is in establishing uniform plasticity for mortars under test. Standards today do not give a very good basis to measure this plasticity and workability, but the authors state that from their tests it seems possible that the basic water content or some proportion thereof might be used as a standard water content for comparative tests of the strength of mortar. For a single mortar mixture the basic water content may be determined in a few minutes and values may be obtained for all probable mortar mixes using a given sand.

As a deduction from the tests the authors conclude that it would be better to test mortar in a richer mix than the customary 1:3 proportion, say 1:2 for comparative test of sand, that being 1:2 by volume, though they suggest that possibly 1:2 by weight would be just as good. The tests also showed that the flow and slump tests appear to be fairly consistent with basic water content control.

Using Pit-Run Aggregate—Prof. Crum's paper is an extension of a paper on a similar subject presented at the 1919 annual meeting of the society, in which he proposed a method of proportioning concrete using pit-run aggregate with a high proportion of fine sand which is about all that can be economically procured in Iowa. Other qualities being equal, the principal objection to the use of pit-run gravel has been the fancied lack of uniformity in the resulting concrete. While Prof. Crum's experiments show that there is a great opportunity for improvement in the uniformity of concrete mixes, he notes that the mixtures of screened aggregates are no better in this respect than pit-run gravel mixtures and often not so good when the pit-run gravel is handled in the most advantageous manner. Acting on these and earlier tests, the Iowa State Highway Commission has based its standard specifications for single-course concrete pavement upon the assumption that it is possible to so design and construct concrete pavements of varying cement, sand, and coarse aggregate content (such as might occur in the natural deposit) that the result would be in as close agreement as may be expected from the arbitrary mixtures in common use. Furthermore, the more heavily sanded mixtures have at least two important advantages: (1) It is quite generally accepted that if the voids in the coarse aggregate are more than filled by the cement and sand mortar the internal grading of the coarse aggregate will have little effect upon the strength of the concrete. That being the case with the mixtures under discussion makes it possible to use certain aggregates which might not be suitable for use in the more common mixtures. (2) In proportioning mixtures of high sand—coarse aggregate ratio the amount of cement should be based upon the maximum amount of sand to be expected; then when the amount of sand at times becomes less, the high ratio of cement to sand will more than compensate for the variation. For instance, if the proportion be based upon 70 per cent of sand and the percentage of sand falls to 60, the mix would have more cement than the 60 per cent sand required and the variation would not be at the expense of the strength of the concrete. Mixes, such as the usual 1:2:4, which are intended to just fill the voids of the coarse aggregate do not provide any such factor of safety, and most of the variation is, therefore, more serious.

The department has established a table from which, given the percentage of sand in the pit-run aggregate by weight, the proportion by weight of cement to gravel and the approximate quantity of cement barrels per cubic yard is given both for pit-run gravel and screened gravel. Thus, for a sand in the aggregate running 34 to 40 per cent by weight with pit-run gravel the proportion by weight of cement to gravel would be 1:4.84 and with screened gravel, 1:1.93:2.91, and the approximate quantity of cement, 1.67 bbl. per cubic yard. The tests given by Prof. Crum in his latest paper show a fair uniformity of strength of field mixed concrete under this method of proportioning.

Concrete-Unit Roundhouses on the Pennsylvania R. R.

Large Buildings Framed of Precast Members—Walls of Brick and Steel Sash—Casting Yard and Unit Erection Methods

IN EXTENDING the large concrete roundhouse at the Pitcairn yard near Pittsburgh, Pa., the Pennsylvania R.R. has adopted a type of construction with precast structural units which was devised by the company's engineers in 1918 to facilitate the carrying out of a large program for the enlargement and improvement of engine terminals where the roundhouses were too small for modern locomotives. This unit construction has now been used for roundhouses at five or six

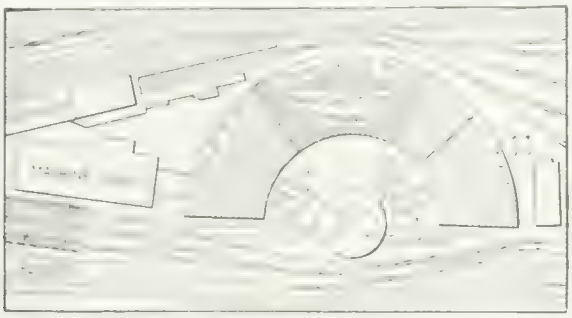


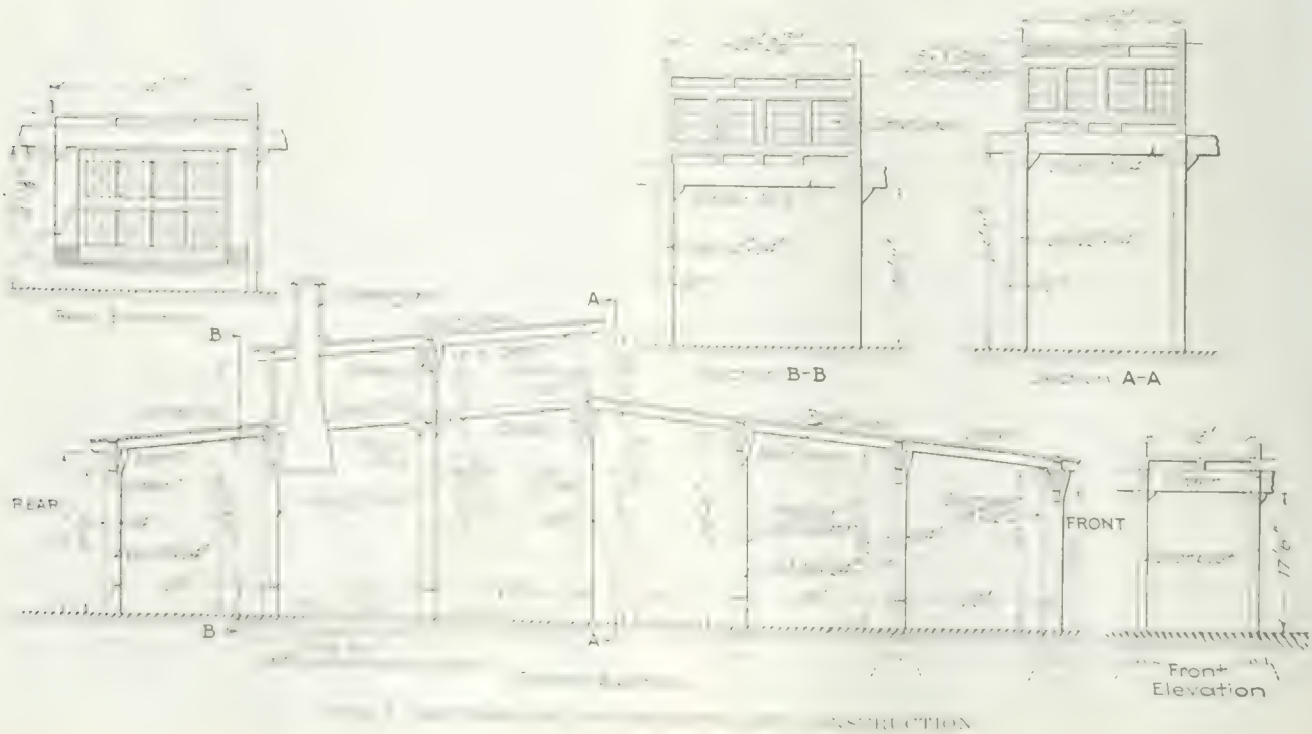
FIG. 1—CONCRETE ROUNDHOUSE AT PITCAIRN YARD

places on the eastern lines but the Pitcairn building is of particular interest since it includes both poured and precast concrete construction. It is notable also on account of its size, the segmental building covering an angle of 180 deg. and having 34 radial tracks or stalls diverging at an angle of 5 deg. 17 min. 38 sec. The building has an outside radius of 260 ft. 9 in. and a space of 85 ft. 9 in. between the inner wall and the 110-ft. turntable. The layout plan is shown in Fig. 1.

Plans for the Pitcairn roundhouse were adopted in 1918 and an 8-stall section of precast unit construction was then erected to form one end of the building. In 1918 a 10-stall section of poured concrete was built to form the opposite end, and in 1919 a 4-stall section of poured concrete was built adjacent to the first precast unit construction. The middle 12-stall section which will complete the structure is now to be built on the precast unit system. Poured concrete was used for the two intermediate sections for the reason that a supply of precast units was not available and it was desired to carry out the work as rapidly as possible owing to the large number of engines being handled at this point. The approximate cost per stall was $10,000 for the precast unit construction and $14,000 for the poured construction, but it must be remembered that the work was done during a period of maximum cost.

Concrete Framing—In cross-section the 120-ft. width of the building is divided into six 20-ft. bays by curved rows of columns, the longitudinal spacing of these columns being 13 ft. c. to c. in the inner wall and 28 ft. 8½ in. in the outer wall. Lines of ring girders are seated on brackets on the columns and have lugs on the ends to fit in recesses in the seats and thus lock the parts together. Lines of radial beams or roof joists laid across the girders are held in position by end lugs which are seated in the grooved top surfaces of the girders. On this concrete framing, which is made rigid by grouting the joints, is laid a 3½-in. roof slab of concrete poured in place or precast gypsum slabs. This roof slab is anchored by bolts or studs projecting from the roof joists and is covered with tar and slag roofing. The original design provided for unit slabs cast integrally with the joists, but these large slabs were unwieldy and their use was not continued.

From the cross-section, Fig. 2, it will be seen that the roof has a slope of about 1¼ in. per foot from the middle to each side and has a monitor roof over two bays. The columns under the sides of the monitor



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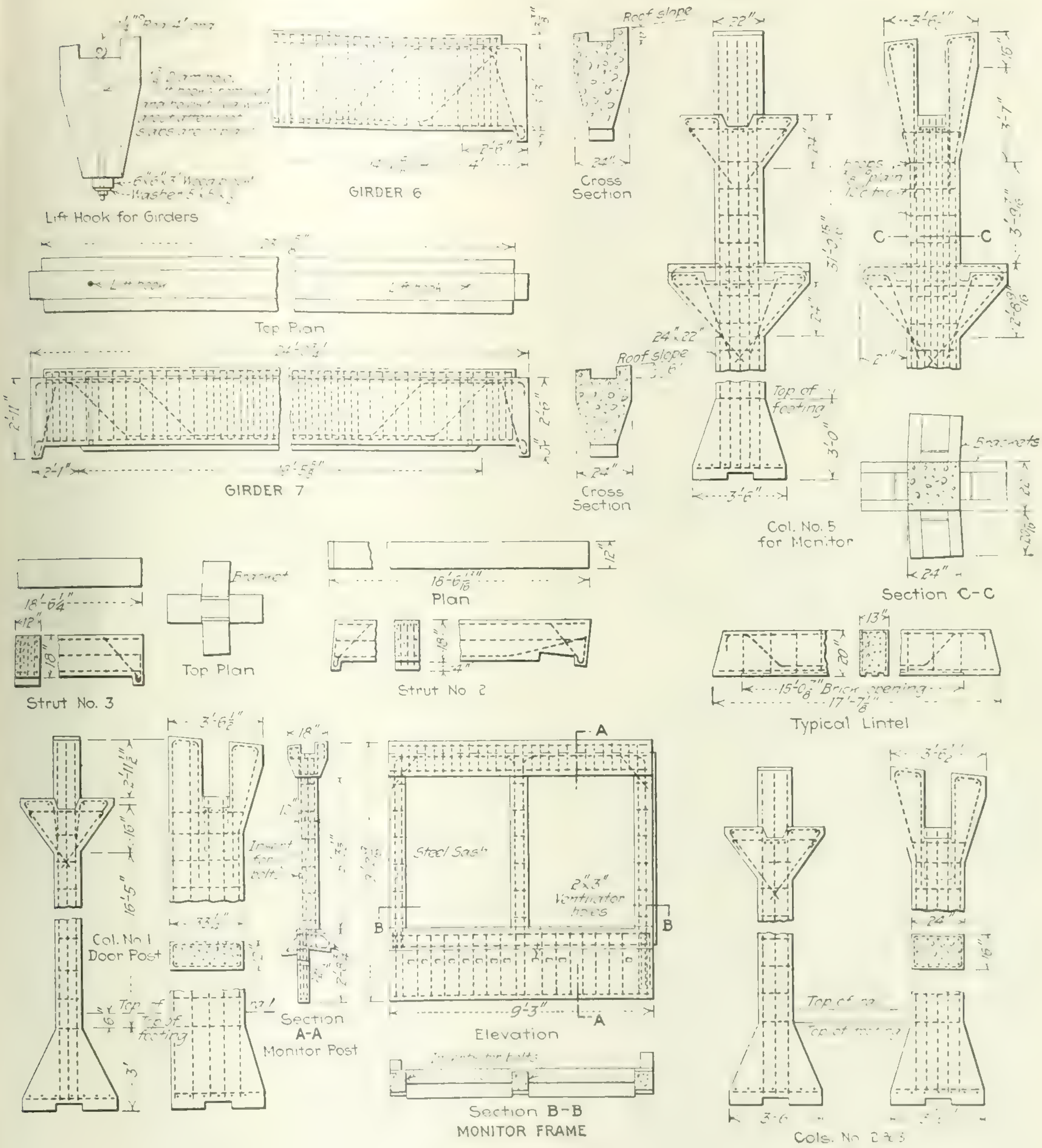


FIG. 3. PRECAST UNITS FOR ROUNDHOUSES; PENNSYLVANIA R.R.

carry short posts which in turn carry lintels supporting the monitor roof joists. But the middle column in each row is made of extra height in order to support the monitor roof girders directly, thus increasing the rigidity of the framing. The building is of ordinary height, being about 17½ ft. in the clear at the walls and 22½ ft. at the middle, increased to 35½ ft. at the high point of the monitor. Cast-iron smokejacks of rectangular section pass through holes 4½ ft. square in the roof slab and are attached to hangers embedded in the joists. Their upper ends connect with flues 40 in. in diameter.

Six of the columns have a uniform width of 24 in. but their thickness varies from 12 to 16 and 22 in. The inner columns or door posts, however, are 12 in. thick with a width of 33½ in. in order to give the necessary stability for carrying the swinging doors. Steel reinforcement consists of vertical rods with hoops spaced 12 in. apart, but in some cases an octagonal spiral of 6 in. pitch is used instead of the hoops. All columns are enlarged at the base to a 42-in. square bearing on the footings which are 3½ ft. below the floor level. These footings are in a firm gravel formation.

In the center of the column base is a 12 x 12-in.

recess 3 in. deep to engage a similar key or projection on the footing. Details of the columns, girders and beams are shown in Fig. 3.

Floor and Wall Construction—The front or concave side of the roundhouse consists simply of the concrete columns and double-swinging doors of wood construction for the track entrances, these openings extending as high as the lintels. For the outer wall red brick is used, with a large glazed area of wire glass in steel sash. Similar sash and glazing form the sides of the monitor, the sash frames being anchored into recesses in the lintels and posts. The lower part of the monitor, however, is closed by concrete panels having ventilating holes 2 x 3 in. Movable sash for ventilation is provided in the main windows and the monitors.

Creosoted block paving between the engine pits is laid on a 1-in. sand cushion with 4-in. concrete base covering the cinder fill. These pits are 104 ft. long and 4 ft. wide, with 33-in. concrete walls. Upon each wall is a continuous floor of 8 x 8-in. transverse timbers 16 in. long, which project 3 in. over the pit in order to protect the heating pipes laid along the walls. These timbers serve as seats for jacking the engines and to them the 130-lb. track rails are secured by ordinary drive or cut spikes. Two drop pits are provided, each connecting a pair of engine pits and having on the pit floor a track with hydraulic jack for handling wheels. Every column in the fifth row is fitted with a 4-ton swinging jib crane for handling cylinder castings and other heavy parts.

Manufacture of Units—A concrete mix of 1:2:4 is used for the precast units, using ¾-in. gravel for the coarse aggregate. Hydrated lime is added in the pro portion of 7½ per cent (by volume) of the cement. These units as well as bridge slabs and other precast members are manufactured by the railway company in a yard at Morrisville, N. J. Three casting platforms 60 x 450 ft. are arranged between four pairs of tracks, with the cement shed, mixing house and hoisting tower beyond the tracks. Two 1-yd. mixers are arranged in a house at an elevation of 30 ft. and supply a 1-yd. bucket in a 100-ft. tower from which a cable-supported chute extends across the platforms. Drop spouts from this main chute supply lateral chutes extending over the platforms and delivering the concrete either directly into the forms or into wheeled carts for distribution to the forms.

To protect the fresh concrete from the weather and also to enable the work to be carried on during the winter, each platform has a traveling roof or shed 100 ft. long. The sheds are provided with heaters. Wood forms are used and are well oiled before each pouring. Concrete is left in the forms for 72 hours and the units are stacked in the yard for at least 30 days before being shipped for erection. In the yard the units are handled by derrick cars and locomotive cranes.

Erection—In erection, the units are handled and placed by locomotive cranes. The heaviest members are the tall columns of the middle row, which weigh about 12 tons each. Other columns weigh about 8 tons, girders 6 to 11 tons, and joists about one ton each. Owing to the broad base the columns are stable when placed on the footings, so that no temporary guy lines are required. Grout is poured over the footing before the column is placed and the joints between columns, girders and beams are grouted when the framing is completed. Concrete for the roof slab will be elevated in a tower and spouted to the form.

This unit system of construction was determined on by A. C. Shand, chief engineer of the Pennsylvania Railroad System. The details were worked out under his direction by H. R. Leonard, engineer of bridges and buildings, and Robert Farnham, assistant engineer of bridges and buildings. Construction of the Pitcairn roundhouse will be done by company forces.

Studying the Physical Property of Road Subgrade Materials

AT THE annual meeting of the American Society for Testing Materials at Atlantic City, June 26-30, J. R. Boyd, of the United States Bureau of Public Roads, read a paper entitled "Physical Properties of Subgrade Materials," which gave in great detail the procedure now being carried out in the Bureau of Public Roads in the testing of subgrade materials. This is an elaborate soil analysis, consisting in an investigation of the finer particles of a subgrade soil, by mechanical analysis, by investigation of the water-holding capacity, so-called moisture equivalent, vertical capillarity, volumetric change, comparative bearing value, and slaking value. As a result of the first year's investigations Mr. Boyd states that there seem to be at least three important factors upon which the physical properties of subgrade soils are dependent; namely, the gradation, which is expressed by the mechanical ratio; the moisture content, which is expresed by the moisture index, and the character of the soil, which is expressed by the adsorption ratio number. These factors influence the physical properties of subgrade soils in the following manner: When the clay content of a soil is increased, its ability to take up and retain moisture is increased and its percentage volume change is increased. The character of a soil influences its percentage volume change as is evidenced by the fact that for increasing adsorption numbers, the percentage volume change increases. When the moisture index of the soil is less than unity, the bearing value will be high; when the moisture index of the soil is above unity, high bearing values can be obtained provided the adsorption of the soil is high.

In the discussion A. T. Goldbeck, also of the Bureau of Public Roads, stated that the tests had been confirmed partly in some field tests, especially in one where adobe subgrade soil had been treated with cement which hardened when wet and increased bearing value of the road remarkably. In the test the dry soil was well broken up and harrowed to a depth varying from 6 to 12 in. and mixed with cement in the proportions of 1 part cement to 10 parts soil, and 1 part cement to 20 parts soil. It was intended to water and roll the surface but rain prevented. One section was allowed to remain untreated for purposes of comparison. A recent inspection showed that the untreated section was badly broken up due to the usual shrinkage cracks characteristic of adobe soils. The treated sections were in good condition and showed no shrinkage cracks. The treatment is not intended to make a hard surface but to alter the properties of soil so that it will be stable and lessen the effects of moisture.

It was also stated by E. O. Fippin (Lime Association) that lime sprinkled over soil had somewhat the same general effect.

New Data on Fire Safety From the Burlington Building Fire

In the remarkable fire which destroyed the sixteen-story office building of the Chicago, Burlington & Quincy R.R. in Chicago on March 15, a great many new facts were brought out concerning fire hazards. Many established facts were confirmed or were modified. Most prominently, perhaps, the serious exposure danger to which modern fireproof office buildings are subjected because of absence of window protection was for the first time brought clearly into view. The danger lying in open floor areas was also made apparent, as was the contributory influence of the heat generated by the burning of ordinary office contents. A summary of the facts and teachings of the fire based on a thorough expert study has been prepared by A. R. Small, vice-president of the Underwriters' Laboratories, who presented it recently before the National Federation of Construction Industries. That part of his summary which is of most direct interest to the structural and fire-prevention engineer is reproduced substantially in full herewith.—Editor.

THE "Q" Building, erected in 1913, was used for the general offices of the Chicago, Burlington & Quincy R.R., its owners. The occupancy throughout the burned floors was a typical office occupancy. The contents were wooden desks and chairs, sheet-metal filing cases, and shelving and paper records of various sorts in and on desks and in the filing cases and elsewhere. Practically no special hazards were present and there was no unusual storage of combustible contents.

Main Structural Elements—The building is of U shape with the closed end to the north, on Jackson Blvd., with a height of 195 ft. and an area per floor of nearly 23,000 sq.ft. It was of steel skeleton or cage construction, with inclosure walls having windows occupying a large proportion of each bay space.

The Clinton St. and Jackson Blvd. fronts were finished with glazed white terra-cotta of somewhat elaborate design; the west and south walls and the walls of the court (which opened to the south) were finished with light glazed terra-cotta brick. Window frames on the two streets, in groups of three, were of wood with wood sash and plain glass, except that on Clinton St. at an outside iron fire escape of the balcony-and-stair type one bay of each floor had hollow metal frames and sash, the center ones with oversized lights of wired glass. The numerous window openings at all floors in the west and south walls were each equipped with a hollow-metal window frame and sash with wired glass. The court window frames were mostly of wood with wood sash and plain glass. The floor arches were of hollow tile, side construction, 3-cell, 15 in.; in the 10th, 13th and 15th floors there were superimposed on them 20 in. hollow tile (3 in. thick, on edge) laid on 4½ in. cinder concrete, to accommodate reinforced concrete ventilating ducts.

Horizontal members of the steel frame were protected with hollow tile according to general practice. The columns were protected with 3 to 4 in. of concrete, and in some cases with 3 in. tile in addition. Corridor and room partitions were of 3 in. hollow tile, with trim, transoms, doors, frames and bucks of wood. All interior wall and ceiling surfaces had plaster finish without furring except in the president's offices. Considerable marble trim was employed in main corridors and elsewhere on each of various floors.

The main passenger elevators, in two opposite banks, had cast-iron grill doors and fixed panels with wired-glass lights of small area (about 10 x 18 in.). Adjoining to the west was the principal stair shaft, with hollow metal doors in pairs at each floor, each door with upper panel of wired glass in two lights and a hollow metal transom with four lights of wired glass. The door frames and bucks at these openings were of steel. The same equipment was provided for the other stairshaft in south-east corner.

Vaults for storage of records were located on each floor adjoining the east bank of elevators. They had double walls on three sides of 4 in. hollow tile with a 6 in. center space filled with broken tile concrete. They had the usual vault door equipment consisting of an outer single swinging door of steel plate with heavy lock bolts and inner steel plate doors in pairs, recessed in an iron frame 20 inches deep.

Vaults Intact—The vaults on each floor when opened were found to have preserved their contents, there being practically no damage in any of them from either fire, smoke or water. Similarly the 3-in. tile enclosures of the ventilating and air washing machinery prevented entrance of fire or excessive heat. Elsewhere, everything combustible was consumed on floors 10 to 15 inclusive. Tile partitions mostly fell, and if not down were insecure; the plaster finish largely fell; the wood flooring and nailing strips burned out from the 9th to the 15th floor.

Stair Shafts Secure—The hollow-metal doors prevented entrance of the fire into either stair shaft. Some blistering of paint within the shaft from radiation took place but the stairs were capable of accommodating people either for exit or refuge or for fire fighting during the entire period of the fire. Had the transoms been omitted and also the wire glass in the upper panels of the doors, there would be no material evidence in either stairway that a fire had occurred.

The cast-iron frames to the openings at the elevator landings warped badly but the wired glass because of the small dimensions employed quite generally remained in place. The elevator equipment was not seriously damaged and was in use within 24 hours. The absence of furniture and other combustibles in the immediate vicinity of these elevator doors no doubt had a substantial bearing on this result.

Wired glass in the hollow-metal frames and sash in the west wall [opposite to the side from which the fire came—Editor] collapsed very generally, due to the fire temperatures reached on the various floors. The frames and sash do not show material distortion. Many of the lights of wired glass in hollow-metal frames and sash in the south wall (not in the court) were still capable of resisting passage of flame following the fire.

The terra cotta tile on the north and east exterior walls (Clinton and Jackson) was badly damaged. Appearance and public safety required its removal from the 8th floor level to the cornice. Of interest is the spalling of projecting ogees, and other ornamental details. These parts in falling added to the glass shower which hampered the work of the department on the sidewalks below in the early stages of the fire.

Columns, Beams and Floors—The concrete served fully to protect the steel columns in every case. Paint on the steel was not softened. Only surface dehydration of this concrete occurred and this was not universal.

Generally speaking the soffit tile similarly protected the steel floor beams and girders, although they were observed to have fallen from a single beam in the 12th floor at the south end of the west wing and from another in the 14th floor at the center of the east wing. There are a few spots on various floors where the soffits of the floor-arch tile have fallen. The plaster fell so generally on the 10th and 14th floors that cracks in soffit corners in arch tile may be common. The cinder concrete fill was dehydrated only very slightly; its insulating value was hardly impaired.

The T-bar mullions in the street front and other triple window openings warped, generally outward near the upper end. There was no provision for their expansion. The terra cotta and tile casings for these mullions failed and fell in many cases. The steel lintel plates in these openings show but little evidence of warping.

The service equipment, such as steam piping, electric conduit and water piping is not materially damaged. There was heat in steam radiators on all floors a day or two after the fire.

The roof covering, which is of flat tile embedded in pitch or asphalt, is not damaged. The projecting cornice deflected the heat wave so that the roof was not exposed.

The east wing was 16 stories high without windows or other openings in the 16th floor. There was no fire damage on this floor.

Lessons of the Fire—If the "Q" Building had been of seven stories or less it would have suffered little damage comparatively from the exposure to which it was subjected. This single-building loss duplicates on a smaller scale the circumstances of the Baltimore and San Francisco conflagrations, the particular lesson of which was the horizontal spread of heat waves at high levels.

Fire exposure *in the case of high buildings* exists at distances much in excess of the 50-ft. maximum now recognized by many organizations, or the 30-ft. limit of most building codes. Street widths or other clearance must exceed building heights by perhaps 100% for a severe fire exposure hazard to disappear even when only moderate winds are considered. Unprotected window openings invite similar burnouts in so-called "fireproof" buildings wherever severe fire exposure exists.

Wired glass in areas not exceeding 720 sq.in. and mounted in metal frames would probably have prevented entrance of the heat wave into the upper floors. In any event it would have delayed its entrance for a considerable time. If, in addition, window sprinklers had been provided and used, wired glass in standard metal frames perhaps even with lights greater than 720 sq.in. would have prevented entrance of the heat wave into the building and probably would also have materially lessened the damage to the terra-cotta exterior finish.

The stairway enclosures functioned nearly 100% and fire did not communicate from floor to floor within the building.

Wired glass in doors, transoms or elsewhere in stairways and other enclosures to vertical openings should be avoided; when used, it should be in small lights, not exceeding 10 x 15 in., and these should be as few as possible.

A horizontal cut-off equivalent to a 1½-hr. fire division wall would have confined this fire to the east wing.

It is clearly wasteful to erect partitions of fire-resisting materials and then to equip them with combustible trim at doors and transoms. The only possible advantage is the reduction of the quantity of fuel, which advantage was of no account in the "Q" Building fire.

Wired glass cannot long withstand temperatures reaching 1,200 deg. F. on both sides or 1,700 deg. F. on one side. At these temperatures it softens so that its weight pulls it from the sash grooves.

The average fire temperatures in the "Q" Building did not exceed 1,800 deg. F., if indeed they reached this point. The ruins suggest a fire of a severity not greatly exceeding the conditions obtained in a 1½ hour test.

Single-cell hollow-tile partitions will not remain in place when subjected to the expansion stresses set up by a fire exposure such as prevailed here and subjected to the forces of sudden cooling and impact from hose streams.

The 3 to 4-in. concrete on the steel columns provided ample fire protection for the exposure which was obtained.

Terra-cotta exterior finish, as employed quite generally in Chicago, is subject to spalling and other material damage from the heat of exposing fires of any intensity or duration. Most other materials of value from a decorative point of view are subject to similar damage, at least to some degree.

Wood furniture and trim and similar combustible material of a "fireproof" building not only are subject to total loss but add fuel to the fire.

The single-wall steel filing cases failed completely to protect their contents.

Automatic sprinklers probably would not have controlled the fire, but very likely would have done so if all the window openings had been protected with standard fire window frames with wired glass.

The rolling steel shutters in the court windows at the 10th and 15th floors at the ventilating machinery rooms prevented passage of flames. The heat radiated from these shutters blistered the paint on both sides of steel partitions at least 18 in. behind the shutters.

The vaults preserved their contents. They were subjected to a moderate fire exposure. The paint on the inner doors blistered. With a mercantile or industrial occupancy including stocks of combustible goods and a complete burnout such as occurred in this building, such vaults would be likely to fail from radiation through the iron doors.

Types and Costs of Concrete Dams Compared by Models

IN MAKING final studies of the comparative costs and advantages of several types of dams to be built in California on the Merced River for the Merced Irrigation District, models of three types under consideration are being used. In addition to facilitating explanation and discussion before the district's board of directors, each model is used as a check on the estimated yardage in the proposed dam by measuring the displacement in water. Another advantage of the plan is said to be in making the layout of the construction plant. R. C. Starr, under whose direction the work is being done, states, "it is much easier to make a construction plant layout, determine chute slopes, trestle locations, etc., from models than from blueprints."

The first step in making the models was the construction of a relief map of the damsite, each contour being built up in wood on a scale of 20 ft. to the inch, or 1 to 240 both horizontal and vertical. After waxing the side slopes to prevent concrete from sticking to them, up-and downstream forms were placed and concrete was poured in a miniature dam. This process was repeated for the three types under consideration—gravity arch, pure arch and constant-angle arch dams. As the three structures were made from the same materials, the weights as shown by water displacement were used to check the estimated comparative yardages.

MODEL OF MERCED IRRIGATION DISTRICT ARCH DAM

Concrete towers, chutes and cableways were actually built around the dam on the same scale to show the relative positions and appearance of the construction plant completely assembled.

Mr. Starr credits the idea of using models in this way to R. L. Bryant, resident engineer, and J. D. McDougald, general superintendent, on the Merced project.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Professor Swain's New Book

Sir—On reading your review of Prof. Swain's "The Young Man and Civil Engineering," I decided to get a copy of the book. After reading it from cover to cover I decided to buy several copies and send them around to places where I thought they would do good. In my opinion Prof. Swain has treated his subject in a manner that will have a far reaching good influence on the young men contemplating civil engineering as a profession and the young men who are actually in school.

If I could afford it I would send a copy of the book to every student in every engineering college in the United States because of my belief that Prof Swain's criticisms are just and practical and point the way to better work than we have been getting from our engineering schools for a long while.

I have had, as you know, about thirty years of experience with college graduates and their usefulness when they come out of school shows to me conclusively there is something very wrong in the way our colleges have been handling this all-important question of fitting young men for engineering work.

New York City. HUGH L. COOPER.

Mechanical Testing in Great Britain

MECHANICAL TESTING: A Treatise in Two Volumes. Vol. I, Testing of Materials of Construction—By R. G. Batson, M. Inst., C. E., M. I. Mech. E., Associate of King's College, London, Senior Assistant in the Engineering Department of the National Physical Laboratory, Teddington; and J. H. Hyde, A. M. Inst. C. E., M. I. A. E., A. M. I. Mech. E., Senior Assistant in the Engineering Department of the National Physical Laboratory, Teddington. [The Directory-Useful (D. U.) Technical Series.] New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 413; illustrated. $9.

In materials testing there are usually many ways of carrying out a given test, but the results obtained by the different procedures will not always be comparable, and some methods are found to correlate better than others with practical experience concerning the resistance of material. Largely from these conditions there has arisen a picturesque variety in forms of test and devices for testing, a variety still further complicated by the fact that standardization has attempted to produce certain fixed points in the field. It is obviously necessary that every man engaged in testing should be familiar in detail with the many kinds of tests and testing machines. The author of this work has therefore performed a useful service in presenting a condensed catalogue of the subject. It will usefully supplement other works of the same kind, for no single work is quite complete or covers each detail with equal thoroughness. The continuous progress made in interpretation of tests, moreover, causes the subject to change as the years go by; in fact, it appears that some passages in the present work are already superseded by later information, particularly in the field of repeated-stress testing.

It is necessary for the reader to know as a characteristic of the work only the fact that being a British work, it is largely foreign as to testing machines and standards, and that one or two of the most important items of the field are treated in a very brief and offhand way. The tension testing machine might be expected to have much space and a great amount of detailed analysis devoted to it, since it is by far the most widely used piece of testing equipment, but it is treated quite summarily. The field of lime and cement testing, which has developed remarkably in recent years, claims large importance because of the extensive use of cement and might properly be given many times the half dozen pages which the present work devotes to it. The same inadequacy is found in tests of road material (9 pages), in which, incidentally, the testing of bituminous materials is passed over entirely.

Science Popularized Without Sacrifice

THE OUTLINE OF SCIENCE: A Plain Story Simply Told—Edited by J. Arthur Thompson, Regius Professsor of Natural History in the University of Aberdeen. Vol. I of Four Volumes [the whole containing] 40 Colored Plates and 80 Illustrations in Black and White. New York and London: G. P. Putnam's Sons. Cloth; 8 x 11 in., pp. 296. $3.75 per volume.

So far as can be judged from the first of the four volumes, this is a remarkably successful attempt to present, without sacrifice of the scientific spirit, the fundamentals of science in such plain language that any person of average intelligence can readily understand them.

The first volume begins with the Romance of the Heavens, or astronomy and ends with Foundations of the Universe, or the new atomic theory, electricity, radio energy, electrons, etc. Evolution fills the intervening pages, opening with the earth and life upon it, continuing with adaptation to environment, the struggle for existence, the ascent of man and "evolution still going," and ending in the dawn of mind. The illustrations are well chosen and effectively presented. To assist the reader to act upon the stimulus of the work to go further, brief reference lists to other and more detailed books are appended to each chapter.

"The Outline of Science" will doubtless attain as much popularity as Wells' "Outline of History," but it falls in an altogether different category as regards likelihood of adverse criticisms from specialists. This is partly due to the nature of the two subjects and partly to the methods of approach in the two works.

Federal, State and Local Taxation

ESSAYS IN TAXATION—By Edwin R. A. Seligman, McVickar Professor of Political Economy, Columbia University. Cloth; 6 x 9 in., pp. 782. New York: The MacMillan Co. $4.

The present revision and enlargement of this standard work on taxation includes three new chapters on (1) The War Revenue Acts, (2) Loans Versus Taxes in War Finance, and (3) The Cost of the War and How It Was Met. Besides this hundred pages of new matter, considerable additions have been made at a few points and slight ones in many places. The book is in part a treatise and in part a collection of essays or occasional addresses, each well rounded and up to date when presented. The essays overlap each other and the treatise part of the book both in sub-matter and chron-

ologically. This compels the reader to go back and forth in order to get a consecutive up-to-date story.

Altogether, the book is a detailed exposition of the theory, and to a less extent of the practice, of federal, state and local taxation, with a historical background and an analysis of the legal and economic phases of the subject, and ample deductions from experience.

A few of the many chapter heads, in addition to those already given, follow: General Property Tax; Single Tax; Double Taxation; Taxation of Corporations (three chapters); Betterment Tax; Relation of Federal, State and Local Revenues. The literature of the subject, including the numerous reports of state and local tax commissions created to investigate taxation, are reviewed.

Economics Humanized and Modernized

PRINCIPLES OF THE NEW ECONOMICS—By Lionel D. Edie, Associate Professor of History and Politics; Director of Current Industrial Problems, Colgate University. New York: Thomas J. Crowell Co. Cloth; 6 x 9 in.; pp. [illegible]. $2.75.

The keynote of Prof. Edie's book is struck in its first sentence: "Economics is the science of human nature in its relations to the ordinary business of life." Before proceeding with abstract theories he considers human instincts and their application to modern economic conditions. In describing the machinery of modern industry and commerce Prof. Edie brings home to the average man principles that otherwise would seem to be of little practical significance.

The application of the conventional economic principles he treats under five main heads: Labor, capital, management, markets, and money and credits. The treatment of all these, however, is specific, up-to-date and practical rather than according to abstract and classical methods. Throughout the reader is made to see that however perfect in all its parts, and however nicely articulated may be our economic machinery, its motive power flows from mankind, and that results obtained from the machine will be measured by the intelligence with which that power is directed. "Economics," the author says, "is not mainly the science of things; it is the science of life. It concerns the realization of human energies, and at the basis of all economic behavior lies instinctive nature."

Prof. Edie closes his work with a discussion of public control, economic radicalism and economic democracy, treating these moot questions from the expository rather than the controversial standpoint.

The author has done so good and important a piece of work that we regret to note that in the part of the book dealing with the "Scientific Basis of Economics" there appears here and there a trace of the "pseudo-science" and inaccuracy that we have become accustomed to expect in the Sunday-supplement and popular-magazine article. To illustrate: On p. 74 the author talks of electricity as though it were a source of power instead of a means for transmitting power. In his discussion of water power on p. 75 is found similar confusion of thought. In his statement on p. 81 as to the likelihood of a "super-power zone" being developed in the Boston-Washington district within the next few years, Prof. Edie has apparently succumbed to the super-power propaganda. On p. 91 reference is made to the Federated American Engineering Societies as a central association "for the purpose of advancing the sciences of technical engineering," whereas its purpose is non-technical. We suggest to Prof. Edie that in his next edition he submit this portion of the book to the scrutiny of a technical critic, as, judging from his preface, he has done with sections dealing with the commercial and financial aspects of his subject.

American and British Local Government

THE MODERN CITY AND ITS GOVERNMENT—By William Parr Capes, Secretary New York State Conference of Mayors; Director New York State Bureau of Municipal Information. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 269; 15 organization charts. $5.

HANDBOOK OF MUNICIPAL GOVERNMENT—By Charles M. Fassett, Specialist in Municipal Government at the University of Kansas; former Mayor of Spokane. New York: Thomas Y. Crowell Co. Cloth; 5 x 8 in.; pp. 192. $1.50.

ASSETS OF THE IDEAL CITY—By Charles M. Fassett, Specialist in Municipal Government at the University of Kansas; former Mayor of Spokane. New York: Thomas Y. Crowell Co. Cloth; 5 x 8 in.; pp. 177. $1.50.

THE LOCAL GOVERNMENT OF THE UNITED KINGDOM—By John J. Clarke, M.A., F.S.S., Lecturer in Law of Housing and Town Planning in the University of Liverpool; Lecturer in Public Administration, Local Government and Citizenship for the Liverpool Education Authorities. With a Foreward by Sir Homewood Crawford. London, Toronto, New York: Sir Isaac Pitman & Sons, Ltd. Cloth; 5 x 7 in.; pp. 374. 8s.

Of these four books on municipal government, the first three deal primarily with principles, methods and results in America, while the fourth is a detailed analysis of actual practice in England, Wales, Scotland and Ireland, with historical backgrounds and summaries of Parliamentary statutes and administrative practice.

Mr. Capes concentrates on a few main subjects, such as the fundamentals of municipal government, the selection of officials, charters and their three chief types (federal, commission and commission-manager), education, and efficiency and cost of government. Mr. Fassett in his "Handbook" touches upon all these subjects and numerous sub-topics, besides many details of administration, but the book is so small and so many subjects are taken up that the presentation of each subject is brief and sketchy. Mr. Fassett's second volume, "Assets of the Ideal City," is in part a repetition and in part an extension of the first, the extension being chiefly on administrative details. The two volumes might have been combined, duplications omitted, and the treatment of some of the more important subjects expanded without making a book either unduly large or expensive.

Mr. Capes' book is suited to the advanced student and fairly well informed citizen or municipal official. One of its valuable features is its discussions and summaries of the advantages and disadvantages of the three main types of city government now prevalent, considered simply and one type against the others. Mr. Fassett's "Handbook" is more elementary and, as already indicated, more sketchy. Both authors have had experience in and much observation of municipal government, and herein and in the recentness of the books lie their chief claims for attention as compared with the many earlier books on municipal government.

Mr. Clarke's "Local Government in the United Kingdom" is a concise, readable and masterly review of parish, district, borough, county and London government in the United Kingdom, including the many relationships of the central and local governments. It includes post-war legislation and its effects.

A commendable feature of each of the four books is a carefully selected classified bibliography. All the books lay stress on the duties of citizenship and on administrative efficiency. All recognize the place of the technically trained man in municipal administration. All are singularly free from statements on engineer-

ing and allied subjects that surprise the well-informed municipal engineer and are likely to mislead the layman. Strangely enough, in view of the statement in H. S. Buttenheim's Foreword to the "Handbook" that Mr. Fassett is "a successful engineer," it is this author who makes the largest number of questionable statements regarding engineering matters—but he deals more extensively with these than do the other authors. It may be added that Mr. Fassett's exposition of the functions of a city health department seems to be one of the least adequate sections in either of his two interesting and suggestive books.

A Magnificent Record Ably Presented

A HALF-CENTURY OF PUBLIC HEALTH: Jubilee Historical Volume of the American Public Health Association. In Commemoration of the Fiftieth Anniversary Celebration of Its Foundation, New York City, Nov. 14-18, 1921—Edited by Mazyck P. Ravenel, M.D., President. New York: American Public Health Association. Stiff paper; 7 x 10 in.; pp. 461; frontispiece portrait of Stephen Smith, M.D., Founder and First President of the Association. $3.75; cloth, $5.25.

Such occasions as the semi-centennial of the American Public Health Association have often and always should have as one of their best fruits the presentation of the history, present status, and future needs of the various fields in the domain of the association concerned. The record in the present volume is magnificent and the presentation by the nearly two-score reviewers and forecasters is ably done.

Rarely can any association listen to an address by its first president fifty years after its organization. Dr. Stephen Smith, himself nearly a centenarian, is fittingly given first place in this volume. There follows a history of the American Public Health Association and sketches of its deceased presidents, and also of Dr. Smith, prepared by Dr. Ravenel, editor of the volume and president of the association last year. Various aspects of sanitation and public health are reviewed by specialists, among others Bacteriology, by Prof. F. Gorham; Water Purification, Prof. George C. Whipple; Sewage and Refuse Disposal, Dr. Rudolph Hering; Stream Pollution and Industrial Wastes, Earle B. Phelps; Milk, Dr. Charles E. North; and Ventilation by Dr. George T. Palmer; State and Municipal Control of Disease, Dr. Charles V. Chapin; Mortality Progress, by Dr. F. L. Hoffman.

The volume should be of interest and value to sanitarians and health workers generally, including many engineers engaged in municipal work in an official or consulting capacity.

Elementary Text on Landscape Gardening

TEXTBOOK OF LANDSCAPE GARDENING—Designed Especially for the Use of Non-Professional Students. By Frank A. Waugh. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 7 x 10 in.; pp. 311; illustrated. $5. (25s. net.)

The elements of landscape gardening are here presented in a manner well designed to meet the needs of students who do not intend to become professional landscape gardeners. Some 30 pages are devoted to surveying, leveling and mapping. Chapters follow on landscape gardening details, architectural details, domestic landscape gardening, civic problems, plant materials and planting, and landscape in its broader phases, extending to parks and reservations. Exercises for the student are provided. There are a few references to books and articles at the close of each chapter, and a short bibliography at the end of the book.

PUBLICATIONS RECEIVED

THE A.B.C.'s of CALCULUS—By C. C. Carpenter, C. E., Ada, Ohio: The Author. Cloth; 4 x 7 in.; pp. 78. $1.50.

Calculus as usually taught is a formidable subject which, unfortunately, is rarely retained by those who study it. This little book is an effort, and a fairly successful one, to simplify the introduction to the study of calculus so as to make its principles more plain and thus to insure their retention. It will be useful, too, in refreshing the memory of those engineers who have forgotten most of their calculus.

AMERICAN CONCRETE INSTITUTE: Proceedings, 1922—Detroit, Mich. Paper; 6 x 9 in.; pp. 449; illustrated.

ANALYSIS AND CLASSIFICATION OF PERFORMANCE IN VOCATIONAL RELATIONS—By J. Osborn Hopwood, M.S. (Yale) Of the Personnel Department of The Philadelphia Electric Co. Formerly of the Emergency Fleet Corporation, Instructor, Operative, etc. Boston: Richard G. Badger. Cloth; 5 x 8 in.; pp. 128. $1.75 net.

BACTERIA FERMENTING LACTOSE and Their Significance in Water Analysis—By Max Levine, Bacteriologist Iowa Experiment Station and Associate Professor of Bacteriology, Iowa State College, Ames, Iowa; Engineering Experiment Station. Paper; 6 x 9 in.; pp. 127; illustrated.

Sections on the colon group, under characteristics, tests for differentiation, classification, detection, and index of pollution; one section on spore-forming lactose fermenters and their significance; appendixes on routine methods of analysis and culture media; 205 references.

BEAUTIFUL HOMES OF MODERATE COST—A Selection of Modern, Artistic, Practical Designs by Well Known Architects, Together with Information on Planning, Financing, Construction, Decoration and Furnishing. New York: Building Age and the Builders' Journal. Paper; 9 x 12 in.; pp. 96; illustrated. $1.

BRUCKEN IN EISENBETON: Ein Leitfaden für Schule und Praxis—Von C. Kersten, Vorm. Oberingenieur Studienrat an der Baugewerksschule Berlin. Teil II., Bogenbrucken. Vierte Neubearbeitete Auflage, Berlin: Wilhelm Ernst & Sohn, Paper; 7 x 10 in.; pp. 228; 521 illustrations.

BUILDING CONTRACTS: The Principles and Practice of Their Administration—By Edwin J. Evans. Foreword by Sir Charles T. Ruthen, O.B.E., F.R.I.B.A.H.M. Director-General of Housing and President of the Society of Architects. [The Directly-Useful (D.U.) Technical Series.] New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 304.

COLUMBIA BASIN PROJECT—A Report by George W. Goethals & Co., Inc., to Department of Conservation and Development of the State of Washington. Olympia, Wash. Paper; 6 x 9 in.; pp. 56; folding map and halftones.

A brief summary of Col. Goethal's report on this vast irrigation project appeared in *Engineering News-Record*, April 20, 1922, p. 666.

CONCRETE COMPUTATION CHARTS—By Richard T. Dana, M. Am. Soc. C. E., M. A. I. M. & M. E., Chief Engineer, Construction Service Co., and James M. Kingsley, B.S. New York: Codex Book Co., Inc. Cloth; 9 x 12 in.; pp. 14; 21 charts. $5.

Design diagrams for reinforced concrete are numerous but few have found their way into books. This set seems to be complete and accurate. Whether they will be used depends a good deal on the taste and fancy of the prospective user.

DAILY RIVER STAGES OF THE PRINCIPAL RIVERS OF THE UNITED STATES, 1920—By H. C. Frankenfield, Meteorologist. Washington, D. C.: U. S. Weather Bureau. Paper; 9 x 12.; pp. 182.

THE DESIGN OF MASONRY STRUCTURES AND FOUNDATIONS—By Clement C. Williams, C.E., M. Am. Soc. C. E., Professor of Civil Engineering, University of Kansas; Consulting Engineer. New York: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 555; 265 illustrations. $5.

DEPARTMENT OF HIGHWAYS, ONTARIO: Report for 1920. Ottawa. Paper; 6 x 10 in.; pp. 70.

DETERIORATION OF STRUCTURES IN SEA-WATER—Second (Interim) Report of the Institution of Civil Engineers. Edited by P. M. Crosthwaite, B. A. L., M. Inst. C. E., Secretary to the Committee, and Gilbert R. Redgrove, Assoc. Inst. C. E., [Department of Scientific and Industrial Research of the British Government.] London: His Majesty's Stationery Office. Paper; 6 x 10 in.; pp. 57; illustrated. 2½s. net.

Addition to the main report (reviewed in *Engineering News-Record*, June 17, 1920), giving mainly the results of some zoological studies of marine borers and adding to some of the report data from various parts of the world.

DOMINION WATER POWER BRANCH; Report for 1920-21—Ottawa, Ont. Paper; 6 x 10 in.; pp. 89.

DWELLINGS AND FAMILIES: 1920 Census—Washington, D. C.: Bureau of the Census. Paper; 9 x 11 in.; pp. 14.

EFFECT OF COLOR OF WALLS AND CEILINGS ON RESULTANT ILLUMINATION—Compiled by A. L. Powell, Lighting Service Department, Edison Lamp Works, General Electric Co., Harrison, N. J. Paper; 6 x 9 in.; pp. 15; 36 color samples of tints, paints and wall papers with corresponding percentages of reflection from mazda lamps.

THE GANTT CHART: A Working Tool of Management [illegible] New York [illegible] Cloth [illegible]

A GUIDE TO THE OPERATION OF SEWAGE TREATMENT PLANTS—By Burns & McDonnell Engineering Company, Consulting Engineers, Kansas City, Mo. Paper; 4 x 6 in.; pp. 8.

HYDRAULIC LABORATORIES IN THE UNITED STATES OF AMERICA [illegible] Hydraulic Research Committee of [illegible] (J. Waldo Smith and Silas H. Woodward) by Alfred D. Flinn, [illegible] New York City. Paper; [illegible]

Describes 49 laboratories under a dozen heads, including owner date established, kind of tests, head, principal equipment, unusual facilities, whether available to outsiders, railway station or siding, person in charge, number on staff, brief general description, research work. Lists eight other laboratories. Contains no summaries or comment but is welcome as probably the first compilation of [illegible]

INSECT LIFE ON SEWAGE FILTERS—By W. H. Parkinson, M.D., D.P.H., M.O.H. to the Basford R.D.C. and Beeston U.D.C., and H. D. Bell, A.I.C., Manager and Chemist of the Stratford-upon-Avon Sewage Disposal Works, and Consulting Chemist on Deodorization of Sewage Disposal Works. London: The Sanitary Publishing Co., Ltd. Cloth; 5 x 8 in.; pp. 64.

Observations on Achorutes viaticus, beginning at the contact beds of the sewage-works of Manchester, England, in 1904 and including research work in 1914-16. Published in 1919, but not previously noted in these columns.

THE INTERNATIONAL LABOR ORGANIZATION OF THE LEAGUE OF NATIONS—Report, National Industrial Conference Board—New York: The Century Co. Paper; 6 x 9 in.; pp. 159; frontispiece map.

AN INVESTIGATION OF THE PROPERTIES OF CHILLED IRON CAR WHEELS—Part I. Wheel Fit and Static Load Strains. Conducted by J. M. Snodgrass and F. G. Guldner. Bulletin 129, Engineering Experiment Station, University of Illinois, Urbana, Ill. European Agents, Chapman & Hall, London, England. Paper; 6 x 9 in.; pp. 95; line cuts and half tions. 55c.

IRON ORE: PART II; BRITISH AFRICA—Summary of Information as to the Present and Prospective Iron-Ore Supplies of the World. [Imperial Mineral Resources Bureau.] London: H. M. Stationery Office. Boards; 6 x 9 in.; pp. 76; folding map. [illegible]

IRRIGATION IN MADRAS PRESIDENCY: Report for 1920-21—Madras: Superintendent Diocesan Press. London: Constable & Co. Paper; 8 x 13 in.; pp. 210; folding maps. 2 rupees 12 annas.

LOUISIANA BOARD OF STATE ENGINEERS—Report for 1921-22. New Orleans, La. Paper; 6 x 9 in.; pp. 213.

MEXICAN PETROLEUM—New York: Pan American Petroleum & Transport Co. Flexible; 6 x 9 in.; pp. 300; half tones and folding map.

MODERN CITY PLANNING: Its Meaning and Methods—By Thomas Adams, Town Planning Consultant to the Dominion of Canada Lecturer on Civic Design, Massachusetts Institute of Technology. New York City: The National Municipal League. Paper; 6 x 9 in.; [illegible]

A concise review of principles and methods which rounds out a series of pamphlets issued by the National Municipal League. The others (25c. each) are: The Law of the City Plan, by Frank B. Williams; Zoning, by Edward M. Bassett; Law of Zoning, by Herbert S. Swann; Special Assessments, by the League's Committee on Sources of Revenue.

MODERN PRACTICE IN HEAT ENGINES—By Telford Petrie, Lecturer in Mechanical Engineering in the Victoria University of Manchester and in the Manchester Municipal College of Technology. London and New York: Longmans, Green & Co. Cloth; 8½ x 11 in.; illustrated. $5 net.

Covers steam boilers, steam turbines and engines, and internal combustion engines. Supplements the late W. Inchley's "Theory of Heat Engines."

NATIONAL FOREIGN TRADE CONVENTION: Proceedings [illegible] India House, Hanover Square. Cloth; 6 x 9 in.; pp. 615.

THE NEW INTERNATIONAL YEAR BOOK: A Compendium of the World's Progress for the Year 1921. Editor, Frank Moore Colby, M.A. New York: Dodd, Mead & Co. Cloth; 7 x 10 in.; [illegible]

The twentieth issue of this useful annual. As usual, the engineering and the other sciences and arts are reviewed and careful attention is given to the various industries, economics, and public questions.

NEW SOUTH WALES DEPARTMENT PUBLIC WORKS: Report for 1920-21—Sydney. Paper; 11 x 13 in.; pp. 85; illustrated.

NOTES ON MECHANICAL [illegible]

OFFICIAL YEAR BOOK OF THE COMMONWEALTH OF AUSTRALIA [illegible]

PETROLEUM: WHERE AND HOW TO FIND IT—By Anthony Blum. Chicago: Modern Mining Books Publishing Co. London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 367; frontispiece portrait of author. $2.

PLAN OF NEW YORK AND ITS ENVIRONS: Report of Meeting of May 10, 1922 (at which announcement was made of the Regional Survey in progress). New York: Russell Sage Foundation, 130 E. 22nd St. Paper; 7 x 10 in.; pp. 25.

PRACTICAL ACCOUNTING FOR GENERAL CONTRACTORS—By H. D. Grant, Staff of W. B. Richards & Co., Accountants and [illegible] Cloth; [illegible] $3.

THE PROBLEM OF DUST PTHISIS IN THE GRANITE-STONE INDUSTRY—By Frederick L. Hoffman, LL.D., Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 178. 20c. from Superintendent of Documents, Washington, D. C.

PROTECTION FOR BUYERS OF PINE: Report of Annual Meeing of Subscribers to Southern Pine Association, March 28-29, 1922—New Orleans, La. Southern Pine Association. Paper; 6 x 9 in.; pp. 264.

PUBLICITY METHODS FOR ENGINEERS: A Manual for Men Engaged in Public Information Work—Proceedings of the First National Conference on Public Information Held Under the Auspices of the American Association of Engineers, 63 East Adams St., Chicago. Cloth; 5 x 8 in.; pp. 186; illustrated. $1.50.

REPORT ON THE FIXATION AND UTILIZATION OF NITROGEN—Prepared by the Nitrate Division, Ordnance Office, War Department; Assisted by the Fixed Nitrogen Research Laboratory, Department of Agriculture, Washington. Paper; 6 x 9 in.; pp. 353.

Reviews world nitrogen situation, with statistics; gives history, chemistry, construction and operating of various fixation processes; describes United States government plants.

THE ROCKEFELLER FOUNDATION—A Review for 1921. By George E. Vincent, President of the Foundation. Paper; 6 x 8 in.; pp. 59, illustrated.

THE SCIENCE OF PURCHASING—By Helen Hysell. With an introduction by J. George Frederick, Author of "Modern Salesmanagement." New York: D. Appleton & Co. Cloth; 5 x 8 in.; illustrated. $2.50.

STATE ENGINEER AND SURVEYOR OF NEW YORK: Report for 1920-21. Cloth; 6 x 9 in.; illustrated. Vol. I., Report of Chief Engineer F. M. Williams, Senior Assistant Engineers, Testing Laboratory, etc.; Vol. II, Report on Stream Gagings.

STATISTICS OF THE RAILWAYS OF THE UNITED STATES. 1919—Washington, D. C.: Interstate Commerce Commission. Cloth; 9 x 11 in.; pp. 819. $1.50 from Superintendent of Documents, Washington, D. C.

STEAM TURBINES—By William J. Goudie, D. Sc., M. Inst. M. E., Assoc. M. Inst. C. E., James Watt, Professor of The Theory and Practice of Heat Engines in the University of Glasgow. Second Edition, Rewritten and Enlarged. London and New York; Longmans, Green & Co. Cloth; 6 x 9 in.; pp. 804; 392 illustrations. $9.

The general scheme of the first edition (published in 1917) has been followed. A chapter on reduction gears, with special reference to marine turbines, has been added and other matrial additions and revisions made.

TEXTBOOK OF LANDSCAPE GARDENING, Designed Especially for the Use of Non-Professional Students—By Frank A. Waugh. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 7 x 10 in.; pp. 344; illustrated. $5. (25s. net.)

THERMAL EXPANSION OF A FEW STEELS—By William Sander, Physicist, and Peter Hindert, Associate Physicist, Bureau of Standards, Washington, D. C. Paper; 6 x 9 in.; pp. 16. Free from Bureau of Standards until stock exhausted; 5c. from Superintendent of Documents.

THERMAL STRESSES IN CHILLED IRON CAR WHEELS—By G. K. Burgess and R. W. Woodward, Physicists, Bureau of Standards, Washington, D. C. Paper; 7 x 10 in.; pp. 35, diagrams and half tones. Free until stock is exhausted; 5c. from Superintendent of Documents, Washington, D. C.

THE WASHINGTON CONFERENCE—By Raymond Leslie Bull, Procter Fellow in Politics in Princeton University. New York: D. Appleton & Co., Cloth; 6 x 9 in.; pp. 461. $3.

Devotes 135 pages to Forces in the Background, which are concerned chiefly with Japan; takes up the Conference under The Passing of the Battleship, The Four-Power Treaty, Future [illegible] closes with the Text of the Treatises, etc., adopted by the Conference.

WATER RESOURCES INDEX INVENTORY FILING SYSTEM FOR RECORDING, COLLATING AND ANALYSING WATER RESOURCES DATA—By J. T. Johnston, C.E., Assistant Director Water Power. Ottawa, Ont.: Dominion Water Power Branch. Paper; 6 x 10 in.; folding maps.

[illegible] TESTS OF CONCRETE [illegible] Professor in Charge of Structural Research Laboratory, Lewis Institute, Chicago, Ill. Reprint from Proceedings American Society for Testing Materials, 1921. Paper; 6 x 9 in.; pp. 24; illustrated.

[illegible] KALENDER [illegible] Baurat, Charlottenberg, Germany; Zementvertag G. m. b. H. [illegible]

[illegible] Directory of German cement industry and manual of cement, concrete and reinforced concrete.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Decries "Band-Wagon" Plea for Licensing

Sir—Your discussion of the licensing question in the issue of July 6 is interesting, timely and good. There are undoubtedly many engineers, as well as some laymen, who favor licensing, in principle, but few seem to carry their arguments or thinking processes to the logical conclusions you reach.

It would almost seem to be self-evident, though it isn't, that licensing is required, if required at all, for the protection of the public, rather than for the protection of engineers, and the difference in this respect between engineers and doctors or lawyers is very well brought out by you. If it is the public which is to be protected, the state, as the protector, must for this purpose specify exactly what degree and kind of skill and ability the licensee possesses, and it should cover not only technical skill but the degree of his business ability and plain horse sense.

At one of the meetings of the licensing committee of the American Society of Civil Engineers, which I was able to attend, all the speakers, except two, advocated the endorsement of licensing, principally because it had been adopted by several states, because it was, so they assumed, here to stay and therefore, we all ought to get on the band wagon.

I am glad to see that as the leading engineering journal of the United States, you have nerve enough to present the cold naked facts, so that the question can be discussed on its merits and not "get on the band wagon," just because there are some engineers, or even a lot of engineers, who proclaim licensing as the panacea for all the evils, if there are any, or many, of the engineering profession.

New York, July 13. F. LAVIS.

Wood Screw Pumps in Holland

Sir—For the Vollenhove drainage district in Holland there has been recently completed and tested a pumping plant equipped with two steam driven 136-in. screw pumps made after the designs of A. B. Wood of New Orleans, La. The capacity of the pumps was guaranteed at 480 cu.ft. per sec. for 6-ft. lift with an average lift of 2.6 ft. The number of working hours was rather high for Dutch conditions, being figured at an average of 2,000 hours a year while the normal pumping plant for polders in Holland works 800 to 1,400 hours.

HOLLAND DRAINAGE PUMPING STATION EQUIPPED WITH WOOD SCREW PUMP

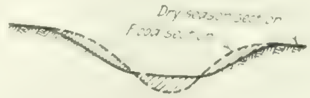
For the given low lift Wood screw pumps gave about 25 per cent better results than centrifugal pumps. It was guaranteed that not more than 2.4 lb. coal per water hp. per hour would be needed. Water is pumped from an area of 110,000 acres, a large part of which is water and morass, so the run-off could be figured at the low figure of 960 cu.ft. per sec. The pumps and machinery were made by Werkspoor at Amsterdam; the plans for the work were prepared by the writer under whose supervision the plant, dikes and improvements were executed. The accompanying picture shows the building from the sea-side

R. VER LOREN VAN THEMAAT,
Nijmegen, The Netherlands, June 28. Civil Engineer.

River Beds Lowered by Floods

Sir—The "fallacy" referred to by your Western Editor on page 819 of the May 18 issue, that an increased height of the levels results in the rise of the river bed has also been entertained here, by not a small number of observers of the biblical rivers Kishon and Namein. These rivers lie south of the Crusade-famed city Acre, and empty directly into the Acre bay.

My close study of these rivers shows that in flood time the actual river beds are considerably lowered. During the dry months (June to October) the mouths of these rivers are practically choked with sea silt. However, there is no record that these rivers have ever gone dry. In flood time the level of the mouth at the sea is about 5 to 7 ft. above the bed.



FLOOD AND DRY-SEASON SECTIONS

It seems to me that the "fallacy" is a result of popular observations of the river banks only. Here as well I have noted that the river banks are somewhat distorted (see sketch), and hence probably the belief that the river beds are higher.

PEREZ W. ETKES,
Haifa, Palestine, Assistant District Engineer,
June 7. Palestine Public Works Dept.

Test of Sewage Sprinkling Nozzles

Sir—We are carrying on a rather exhaustive study of sewage sprinkling nozzles in our hydraulic laboratory and wish to cover the field as completely as possible. The nozzles we have are as follows:

	Name	Shape	Size of Orifice In.
	Chase...	Square	[illegible]
2	Taylor....	Round	[illegible]
3	Taylor..	Square	[illegible]
4	Worcester	Round	13/16
5	Worcester	Round	11/16
6	[illegible]	Square	[illegible]
7	Priestman Bedd[illegible]	Round	[illegible]
8	[illegible]	Round	15/16
9	Columbus modified	Round	[illegible]
10	Binks spray....	Round	[illegible]
11	Binks spray	Round	[illegible]

Information as to any additional nozzles which we might secure for test purpose would be appreciated.

Purdue University R. B. WILEY,
Lafayette, Ind. Acting Head, School of Civil Engineering.

Concrete Roads in Manchester 100 Ft. Wide

Two arterial roads have recently been constructed of reinforced concrete in Manchester, England, under the direction of J. B. L. Meek, city engineer. One of these, Princess road, estimated to cost £144,000, is 100 ft. in width and is divided along the center by a strip of land to be laid out as a garden. A second arterial road is now under construction for the same corporation, for which several existing roads have been reconstructed in reinforced concrete with special provision for heavy traffic. In all these works lattice reinforcement was adopted.

NEWS OF THE WEEK

New York, July 20, 1922

Committee Rejects Ford Muscle Shoals Offer

Senator Norris Writes Majority Opinion Severely Condemning Detroit Manufacturer's Proposal

A majority report of the U. S. Senate Committee on Agriculture and Forestry just submitted reports on the various bills referred to it by the Senate in regard to the government-owned property at Muscle Shoals, Ala. After extended hearings the committee decided to reject all of the bids and all of the bills before it. Senator Norris of Nebraska, chairman of the committee, wrote the majority report so far as it is a rejection of the bid and a minority report in so far as it relates to Senate Bill 3420, a bill providing for the government continuation of construction and operation of the plant at Muscle Shoals.

Nine members of the committee signed the Norris report and of these, eight were Republican senators from northern states and one a Democratic senator from Wyoming. Seven members of the committee would not sign the majority report and of these five were Democratic members from the far South and two were Republicans, from Kansas and North Dakota.

Ford Offer Condemned

The majority report considers thoroughly the history and possibilities of the water power and nitrate development at Muscle Shoals. Because all offers but that of Henry Ford were rejected unanimously there is no discussion of any but his offer and that offer is severely condemned as being unfair to the government and unprecedented in its distribution of the people's property to a corporation.

It states first that the Ford offer is not made as an individual, but as a corporation and that Mr. Ford will be approximately 70 years old before the corporation's control of the property can begin to operate. It recites the various items which go to make up the property and states that in actual salable goods the Ford company would get back a large part of its first payment.

It states further that there is no agreement that the cost of fertilizer shall be reduced one penny, either to the farmer or to anyone else and that after the company had supplied the necessary power to operate Nitrate Plant No. 2, it will have 500,000 to 800,000 hp. to do with as it pleases without government regulation. It calls attention to the hue and cry that would arise if Mr. Rockefeller, say, had made this proposal and states that in spite of Mr. Ford's high reputation, which is acknowledged, that he himself can have no control over the corporation after his death. In effect the proposal would give to a soulless corporation unprecedented rights.

The report condemns severely the so-called amortization payment, whereby the Ford company would pay over to the government annually enough money so that if it were compounded annually at 4 per cent it would pay for the cost of the dam in 100 years. The report points out that the government is not in the money lending business and that instead of amounting to fifty or more million dollars at the end of 100 years as the Ford offer intimates, it would amount only to the actual amount paid in, or about four million dollars. On this basis the Ford company would be getting from the government money at the rate of 2.85 per cent and, as the report notes, it is permitted to make 8 per cent profit on its fertilizer sales, figuring only the actual cost of the fertilizer. The report further condemns the requirement that the government maintain the dam and says that this may be many millions of dollars in the 100 years. It sums these features up as follows: "It means that the government has in effect loaned to this corporation $75,000,000 at 2.85 per cent interest for 100 years and has never received back one-tenth of the principal."

The report devotes a number of pages to a defense of the Norris bill for government management and operation of the work at Muscle Shoals, claiming that this is the only possible way in which the problem of future disposal of the resources of the Tennessee River can be maintained.

St. Louis $74,000,000 Bond Election Date Uncertain

The Board of Aldermen of St. Louis, Mo., adjourned for the summer without passing an ordinance for the $74,000,000 bond issue for public improvements, recommended by a committee of the general council on civic needs after careful study (see *Engineering News-Record*, July 6, 1922, p. 35). The general plan has been approved by the St. Louis Board of Estimate. It is now thought that the bond election will not be held until after the close of this year.

Seek Clarion River Power Permit

The Clarion River Power Co., in care of C. B. Hawley, Munsey Building, Washington, D. C., has applied for a preliminary permit covering the erection of a powerhouse on the Clarion River and the building of a dam to a height of 240 ft. at a point two miles above the mouth of Mill Creek, near Ridgeway, Pa. It is estimated that these works will make available 120,000 hp. of primary power. The plan is to install equipment sufficient to generate 175,000 hp., to be used for public utility purposes.

French Would Have Germans Build Public Works as Reparation

Payment of reparations in the form of public works of vast scope and value has been proposed by Yves le Trocquer, minister of public works of the French government. News dispatches announce that the plan has the approval of the Poincaré government and that it has been referred to the reparations commission.

Although proposals for immediate execution are confined to the establishment of power stations in the Rhone valley for the electrification of railroads in that district, M. Le Trocquer's proposal contemplates the extension of the principle to power development on several other rivers, the reconstruction of the French ports and the construction of new railroads and canals.

The plan is to have French engineers direct the work with Germany supplying the contractors, workers and materials under a stipulation that one-third of the supplies be bought in France. The Rhone River improvements are estimated to cost 3,250,000,000 francs and to require the labor of about 120,000 workers and 10 years' time. A tunnel in the Vosges mountains from St. Laurice to Wesserling would cost 64,000,000 francs and five years' time. Other projects included in the proposal are the Truyere River development to cost 210,000,000 francs, and the Dordogne, 200,000,000 francs.

A. A. E. Joins American Construction Council

The American Association of Engineers at the meeting of its Board of Directors held in Chicago on July 8 accepted the invitation of the American Construction Council to become a member of that body. A. N. Johnson, president of the A. A. E., expressed the opinion that "the American Construction Council will have a most stimulating effect in adjusting the many perplexing problems that confront the public today in the endeavor to carry on the construction of both public and private enterprises in all parts of the country."

Niagara River Bridge Opposed

A bill to incorporate the Buffalo & Fort Erie Public Bridge Co. to build a bridge from Buffalo to Fort Erie was recently defeated in the railway committee of the Canadian Senate. It was represented that the owners of the present bridge, the International Railway Bridge Co., would investigate the possibility of extending their structure so as to accommodate all traffic. Should such extension not be undertaken, it is expected that the proposed charter may be granted at the next session of Parliament.

American Firm To Build Exhibit Building at Rio Exposition

Dwight P. Robinson & Co., New York contractors, who some time ago were awarded the contract for the construction of the building to house the American official exhibit at the Brazilian Centennial Exposition to be held in Rio, beginning Sept. 7, was recently awarded the contract for the construction of the building which will house the commercial exhibit to be put in by American firms or their accredited representatives in Brazil. The building will be constructed of steel and concrete on a site occupying 90,000 sq.ft.

Lets First Brick Road Contract

Contract for construction of the first brick road to be built by the State of Illinois since Governor Len Small's "$30,000 a mile" edict went into effect, was let last month by the Illinois State Highway Department. While smaller political units in the state have been building brick roads, this is the first action of its kind on the part of the state highway department under the present administration.

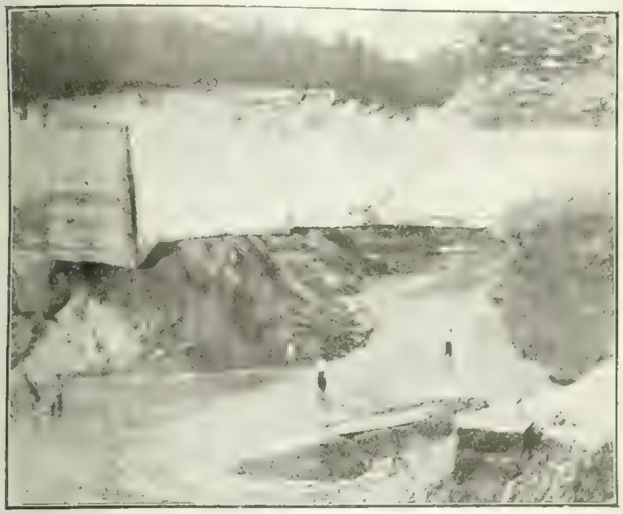
The Illinois contract, let to J. E. Craine of Murphysboro, Ill., is for 13.32 miles from Cobden to Dongola, Ill. Specifications provide for a base of 10 in. of novaculite or disintegrated chert, laid in two 5-in. courses, a 1½-in. sand cushion, 3-in. vitrified brick and asphalt filler. Curbs of compacted novaculite will be 12 in. wide and 4½ in. deep. The pavement will be 18 ft. wide.

Small Dam Failure Wrecks Large Residence Section

Undermined Concrete Core-Wall to Earth Fill Near Holyoke, Mass., Causes Serious Flood

By C. A. Latimer
Civil Engineer, Holyoke, Mass.

On July 17, at 1:30 a.m. the dam at the west end of Langwald's Pond in Fairview, Mass., failed. The released waters hitting the dam at the lower end of Robert's Pond, approximately a half-mile below, carried that structure out and the combined waters



Langwald's Pond Dam Failure

(Upper Left) Upper Portion of Concrete Core-Wall Bridged Gap at Point of Undermining

(Upper Right) Craters Formed by Washout of Earth on Both Sides of Core-Wall

(Lower Left) Buildings in Pleasantdale Damaged by Water Released by Dam Failure

swept on down through Willimansett Brook, into Willimansett, doing what is roughly estimated at $500,000 worth of damage in the Pleasantdale section, without, so far as can be learned, loss of life. The buildings which suffered most were a garage automobile paint shop, laundry and barrel shop which were completely wrecked. Several residences were lifted from their foundations and twisted and a number of outbuildings were carried away. The fact that the Boston & Maine R.R. tracks are carried through Willimansett at this point on an embankment at practically 90 deg. to the path of the flood undoubtedly reduced the loss considerably.

The Langwald's Pond dam, built about twelve years ago at a cost of $65,000 was an earth dam with a plain-concrete core-wall, 30 ft. high, by 300 ft. long, and 15 ft. wide on top. Its upstream slope was 3 to 1; downstream it sloped 2½ to 1 for about 10 ft., then 4½ to 1 for the remaining distance. The soil in this vi-

Floors Fall During Reconstruction of Philadelphia Building

Parts of the tenth and eleventh floors and a wall of an eleven-story building in course of reconstruction in Philadelphia collapsed on July 13, causing the death of two men. The building, located at Broad and Cherry Sts., and known as the Parkway Building, was nearly thirty years old and had originally been the home of a fraternal organization; it was being remodeled for office use. Investigation of the accident is in progress by the Building Inspection Department and by the coroner. Such statements of the owners and of workmen as were obtainable indicate that the inadequate shoring of a wall girder was responsible.

Secretaries Honor Chandler

The secretaries of the A. I. M. E., the A. S. M. E., and the A. I. E. E. tendered a luncheon on July 13 at the Engineers' Club, New York, to Elbert M. Chandler, retiring as acting-secretary of the Am. Soc. C. E., at which they voiced their appreciation of the qualities Mr. Chandler had shown in his contacts with them. Expressions of regret at his leaving were mingled with good wishes for his future.

cinity is sand on clay, and the dam was built of this material. The failure was undoubtedly due to the undermining of the dam and core-wall by leaks or springs, of which several may be seen in the immediate vicinity of the break. The upper section of the core-wall and the spillway are still in place but about 80 ft. of the bottom from 6 ft. to 16 ft. in depth has gone out with the dam.

The Robert's Pond dam had what appears to have been an 18-in. puddle core confined between 2-in. sheathing and is a complete failure. Water marks indicate that this dam was carrying a 5-ft. crest, which, of course, would cause failure of any dam of this type.

The capacity of both ponds was over fifty million gallons of water.

National Societies Urge Use of Employment Service

The four national engineering societies—civil, mechanical, electrical and mining—are engaged in a campaign to increase the usefulness of their free employment service. The societies have issued the following statement regarding the employment bureau, which was organized primarily for members of the parent organizations but which may be used under certain conditions by non-members:

"An employment service for engineers of every variety of training and experience is conducted by the four national engineering societies of the United States. This service brings in touch with the various business men the service of 50,000 trained technical men who are members of these societies and one of the objects of it is to show to the various commercial houses the aid which engineers are rendering to others in the same lines and to help these firms and corporations secure similar assistance. Men of engineering training are prominent in all branches of commercial endeavor and their creative ability is recognized as being of great help in the building up of the Nation's wealth.

"This service is in a position to supply the readers of *Engineering News-Record* and civil engineers, construction superintendents, mechanical engineers, sales engineers, managers and other executives trained in the industry, and is under the direction of W. V. Brown. The office is located in the United Engineering Building, 29 West 39th St., New York City, and is free to both employer and to employee."

Equipment Shipped to Electrify French Midi Railways

Transmission equipment, part of an order amounting in value to more than $1,000,000, has been shipped by the Westinghouse Co. to Bordeaux, France, where it will be transferred to the Midi Railways for use on the electrification of its lines. This road serves the territory in the south of France just north of the Pyrenees. Electrification was begun before the war, using single-phase current at 12,000 volts. Since the war, however, the problem has been restudied and a decision reached to carry through the project on the basis of 1,500 volts direct current. The sections already completed will be changed to make the system uniform throughout

The Engineer in Public Life

EDWIN K. LARGE

On July 16 Edwin K. Large, a civil engineer, became postmaster of Atlanta, Ga., following approval by the Senate of his nomination by President Harding.

Mr. Large is a native of Flemington, N. J., where he was born 41 years ago, but has lived in Atlanta for the past 12 years. After graduation from Princeton University in 1902 with the degree of civil engineer, he began work with the engineering department of the Pennsylvania R.R. as office assistant and instrument man on construction work in Jersey City and Newark. After a brief period on the Pennsylvania's East River tunnels in New York he became main-line assistant supervisor of track maintenance in the Maryland division.

He gave up railway work in 1910 to engage in general development work at Atlanta, Ga., first with the Edgewood Park Realty Co. and later with the Durand Realty Co., of which organization he was vice-president and secretary. During the war Mr. Large served as supervising engineer at Camp Gordon.

"The appointment of Edwin K. Large to the Atlanta postmastership," said a recent editorial in the Atlanta *Constitution*, "will insure for Atlanta the continuance of the post office under honest and highly competent management."

New York Central Wins Suit with City Over West Side Tracks

After litigation begun in 1918 by Mayor Hylan of New York, the Court of Appeals of New York State has unanimously confirmed the title of the New York Central R.R. to its right-of-way along the west side of Manhattan Island between 72nd. St. and Spuyten Duyvil.

The suit grew out of efforts of the preceding city administration to co-operate with the railroad in improving this and adjacent sections of its lines over which is handled the bulk of the freight traffic into the city. The present administration chose to force the improvements by attacking the title of the road to its right-of-way rather than by treaty. The Mayor announces his intention to carry the fight to the U. S. Supreme Court.

Roof of Ancient Mosque in Cairo Collapses

Cable dispatches from Cairo, Egypt, report that the roof of a mosque which has stood for six centuries collapsed on the morning of July [illegible] at a time when [illegible] worshipping. [illegible] persons were killed.

U. S. Chamber of Commerce Takes Up Fire-Reduction Movement

An active fire-reduction campaign is about to be undertaken by the insurance department of the Chamber of Commerce of the United States as the result of two conferences on the subject, held on June 26 and on July 12. The conference of June 26, called by Governor Ritchie of Maryland, was held at Baltimore, and was attended by several governors, state insurance commissioners and representatives of fire-fighting and credit associations. After a discussion of fire losses and the possibility of reducing them by systematic work, the conference reached the conclusion that some fire-reduction activity should be undertaken at once, that, as it should be national in scope rather than local, the Chamber of Commerce of the United States would be the most logical organization to undertake it. On the basis of this conclusion a second conference was held at Washington on July 12, with the conclusion that the chamber accepted the invitation to direct a fire-reduction campaign.

It was decided at this conference that the various organizations present should appoint one or two representatives each, to form a general co-operating committee for the purpose of conducting the fire-reduction work. The work will be directly in the hands of the insurance department of the Chamber, James L. Madden, manager. A fire-prevention program has already been formulated by the department, to be placed in the hands of local fire-prevention committees, as a means of initiating a general survey on which future effort may be based.

To Sell French State Railways

Carrying out the policy forecast in an earlier issue of *Engineering News-Record*, private ownership of the State Railways of France has been proposed by the new Railway Council, composed of representatives of the five large private railway systems, the government and several public associations. A plan to parcel out the several state lines among the adjacent private systems was rejected by parliament in March. Later, the Minister of Public Works proposed the organization of a company with 66 per cent of the stock held by the government and the remainder by the departments in which the lines are situated, together with the municipalities, local chambers of commerce and a few private individuals. The Council's plan eliminates all state and public participation except that of local chambers of commerce and agriculture. It is stated that experience with government ownership and operation has demonstrated the high cost and unsatisfactory service for such a system.

Concrete Institute to Hold 1923 Meeting in Cincinnati

At a recent meeting of the Board of Direction of the American Concrete Institute decision was reached to hold the 1923 convention in Cincinnati. The date of the convention is Jan. 22-25, inclusive.

Grant Permit to Develop Power at Kettle Falls on Columbia

The Federal Power Commission has authorized the issuance of a preliminary permit for three years to the Washington Water Power Co. for a power project at Kettle Falls on the Columbia River. The ultimate installation is estimated at 153,400 hp. The company proposes to develop the project in three stages correspondingly as a market for the power can be found. In the initial development it is proposed to use the natural fall of about 30 ft. at Kettle Falls. As the demand for power increases, additional capacity will be provided by building a 60-ft. dam across the Columbia River. The height of the dam may later be raised to 75 ft. by the use of gates. Provision is made in the permit for the conveyance to the United States of such lands and rights-of-way as may be required for navigation facilities built by the United States.

Under a treaty with Great Britain made in 1846, the Columbia River is to be kept open for navigation by British subjects trading with the Hudson Bay Co. The permit provides that project works shall be designed to keep existing portages free and open.

English Railways Withdraw Road Transport Bill

Withdrawal of the bill authorizing the London and Northwestern and Midland Rys. of England to engage in highway transport is announced in a report to the Department of Commerce by the commercial attaché at London. Opposition in the House of Commons has been based upon the danger of the railroad companies and other large aggregations of capital competing so severely with smaller transport firms as to drive them out of business.

Hetch Hetchy Tunnel Headings Advanced 4,817 Ft. in May

Although no new records for single heading advances were established in May on the Hetch Hetchy tunnel of the San Francisco water-supply project, the average advance for the month in eleven headings was 437.9 ft., an average of 6.346 ft. per shift.

The detailed figures for each heading are given in the accompanying table. Priest Portal, under sub-contract to Dennis & Wilson, lost three shifts on account of lack of power. The tunnel work as a whole is under contract to the Construction Company of North America.

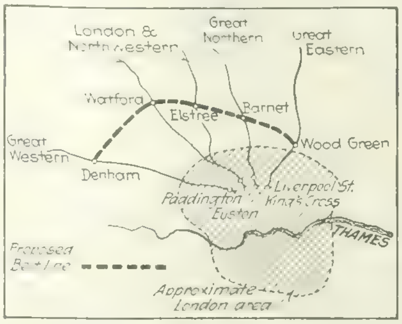
ADVANCE MADE ON TUNNEL HEADINGS IN MAY

Heading	Tunnel Section	Character of Rock	Holes per Round	Superintendent	Shifts Worked	Progress Month of May, Feet	Total Progress to Date Feet
Intake...	13 ft 4 in	Monolithic Granite	48 52	Johnson	62	326	8,819
South Fork E...	13 ft 4 in	Monolithic Granite	45 50	Peterson	70	357	9,099
South Fork W..	13 ft. 4 in	Grandiorite	38	Peterson	74	476	5,082
Adit 5-6 East...	13 ft. 4 in.	Granodiorite	38	Gallagher	62	502	3,576
Adit 5-6 West	13 ft. 4 in.	Quartzite and Diorite	34	Gallagher	93	441	3,636
Adit 8-9 East....	11 ft. 3 in.	Quartzite Schists and Altered Slates	25	Criddle	93	614	2,756
Adit 8–9 West..	11 ft. 3 in.	Schists and Altered Slates	25	Criddle	93	596	2,437
Big Creek East..	11 ft. 3 in.	Altered Slates	25	Fowler	61	419	5,973
Big Creek West.	11 ft. 3 in.	Diorite	25	Fowler	61	405	6,752
Priest	11 ft. 3 in.	Altered Slates and Diorite	25	Hackman	90	681	16,691
					759	4,817	64,821

London to Have Belt Railway Connecting Trunk Lines

London Correspondence

A scheme is being formulated for a belt line to link up with the trunk lines of the Great Western, London and North Western, Great Northern and Great Eastern Rys. just outside the congested London area. The line, which will be around twenty miles in length, will make possible direct communication between north and south England without having to pass through the busiest sections.



PROPOSED LONDON BELT LINE

A further advantage is that, in the new grouping scheme, circular suburban services can be operated on the new line without necessitating travel to the terminals and changing from one line to another. On the group which includes the Great Northern, Great Central and Great Eastern Rys., a more equitable distribution of the passenger traffic will be possible. Under present conditions, one terminal of this group, Liverpool Street, is congested while Marylebone (Great Central Ry.) can accommodate more trains. Under the proposed plan, traffic authorities will be able to distribute traffic, according to the capacities of the terminals, between Marylebone (Great Central Ry.), Kings Cross (Great Northern Ry.) and Liverpool Street (Great Central Ry.).

Charge Half Cent to Cross Bridge

It has been announced by the Public Utilities Commission of the District of Columbia that it has authorized the Capital Traction Co., one of the local street-railway companies, to extend its tracks over the new Georgetown bridge across the Potomac River at a cost of $150,000, and to charge an additional fare of one-half cent for each passenger, which extra fare goes to the government for the use of the bridge.

Lumber Men Would Supply Trade Data to Public

Manufacturers Offer Periodical Summaries of Production, Shipments and Stocks

In a letter to the newly-established Trade Associations Division of the Department of Commerce, Wilson Compton, secretary-manager of the National Lumber Manufacturers Association, places its whole statistical organization at the service of the government in such a manner that the public will have all the trade information that the lumber manufacturers compile for themselves as soon as, if not sooner than, it is available for individual member manufacturers.

The purpose of the National Lumber Manufacturers Association in thus making available to the government and public without charge a statistical service that has been built up through many years at great cost is two-fold: (1) To give prompt and conclusive evidence that the subscribers of the association in the collection and dissemination of lumber trade information neither have nor desire any commercial advantages; (2) to pioneer the way for a general exchange of trade association industrial statistics, through the Department of Commerce, so that it may be possible to obtain an accurate current record of the industrial activities of America.

Scope of Statistics

Mr. Compton's letter gives the Department of Commerce exact information concerning the manner in which the National Lumber Manufacturers Association collects and distributes lumber trade information, which consists of weekly statistics of the softwood lumber movements, giving the production, shipments and orders and changes in stocks as reported by eight regional associations, a quarterly graphic lumber summary and a monthly graphic summary of general business statistics.

It is the conviction of the National Lumber Manufacturers Association that if the Department of Commerce chooses to act favorably on its offer to complete statistical co-operation with the government, other great industrial associations will follow suit, with the result that it will be possible to present to the business world periodically an accurate current statistical picture of the commercial movement of the country. It is hoped that such information, wisely diffused, will help to avoid the excesses of industrial activity which are one of the great contributing causes to alternating periodical business depressions.

English Channel Tunnel Again Under Discussion

Discussions of the prospects of building the channel tunnel between France and England have recently been resumed, after they had been suspended for a year or more due to unfavorable governmental attitude. No new financial arrangements have been reported and it is not yet apparent that conditions have changed to make the prospect of the work proceeding any better than heretofore.

Engineering Societies

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA [illegible] fessional Meeting, Winnipeg, Man., Sept. 5-7.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

The Engineers Club of Kansas City at a recent meeting had as its guest of honor Prof. Henry S. Jacoby, former professor of bridge engineering of Cornell University.

The Richmond, Va., Chapter of the American Association of Engineers on July 5 gave a "welcoming dinner" to H. G. Shirley, recently appointed chairman of the Virginia State Highway Commission. Guests included Governor Trinkle, of Virginia; Mayor Ainslie, of Richmond; Eppa Hunton, president of the Richmond Fredericksburg & Potomac R.R., Attorney-General Saunders and officers of the leading civic and professional clubs of Richmond. J. C. Carpenter, president of the Richmond chapter, was toastmaster.

Personal Notes

E. MORGAN BARRADALE, formerly secretary of the New Jersey Interstate Bridge and Tunnel Commission, has been appointed assistant to Clifford M. Holland, chief engineer to the New York and New Jersey commissions which are charged with the construction of the Hudson River vehicle tunnel between New York and Jersey City.

H. L. LEVENTON, former assistant engineer with the California State Highway Commission, has resigned to accept a position with the Western States Power and Electric Co., where he will be engaged on the construction of a large earth dam, with concrete core wall, in Alpine County, Cal.

OTTO FUETTER has been appointed city engineer and street superintendent for the city of Venice, Cal.

J. O. WANZER, formerly with the California State Highway Commission, has been appointed city manager of Marysville, Cal.

JOHN LEONARD VOGEL, formerly designing bridge engineer of the New Jersey Board of Public Utility Commissioners, has been appointed bridge engineer of the New Jersey State Highway Department. Mr. Vogel has had wide experience in bridge and steelwork design and estimating, chief among his positions in the past ten years being assistant bridge engineer for the Central Railroad of New Jersey, principal assistant engineer of the New Jersey Board of Public Utility Commissioners, and designing engineer with Henry Steers, Inc., contracting engineers, New York City.

GEORGE F. NICHOLSON, chief engineer of the Port of Seattle, has returned to this country from Cork, Ireland, where for the last seven months he has been engaged in the study of the port of Cork and its neighbor, Queenstown. Mr. Nicholson submitted a report to the Cork Harbor Commissioners recommending many revisions and improvements in the port facilities.

MAJOR CARY H. BROWN, assistant engineer commissioner of the District of Columbia since March, 1919, will shortly be relieved of that duty and assigned to duty at the engineer school at Camp Humphreys, Va. As assistant engineer commissioner Major Brown has had jurisdiction over the electrical, water and sewer departments and the office of the building inspector of the District.

L. M. WEISIGER, field engineer of the South Carolina State Highway Department, has resigned to accept a position with J. M. Gregory of Newton, N. C. E. D. SLOAN has been appointed to succeed Mr. Weisiger.

H. M. GALLAGHER, formerly chief engineer of the board of port commissioners of the Port of New Orleans, and more recently assistant to the general manager, has resigned to accept the management of the port of Charleston, S. C. TILEY S. McCHESNEY, the present assistant secretary and treasurer of the board, has been advanced to the post of assistant to the general manager.

Obituary

CAPT. S. B. RICE, one of the oldest officials of the Richmond, Fredericksburg & Potomac R.R., died in Richmond June 27, aged 74 years. He first settled in Virginia when he went there on the construction of the bridge over the James River for the Richmond & Petersburg R.R. in 1865. Lated he was employed by the railroad with which he was associated at the time of his death as engineer of maintenance-of-way.

FRANKLIN D. MACK, for the past twenty-five years consulting engineer for the New York Life Insurance Co., died recently at the age of 58. Previous to his connection with the insurance company Mr. Mack had been in railroad work, having had charge of construction work on the Boston and Westchester R.R. He also had done various other engineering work, including landscape engineering and the installation of refrigerating plants.

W. H. BIGGAR, K. C. vice-president and general counsel of the Grand Trunk Ry. system died in Montreal July 7, aged 69 years. Mr. Biggar, who became general counsel of the system in 1910, was regarded as having the most accurate knowledge of the proceedings connected with the building up of the Grand Trunk system and the Grand Trunk Pacific. He was chief counsel in connection with the recent arbitration proceedings for the valuation of Grand Trunk stock.

J. W. EVANS, former state sanitary engineer and assistant state engineer of Oklahoma, was killed recently at Madill, Okla., when a piece of equipment which was being used in constructing a building, fell while being raised to an upper story. Mr. Evans was formerly with the Oklahoma State Highway Department and previous to that time had done engineering work in the Philippine Islands. He had also taught in the Oklahoma Agricultural and Mechanical College.

Business Notes

THE AMERICAN CONCRETE TIE CORP., of Portsmouth, Va., has been recently been organized and a plant established at Portsmouth, by W. T. Dicky and J. C. Darst for the manufacture of concrete railroad ties. The ties have been used by the Norfolk & Portsmouth Belt Line RR., which has recently placed orders for them.

THE STRAUSS BASCULE BRIDGE CO. announces the completion of its reorganization as follows: J. B. Strauss, president and chief engineer; C. A. Ellis, vice-president and engineer in charge of design; P. L. Kaufman, assistant secretary and contracting engineer, and C. E. Paine, designing engineer. L. O. Hopkins, who had been transferred from the Strauss Bascule Bridge Co. to the Strauss Yielding Barrier Co., has severed relations with both companies.

L. S. GREENWOOD, assistant engineer, Barber Asphalt Co., has been transferred to Boston, Mass. He will be in charge of engineering and sales of built-up roofing, mastic and waterproofing for the New England States.

THE HAMMER-SPRAY CO., New Haven, Conn., consulting and contracting engineers, has recently been formed. The incorporators of the new company are S. A. Hasbrouck, New Haven; C. T. Hull, New Haven; and K. A. Hawley, Canadaigua, N. Y.

F. J. SCHLINK, formerly of the development branch of the engineering department of Western Electric Co., New York City, has been appointed assistant secretary of the American Engineering Standards Committee.

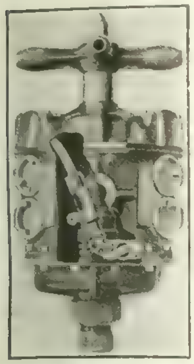
HOLBROOK, WARREN & VAN PRAAG, Decatur, Ill., is the new name of the civil engineering firm formerly known as HOLBROOK, WARREN & ANDREW. Major C. R. Andrew, the retiring member of the firm, is now consulting engineer for the city of Decatur. Alex Van Praag, Jr., the new member of the firm, has been assistant state sanitary engineer for the past two and one-half years. The firm specializes in municipal engineering work.

TERRY, COWAN & SMITH has purchased the machinery sales business formerly known as the Merkle Machinery Co., Kansas City, Mo. The firm will handle complete equipment for water works, electric light and power plants.

Equipment and Materials

Oil Vent Cuts Air Drill Costs

An oil vent designed to prevent oil leakage and lessen the frequency of oiling air drills has been developed by the Chicago Pneumatic Tool Co., New York City. It is applicable to most sizes and types of Little Giant air drills and on new drills is furnished as regular equipment. The vent, as shown in the illustration, contains a top-shaped plunger which automatically prevents all leakage regardless of the operating position of the drill. According to the manufacturer's estimates the saving in time, labor and lubricant effected by this device ranges from $39 to $90 per year, depending on labor costs (40 to 60c. per hour) and time ordinarily consumed (15 to 30 min.) to lubricate drills. Another new air-drill feature is a one-piece interchangeable toggle which permits direct contact of lubricant with crank pins.

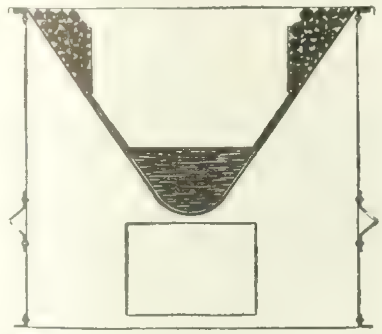


Strengthened Wheelbarrow

An extended nose brace is the new feature which the Akron Barrow Co., of Cleveland, Ohio, has added to its contractors' wood-handle type barrow. As shown in the accompanying illustration, heavy steel braces extend from the frame to the reinforcing plate and thence to the top band, where they are securely bolted, thus reinforcing the entire front end of the barrow.

Continuous Asphalt Roofing Material Kettle

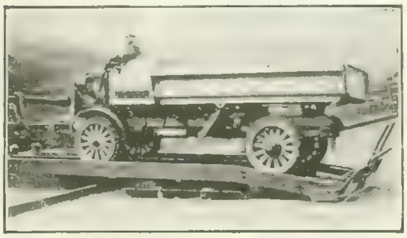
A continuous asphalt-melting kettle for roofing work, with a capacity of 100 gal. and a low fuel consumption, has been put upon the market by the Barber Asphalt Co. of Philadelphia. A cross-section of the equipment is shown herewith. The V-shaped tank is cased with sheet metal and the overall dimensions are: Width, 38½ in.; length, 54 in.; height, 36 in. According to the claims of its manufacturers, less than 10 lb. of fuel are required for each 100 lb. of asphalt to be melted.



The continuous feature of the kettle, secured by the arrangement of the side pockets for cold asphalt, where the material is warmed and from which it flows into the bottom of the tank, insures a supply of hot asphalt as long as the fire is kept burning. Cold material never comes in contact with hot material, thus precluding lumps in the bottom of the tank.

Truck Turntable for Road Construction

The Blaw-Knox Co., of Pittsburgh, Pa., has added to its line of construction plant a truck turntable for road building work designed to handle trucks up to 5 tons capacity and with a wheel base of 168 in. The turntable does not take up more than 8 ft. of roadway when the truck is mounting or backing off. The device is mounted



upon a skid which protects the finished subgrade from damage.

The turntables are made in three sizes for 2½, 3 and 5-ton trucks, and are operated by one man.

Out-of-the-Ordinary Trade Publications

Drawing Instruments—The C. F. Pease Co., Chicago, has issued a catalog illustrating and describing its line of American-made drawing instruments.

Steel Wheels—The Carnegie Steel Co., Pittsburgh, has issued revised editions of two booklets describing wrought steel wheels for railway and industrial use. Detailed drawings and specifications for different wheel types and sizes are given.

Dump Wagons—The Watson Products Corp., Canastota, N. Y., has issued several illustrated pamphlets describing its line of dump wagons, tractors and trailers. Bulletin 11, dealing with the Watson tractor, is published both in English and Spanish. A 4-page leaflet describes the company's train hitch for hauling a string of wagons with a traction engine or road roller.

Metal Coating—The Metals Coating Co. of America, Philadelphia, describes the Schoop metal-coating process in a 17-page illustrated pamphlet just issued. With the company's spraying pistol any of the commercial metals, such as zinc, lead, aluminum, tin, copper, bronze and nickel, are simultaneously melted, atomized and impacted on any surface. Among the uses of the process illustrated in the pamphlet are the following: Structural steel columns coated with zinc after fabrication; coils for superheated steam in chemical apparatus coated with aluminum; 8-in. wrought iron pipe coated with various metals; transmission towers coated with zinc either before or after fabrication; bridge girders coated with zinc, lead or aluminum. An important use of the process is the protection of iron and steel from atmospheric corrosion by the application of zinc coating. In addition to the pistol method of application there are the Gravitas, utilizing metals in the form dust, and the mass coating machine, a new development for spraying in bulk articles weighing from a fraction of an ounce to about 10 lb. Illustrations are shown indicating the resistance of aluminum-coated parts to high temperatures.

Air Compressors — The Domestic Engine & Pump Co., Shippensburg, Pa., describes in a 12-page illustrated pamphlet several types of its portable gasoline engine driven air compressor. The machines are designed particularly for pumping and hoisting service and for operating rock drills or other pneumatic tools.

Asphalt Heater — Littleford Bros., Cincinnati, have issued a leaflet describing their Midget No. 69 tar and asphalt heater for road and street maintenance. It is designed to be moved and handled by one man. The capacity of the kettle is 25 gal. The firebox is fitted with renewable cast iron grates and the furnace shell is protected by liners of fire-box steel. The kettle is removable. The equipment is mounted on a pair of 18-in. steel flat-tired wheels.

Dynamite—The Hercules Powder Co., Wilmington, Del., presents the story of the part played by dynamite in the industrial development of this country in a booklet by T. W. Bacchus, vice-president. Among the facilities of modern civilization in the creation of which dynamite has played a part are the railroads, highways, coal and metal mines, improved rivers and harbors, and land cleared of stumps for agricultural purposes.

Integral Waterproofing — The Truscon Laboratories of Detroit, Mich., have issued in pamphlet form the discussion entitled "Integral Waterproofing of Concrete," which was presented by R. A. Plumb of the Laboratories to the Joint Committee on Concrete and Reinforced Concrete last fall. This discussion is an elaborate investigation of the theory of circulation of water into concrete and a justification of the integral method of waterproofing.

Business Side of Construction

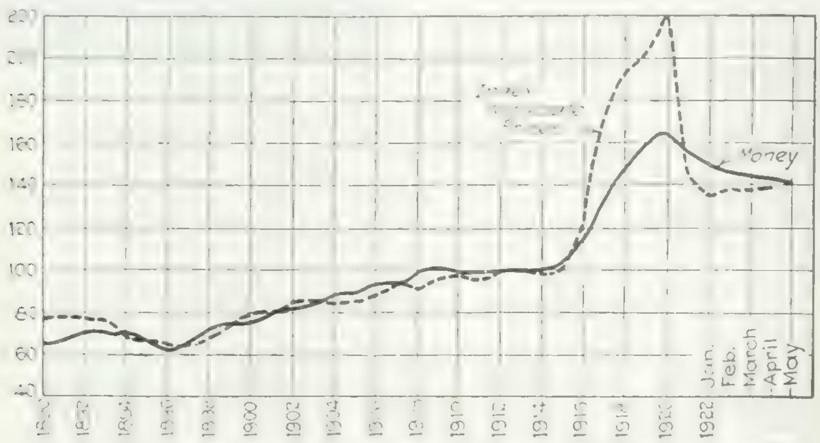
Facts and Events that Affect Cost and Volume

Future Wholesale Prices Will Agree With Money Supply

Is the Opinion of D. L. Bissell, Who Has Studied Relationship Between Prices and Financial Barometers

"In my opinion wholesale prices will in the future agree closely with the per capita circulation," writes D. L. Bissell, C. E., San Diego, Cal., in answer to *Engineering News-Record's* inquiry as to what may be expected of prices. "For the last four years," he continues, "I have made quite a study of the relation between wholesale prices and the money supply. Have also investigated prices in relation to loans and discounts, gold stock, ratio of paper money to gold and in fact about every combination that I could think of that would lead to some concrete result. About the best combination I have been able to make is shown on the chart. From 1890 to 1916 wholesale prices (mean of four standard index numbers) and money agree very well, but due to abnormal conditions brought on by the war do not agree from 1917 to 1920. From 1920 to the present, however, they are agreeing as well as in the years prior to the war.

"If per capita circulation goes down, I believe prices will also recede. As a base 1913 is as good as any other year at present, but I am of the opinion that 1922 would be a good base to use for the future as practically all the inflation and wind will have been taken out of things this year. If things ever do get back to the pre-war basis it will be because the money supply per capita recedes to the same point."



COMPARISON OF PER CAPITA WEALTH WITH WHOLESALE PRICES

Outlook for American Cement in India Promising

Plans for construction operations in India, contingent upon the improvement in the country's finances, are arousing interest in the extent to which American cement may participate. The large stocks of constructional material accumulated during the past three years are exhausted, and engineering firms and importers of cement are inquiring into the availability, quality, and price of materials offered by American, Japanese, and German producers. The cement generally used in India falls into three classes: (1) High-grade British cement, used where special European construction or government specifications name a standard quality; (2) native Indian cement, used only in temporary construction or for purely native enterprises; and (3) a fair quality of cement in which price is the governing factor. British and Japanese, and recently German, manufacturers have competed in supplying the large demand for this latter grade of cement. The extent of the market, however, the great irrigation and hydro-electric projects now in view, and the inevitable revival of building construction in India, warrant a careful consideration of the situation on the part of American manufacturers.

After investigating plans for introducing American cement into India on a competitive basis, it is felt that if advantage is taken of the low cost of Indian manual labor and the low prices of jute sacks, shipments in bulk by steamer lots of American cement can be made at a very low cost, and the cement can be bagged at the port of entry with no loss in quantity and at a total cost sufficiently low to successfully compete in this market. If direct communication with Indian importers and constructional engineers is desired, further information may be obtained from the Far Eastern Division. Refer to report No. 60432.—*Commerce Reports.*

Contracts for First Half of 1922 Exceed Billion

Gain of 34 Per Cent Over Corresponding Period in 1921—Middle Atlantic States Lead

A total of 3,867 important engineering contracts were let in the United States from Jan. 1 to July 1, 1922, valued at $779,766,747 as compared with $581,249,777 for the first half of 1921—a gain of 34 per cent. These figures and the accompanying table were compiled from Construction News, where minimum projects reach $25,000 each on public works, $40,000 on industrial construction and $150,000 in the case of commercial buildings.

If railway contracts ($4,000,000 reported in *Engineering News-Record*) and smaller engineering projects were added to the total given in the table the value of all engineering construction placed in the first six months would probably exceed $1,100,000,000 *exclusive* of residential construction (which exceeds $700,000,000).

The Middle Atlantic section leads with 1,024 contracts valued at $285,457,844 representing 37 per cent of the total value of all large contracts let and includes 52 per cent of the total value of all bridges, 25 per cent of streets and roads, 27 per cent of industrial buildings, 49 per cent of Federal Government contracts and 67 per cent of miscellaneous awards. Other sections of the country stand as follows: New England, 7 per cent of the six month's total value; South, 11 per cent; Middle West, 24 per cent; West of Mississippi, 10 per cent and Far West, 7 per cent. The 3,867 contracts are distributed numerically as follows: New England, 7 per cent; Middle Atlantic, 26 per cent; South, 10 per cent; Middle West, 25 per cent; West of Mississippi, 19 per cent, and 11 per cent for the Far Western states.

VALUE OF CONTRACTS LET IN THE UNITED STATES
JAN. 1 TO JULY 1, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total
Waterworks....	$1,019,000	$2,397,844	$1,213,000	$3,190,000	$3,295,000	$3,133,000	$14,247,844
Sewers..........	232,000	6,898,000	1,693,000	8,580,000	2,055,000	1,640,383	21,098,383
Bridges	369,000	12,056,000	2,421,000	2,794,000	3,888,000	1,415,000	22,943,000
Excavation and irrigation	68,000	794,000	747,000	700,000	1,946,000	2,261,000	6,516,000
Streets and roads	5,882,000	44,529,000	38,610,000	41,865,000	26,121,000	21,029,000	178,036,000
Industrial works	14,119,000	24,259,000	15,953,000	23,108,000	5,062,000	5,048,000	87,549,000
Buildings.......	32,279,000	151,041,000	25,745,000	108,260,000	30,471,000	32,782,000	380,578,000
Federal Government work....	261,500	7,665,000	2,619,000	112,000	55,000	4,729,000	15,441,500
Miscellaneous...	1,752,000	35,818,000	1,849,000	3,243,810	6,228,410	4,465,000	53,357,020
Total......	$55,981,500	$285,457,844	$90,850,800	$191,852,810	$79,121,410	$76,502,383	$779,766,747

Coal and Railroad Strikes Still in Force

The mines have "withheld acceptance" of President Harding's plan to settle the coal strike. The anthracite operators accepted it and a majority of the bituminous operators also have subscribed unconditionally.

The plan proposed: (1) immediate resumption of work under wages and conditions in force Mar. 31: (2) appoint-

(Concluded on p. 128)

Building Trade a Good Business Barometer

Construction Operations in Next Two Months Will Indicate Course of Business in General

Morton C. Tuttle, general manager of the Aberthaw Construction Co., Boston, Mass., in giving his views of the present situation in the building trades, says in part:

"It will be interesting to observe the next three months' development in the building trade because the increasing buying by the building trade will stimulate not only the production of building material like steel, lumber, cement, but also will have a tremendous effect upon railroad traffic. It is also worth while to watch developments in the building labor field, because the reactions in the building trade occur with almost laboratory quickness. Movements in the building market probably forecast very accurately the slower but similar movements in manufacturing, giving as accurate a forecast of the future of industrial conditions as can be obtained.

"Following the war there was a building boom, largely caused by the expansion of factories. This boom raised the cost of building until in the middle of 1920 it cost $266,000 to build a factory that would have cost $100,000 in 1915. Following 1920 came the depression, and the price of buildings dropped to 150, compared to the pre-war 100."

It will be noted that Mr. Tuttle calls particular attention to the principal three construction materials of national importance, and to labor, which happen to comprise the four basic factors of the *Engineering News-Record's* Construction Cost Index Number. In November, 1915, the number stood at 101.06 as against $100,000, the actual cost of building a certain factory at that time. By the middle of 1920, costs had advanced to $266,000 for erecting this type of building and this figure is compared with the *News-Record* Cost Index of 265.65 for July, 1920. In the drop from the peak the Index Number fell to 162.04 in March, 1922, at which time building costs in Boston, according to Mr. Tuttle, were 50 per cent above 1913. The present Index Number is 169.70 for July, 1922, showing a rise of over 7 per cent during the last four months.

Cement Production in June Gains 1,949,000 Bbl. Over Year Ago

Cement production figures for June, released last week by the Geological Survey, show an increase of 1,949,000 bbl. over June, 1921, while shipments were 2,893,000 bbl. heavier. Stocks are 2,225,000 bbl. lower than at the end of May and 482,000 bbl. under the reserve on hand one year ago.

Bond Prices During June Irregular

Sales of municipal bonds in June showed a slight falling off from the May record, but a considerably stronger demand has been the feature of the market throughout the week just past. Bond prices, generally, showed marked irregularity until the first week in July.

Among the more important new issues were the Chicago Sanitary District, $5,000,000 4s yielding 4@4.30 per cent; Cleveland $2,000,000 4½s yielding 4@4.35 per cent, and Nassau County, N. Y., $1,500,000 4½s (road improvement) at 102.319, a basis of about 4.10 per cent.

Of the forty-three representative issues shown in the accompanying table, one sold at par, thirty-nine above and three below par; the yields ranging from 3.98 to 5.93 per cent. The rates varied from 4 to 6 per cent. All those drawing 6 per cent were in the Southern and Western states; the 5s and 5½s in the Middle West and west of the Mississippi; the 4½s and 4¾s in New England and the Middle Atlantic states and both 4s in Maine.

The number of municipalities issuing permanent bonds and the number of separate issues during June were 521 and 703 respectively, according to the *Commercial and Financial Chronicle*. This contrasts with 600 and 805 for May and 366 and 520 for June, 1921.

REPRESENTATIVE BOND SALES OF JUNE AND JULY, 1922

State	Purpose	Amount	Maturity	Rate Per Cent	Basis	Sold For	Dated	Purchased By
Maine	Highway	$650,000	1943-52	4	3.98	100.403	July 1, 1922	S. W. Straus & Co., New York.
	Bridge							
County								
Allegany, N. Y.	Highway	$250,000	1932-36	4½	4.15	103.26	Mar. 1, 1922	Barr Bros. & Co., New York.
Bay, Mich.	Highway improvement	76,790	....	5	....	100.388 / 100.396	June 1, 1922	Northern Title & Trust Co., Bay City.
Broward, Fla.	Highway	400,000	1932-46	6	5.81	102.115	Jan. 1, 1922	A. T. Bell & Co., Toledo.
	Navigation port	100,000				102.135		
Cumberland, Me.	Courthouse	160,000	1942	4	4.13	98.237	July 1, 1922	Fidelity Trust Co., Portland.
	Bridge	100,000						
Dubois, Ind.	Roads	10,500	1932	5		102.314	June 15, 1922	John H. Kroslel, Jasper, Ind.
		8,300				102.571		Geo. L. Drexler, Jasper, Ind.
Essex, Mass.	Bridge	56,000	1923-32	4½	4.17	100.37	July 1, 1922	Merrill, Oldham & Co., Boston.
Hamilton, Ia.	Drainage	60,900	1926-32	5½	....	100.56	May 1, 1922	White-Phillips Co., Davenport.
Harris Co., Drainage Dist., Tex.	Ditch	56,000		6		92		
Kosciusko, Ind.	Highway improvement	18,700	1923-32	5	4.55	102.197	May 15, 1922	A. P. Flynn, Warsaw.
Morgan, Ind.	Highway improvement	14,000	1923-32	5	4.69	101.51	July 1, 1922	Thos. D. Sheerin & Co., Indianapolis
Polk, Minn.	Road improvement	150,000		4½		100.13		Minnesota Loan & Trust Co., Minneapolis.
Pulaski, Ind.	Highway	54,000	1923-32	5	4.59	102	June 15, 1922	J. F. Wild & Co., Indianapolis.
Seminole, Fla.	City improvement	100,000	1952	6	5.40	101.131	July 1, 1922	Marx & Co., Birmingham.
Smith, Tex.	Road	360,000	1952	5½	....	100.31	....	Weil, Roth & Co., Cincinnati.
Trinidad Paving Dist. No. 13, Col.	Paving	110,000		6		100		
Trumbull, Ohio	Road	104,900	1923-31	5½	4.91	102.629	July 1, 1922	Hayden, Miller & Co., Warren
Municipality								
Amity, Ore.	Water supply	$8,000	1942	6	.....	102	July 1, 1922	V. R. Dennis Constr. Co., Amity.
Bellevue, Ohio	Street improvement	9,200	1924-38	5½	5.47	100.04	June 1, 1922	Friedley and Mench, Bellevue.
Bellefontaine, Ohio	City improvement	117,000	1923-38	5½	5.07	102.50	Mar. 1, 1922	Seasongood and Mayer, Bellefontaine
Bristol, R. I.	Highway	110,000	1923-42	4½	4.47	100.219	July 1, 1922	Merrill, Oldham & Co., Boston
Cadiz, Ohio	Paving	15,000	1924-31	5	4.99	100.067	June 1, 1922	First National Bank of Cadiz
Central Falls, R. I.	Highway	100,000	1923-32	4½	4.44	100.79	July 1, 1922	Harris, Forbes & Co., Boston.
	Sewer	125,000	1938-52					
	Water	150,000	1933-52					
Deposit, N. Y.	Highway improvement	20,000	1923-42	5	.....	100.50	July 1, 1922	Sold locally.
Durham, N. C.	Street improvement	300,000	1924-42	5	..	100.65	July 1, 1922	A. B. Leach & Co., New York and others.
	Water	150,000	1925-62					
Estelline, S. D.	Light	16,000		6	....	100.25	June 1, 1922	Gates, White & Co., St. Paul
Freeport, N. Y.	Light	150,000	1927-51	4½	4.30	102.422	July 1, 1922	Farson, Son & Co., New York.
Glendale, Col.	City improvement	23,000	1926-48	5½	5.49	100.049	June 1, 1922	Wm. R. Staats Co., Glendale.
Great Barrington, Mass.	Pavement	40,000	1923-32	4½	4.14	100.516	July 1, 1922	B. J. Van Ingen & Co., Boston.
Greensboro, N. C.	School	300,000	1924-51	5	4.92	100.78	July 1, 1922	Clairborne, Royall & Co., Goldsboro [illegible]
	Water and sewer	275,000	1925-62					
	Street improvement	400,000	1923-32					
Kernersville, N. C.	Water	105,000	1924-62	6	5.93	101.	July 1, 1922	Prudden & Co., Toledo.
	Sewer							
Lima, Ohio	Paving	97,200	1923-31	5½	5.02	102.37	May 1, 1922	Guardian Savings & Trust Co., Cleveland.
Lorain, Ohio	Paving	101,807	1923-31	5½	4.92	102.569	May 15, 1922	Title Guarantee & Trust Co., Cincinnati
Monrovia, Cal.	Park	40,000	1923-62	5	4.766	102.75	June 1, 1922	Citizens National Bank, Los Angeles
Morgantown, N. C.	Water	250,000	1925-62	6	...	104.04	July 1, 1922	Provident Savings Bank & Trust Co., Cincinnati.
New Britain, Conn.	School	570,000	1925-52	4½	4.51	100.715	Feb. 1, 1922	Estabrook & Co., Boston
	Park	100,000	1924-43	5	4.51	100.75	..	[illegible] & Co., Boston and others
Oxford, Ohio	Waterworks	56,000	1923-46	5½	5.03	104.17	June 1, 1922	Title Guarantee & Trust Co., Cincinnati.
Penn Yan, N. Y.	Street improvement	27,500	1923-33	5	4.66	101.81	July 1, 1922	Union National Corp., Penn Yan.
Seaside Park, N. J.	Water supply	70,000	1924-62	6	5.99	100.178	.	Outwater and Wells, Jersey City
Texarkana, Tex.	Paving	200,000	1928-42	5	...	97.85	June 1, 1922	Wm. R. Compton Co., St. Louis and others.
Tonawanda, N. Y.	Street improvement	88,000	1933	4½	4.30	101.74	July 1, 1922	First Trust Co., Tonawanda.
Vero, Fla.	Public utility	68,000	1940-49	6	5.89	101.47	Mar. 1, 1920	G. B. Sawyers Co., Jacksonville.
Wilson, N. Y.	Water	58,000	1926-62	5	.	106.077	June 22, 1922	[illegible] Savings Bank, Wilson.
	Sewer	56,000	1924-52	5		105.857		

Coal and Railroad Strikes

(Concluded from p. 126)

ment of a commission of eleven, of whom three would be named by the miners, three by the operators, and five by the President; which should (a) fix by Aug. 10 wages and working conditions to hold until Mar. 1, 1923; and (b) institute an exhaustive investigation looking to the complete reorganization of the industry.

The miners' stand was that (1) they were unwilling to consent to any revision of wages and working conditions until the conclusion of the reorganization commission's work, and (2) they wished acceptance of the plan to include all mines affected by the strike, including those in non-union fields.

* * * * *

Although peace talk is rife no definite information is available as to a settlement of the shopmen's strike. At a conference between the union leaders and the managers called by the Labor Board on July 14, the former laid down four questions for discussion. (1) farming out shop work by contract; (2) Labor Board decision as to certain rules; (3) as to wages; and (4) establishment of adjustment boards. They demanded also the restoration of strikers without impairment of seniority. The carriers offered to meet their stand on (1) and (2); but urged that (2) and (3) be settled by rehearing before the Labor Board. They refused to agree to the stipulation as to the seniority and the union leaders insisted on a settlement of (2) and (3) before calling off the strike.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of July 6; the next, on August 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.68	$3.65	$4.00	$2.68	$2.86	$3.60	$3.10	+$3.75	$3.75
Structural rivets, 100 lb	[illegible]	4.35	5.50	3.10	3.90	4.45	4.25	3.75	6.50
Reinforcing bars, ¾ in. up, 100 lb	2.58	3.50	3.50	2.58	2.76	3.67½	2.55	3.60	2.90
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9–5%	−46%	49.1%	53%	30.00
Cast-iron pipe, 6 in. and over, ton	50.80	49.00	51.50	46.60	50.50	57.00	51.00	53.00	50.00
Concreting Material:									
Cement without bags, bbl	2.40@2.50	2.50	2.25	2.05	2.29	2.90	+2.71	2.90	+2.78
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	1.80	1.50	1.75	2.25	1.10	1.50
Sand, cu.yd	1.00	1.15	2.25	1.80	1.00	0.75	1.50	1.10	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	39.00	39.00	49.00	−40.00	+51.00	31.00	22.50	47.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	2.75@3.14½	1.80	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	11.00	11.15	11.00	−16@17	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	+.0758	.115	.0707	.086	.08	....	.11	.09
Hollow partition tile 4x12x12, per block	.1112	+.0758	.115	.0657	....	.08	.108	.11	.08
Linseed oil, raw, 5 bbl. lots, gal	.93	−.98	1.07	+1.01	1.03	+1.16	−.04	.86	1.04
Common Labor:									
Common labor, union, hour	.60	.35	....	.80	....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.44@.60	.20	.25	.72½	.35@.50	.35@.50	.47½@.50	....	+.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at pit.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.10 cents. Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Structural steel quoted in Seattle warehouses at $3.75 as against $3.60 per 100 lb.; mill shipments, $3.25 by both rail and water, taking from six to eight months for deliveries from Eastern producing centers. Steel stocks are low in Seattle warehouses with demand increasing. Uncertainty in the fuel situation is causing growing firmness in the Pittsburgh mill price. Shapes and bars quoted at a minimum of $1.70 on current business; $1.80 on small tonnages with deliveries uncertain. Price of $1.60 per 100 lb., however, still existent on contracts, for large tonnages, already made with regular trade.

Cement quoted in San Francisco at $2.71 as against $2.63 and in Montreal at $2.78 as compared with $2.46 per bbl. last week. Duluth quotes $2.04, advanced from $2.02. No price changes elsewhere despite advancing fuel costs.

Douglas fir quoted in Minneapolis at $40 as against $41 per M ft. b.m. Although demand for structural timbers has continued exceptionally active during the last week, no changes in price are noted at the principal cities.

Common brick down $1 per M in Minneapolis; hollow wall tile advanced slightly in Atlanta.

Linseed oil up 3c. in Chicago; 4c. in Denver and down 2c. per gal., 5 bbl. lots, in Atlanta. Flax seed market firmer and paint trade active.

Common labor rates in Montreal quoted at 25c.@30c. per hr. as against 20c.@30c. per hr. last week. Demand for building labor affecting rates in other cities. Plasterers are in greatest demand in New York; other building trades mechanics scarce. Cement and concrete laborers, however, greatly in excess of demand.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 89 NEW YORK, JULY 27, 1922 Number 4

A Way Out

AT LAST a road has been opened toward a solution of the German reparations tangle. The German government has agreed to submit to a minute and rigid supervision of its financial affairs by the Reparation Commission. On that basis there is hope for a moratorium and, given a moratorium, there is hope for the flotation of an external loan. During the past week there has developed also an inclination on the part of France and Great Britain to discuss without display of temperament the scaling down of reparations. All of which bids us hope and watch expectantly for further developments.

Russia and Capitalism

THE Hague conference has ended precisely as was foreshadowed when Secretary Hughes refused to participate in it. He declined to negotiate with a government that refuses to respect property rights or the obligations of contract, for on those rights and obligations only can industrial and commercial enterprise find a sure foundation. The European nations, more hopeful or more anxious, have attempted such negotiation and have failed. The Bolshevik rulers will have none of our capitalistic ideas. Just now, they are cocky and independent. Crops promise well and they can afford to wait. Meanwhile 8,500,000 Russians, the real victims of the Red supremacy, are kept alive by $59,500,000 of capitalistic gold poured into that stricken land by American charity. Capitalism may be anathema to the government of Russia, but her people owe their very existence to the triumph of capitalistic charity over self-interest.

"Taintor" or "Tainter"

FOR a number of years there has been used a type of dam crest gate of well-recognized design known variously as the "Taintor" and as the "Tainter" gate. The literature of the subject uses the two spellings indiscriminately, and there is not readily found any authoritative reference to the man from whom the name is taken. In the interests of uniformity, one spelling should be adopted even were it not due to the original designer to have his name spelled correctly. Can any engineer throw light on the right name of this man?

Getting Down to Cases

NOT the least valuable among the services the American Association of Engineers renders to its members is the work of its Practice Committee, which considers and reports on questions that involve the ethics of professional practice. Following the method of the American Institute of Consulting Engineers, its reports are published in the form of hypothetical problems with answers, although the cases they discuss are concrete and specific and concern actual practicing engineers and their clients. The whole procedure contrasts pleasantly with the fog of generalities that so often falls over a discussion of such questions by an engineering society. So far, more than forty cases have been reported, and the association proposes to compile these and edit them for more general circulation. It is hoped that by this means it may be possible to introduce the engineering student to a consideration of the ethics of his profession and that another step may be taken toward a code of practice that may eventually be of service to engineers in general. Both objects are worthy, and the effort deserves to succeed.

Design or Invention Again

ENGINEERS will be interested in Judge Dickinson's decision in the concrete chute patent case, outlined in the news pages, more as an indication of the trend of patent rulings than because of its effect on chute royalties. It is only a lower court case and is, in effect, in opposition to both the lower and upper court decisions in another circuit, so that it is by no means final in its application to the patent in question. The important part of the Dickinson decision is that once again the courts have emphasized how difficult it is in the construction field to distinguish design from invention. Rarely in that field does anyone discover anything fundamentally new; the best that can be hoped for is to combine old things in a new way. But after all that is what design is. So the courts have to fall back on the principle, reiterated in this case, that in such novel combinations invention lies only in the exact arrangement and amount of combination claimed. Those engineers who are tempted to patent their new ideas will do well to test out their value by this criterion.

Highway Footpaths

AT the next session of the New Jersey legislature the state highway commission will endeavor to secure an amendment to the state highway act which will provide for the construction of paths for pedestrians along state highway routes. Statistics are not needed—although plenty are available—to show that prompt measures should be taken to reduce the number of accidents which have followed in the wake of increased motor traffic. The rural highway, as built under present conditions in the United States, is designed and constructed solely for vehicle traffic. The pedestrian has received little, if any, consideration. Where the automobile driver and the man on foot must use the same traffic way, it is inevitable that the toll of accidents will be heavy. The action of the New Jersey Highway Commission, in its campaign for footpaths, should be followed by other state highway departments. The problem is not a new one. British highway engineers, for years, have included footpaths as an essential part of rural roads. In fact, this detail of British practice so impressed the editor of this

journal during his European trip in 1920 that he wrote (see *Engineering News-Record*, Aug. 5, 1920, p. 275) that "this construction and maintenance of footpaths is but one of the many evidences of a development far beyond our own." It was further pointed out in the letter just referred to that in British practice footpaths are generally of gravel and that a recent trend of practice is to tar-treat them. In two counties, Midlothian and Lancashire, there are many miles of tar-treated footpaths, with stone ranging from ¼ to ½ in. in size. Spraying in alternate years keeps the paths in good condition. In the light of New Jersey's plans, the adoption of footpaths along state roads in this country was accurately forecast two years ago, for the article previously quoted concludes with this sentence: "Before long some one [in the United States] will break the ice by building footpaths; their acceptance after that is likely to be rapid."

Wilmington Garbage Muddle Continues

WILMINGTON on the Delaware is again—or still—in a garbage muddle. A year or two ago the city council and health board got into a mess over a new garbage furnace which failed on test, the health board claimed, but which nevertheless, was promptly paid for by the city council—and immediately broke down. The contractor for the furnace claimed that it could not be expected to burn wet garbage, and for some months there was much local contention over the enactment and enforcement of an ordinance requiring all householders to drain their garbage and wrap it in paper. Now the contractor for garbage collection demands an increase in pay, partly because of the increase in volume of collections through the paper wrappings. Once more the council and health board are at loggerheads. The lesson is to put garbage collection and disposal, whether at Wilmington or elsewhere, in the sole administrative control of one department, under the immediate charge of an engineer experienced in this class of work. Whether collections should be made by the city direct instead of by contract is largely a matter of local expediency, with the consensus of competent opinion, based on both theory and experience, in favor of municipal rather than contract collection.

Trouble From Plastic Subsoil

CONTINUING settlement of foundations is fortunately a rare trouble, but when it happens it is apt to be costly and troublesome in the extreme. This is illustrated by the notorious West Side filter plant in Cleveland, and is another aspect by the Lincoln Memorial approaches, whose underpinning is described on p. 146 of this issue. The engineer gifted with the ability to foresee such settlement trouble will avoid many a grief, and, in so far as careful study of cases of trouble will develop this ability, it is therefore well worth while to scrutinize each new recorded instance. For this purpose the Lincoln Memorial case is of particular value, because it appears to involve plastic action of a relatively unstable subsoil. It adds to the number of cases in which a fill placed on river-bottom deposits has produced a slow squeezing of these deposits chargeable to plastic flow laterally rather than bodily compression. The instability or fluidity of the Potomac River mud has manifested itself on prior work in the valley, for example on some of the District of Columbia bridge work. There is enough parallelism between the behavior of a soil as a fill and its behavior as a subsoil to make it a safe, practical rule that a material which would be questioned for use as a filling material behind a retaining wall should also be considered with suspicion as a foundation or sub-foundation stratum. For either use, we know, a sharp grained material that will settle to a firm, solid condition is quite sure to be satisfactory, while river-bottom soils are common sources of trouble. It should not be difficult for the foundation engineer to check up the quality of foundation subsoils by the criterion of their suitability for wall filling, and thereby get better assurance of stable construction.

Sewage-Sludge Dewatering at Houston

THE latest report on sewage-sludge dewatering at Houston is promising. Had it not come in time to supplement the lengthy review of the operations of the two activated-sludge plants at Houston, published elsewhere in this issue, the outlook for sludge dewatering, as far as experience of Houston is concerned, would have been discouraging.

The cause for discouragement would have been due to the long train of difficulties encountered and apparently not overcome in 1921 at the Houston dewatering plant and to the high cost of pressing and drying the sludge. Mr. Fugate's supplementary note on dewatering tests thus far in 1922 indicates a heavy reduction in pressing costs by conditioning the sludge with sulphur dioxide (without steam) and by using a continuous roller press instead of a filter press. Details of this recent and promising work at Houston will be awaited eagerly by many.

Commendation and thanks are due to the engineering staff and all who have joined the latter in the long-continued and sometimes almost baffling work of adapting available sludge handling appliances to the idiosyncracies of the sludge from the activated process, and of devising new methods of treatment. How well deserved praise and thanks are will be more apparent when emphasis is placed on these facts: (1) Houston, as early as May, 1917, put in operation what is still by far the largest activated-sludge sewage-works in use; (2) that in January, 1918, the city let a contract for a dewatering-plant, designed to produce a commercial (10 per cent moisture) sludge; and that (3) all concerned have persisted through more than four years of effort to build the dewatering plant and get it into dependable operating condition at reasonable cost.

The difficulties incident to commercial sludge dewatering may be further illustrated by the long and varied series of experiments carried on by Mr. Hatton at Milwaukee, preparatory to a decision—not yet announced—on which to base the design of the proposed dewatering plant to handle the sludge from the activated-sludge works that is to treat the sewage of that large city.

That the sludge problem still remains the crux of sewage disposal except where plenty of land is available, is attested by the experiences at Houston and Milwaukee and by the tentative manner in which commercial sludge dewatering has been dealt with—or more generally postponed—by nearly all engineers who have been confronted with the problem in connection with activated-sludge plants in both America and England. Is it at least on the eve of solution? The question is not one of scepticism, but rather of caution and of hope.

A Question of Realism

PROGRESS in the field of engineering structures has consistently been directed toward more accurate definition of the attacking forces to which a structure is subjected and its resisting powers. In the primitive period of the art hardly more than intuitive perception was available to guide the planning of a new structure, while today loads are estimated very precisely, to approximate actual facts as closely as possible, and the structure is proportioned to carry these loads with only the necessary margin of safety. Essentially the change has been in the direction of realism, and the meaning of any step or proposed step in the field may be appraised on the basis of whether it tends in this same direction.

Simple as it appears, the problem involved in load determination is complicated and delicate, because—except in relatively few instances—the loads change from moment to moment, and their amount is beyond the control of the constructing engineer, so that in his design he actually has to enter into a forecast of what the future may bring. Most peculiarly complex, in this aspect, is load determination as it affects the design of railway structures, for this has to deal with progressive growth in traffic and motive-power conditions and therefore involves prediction, perhaps prophecy, in a way quite outside of mere probability calculations. The same general view, however, applies to this subject as was indicated just above, namely, that progress is to be measured in terms of approximation to physical fact.

It may not be generally realized that the loading for which railway bridges are designed is of a kind that does not exist. The heaviest actual train loads affect bridges in a different way from the standard loadings for which they are built. This has been true for quite a few years, and the subject has been repeatedly discussed by engineers with a view to changing to a more satisfactory condition. The Cooper loading system fitted the actual facts excellently for a number of years after its adoption in the '90s, but changes in railway practice soon brought it out of harmony with fact; the divergence between the two has increased until the old load system is no longer safe to use without various arbitrary adjustments, different for each case.

Engineering discussion of this subject in the past has given evidence of a widespread desire to get back to actual fact, if it is possible to determine what the facts as to present and future loading really are. Yet the discussions have remained without positive conclusion except more or less enthusiastic reapproval of the Cooper system. Opportunity is now at hand for a new examination of the question by a discussion within the American Society of Civil Engineers based on a noteworthy analysis presented in a paper by D. B. Steinman. Through a study of the heaviest locomotives and trains used on American railways, and of their effect upon bridges, Dr. Steinman has obtained numerous actual figures showing the discrepancy between the strength results given by the old loading system and the strength required for modern traffic. He has also set up and analyzed several new loading systems which approximate the facts much more closely than the Cooper system.

The discussion opens up not merely the question of this or that wheel load system, however, but the more fundamental question of whether bridge analysis by wheel loads is desirable at all. Wheel-load calculation has been practiced almost universally for three or four decades, in spite of the fact that it is more complex in its handling than calculation on the basis of distributed loads. Its use rests on the very appealing argument that it is a direct representation of actual fact: that cars and locomotives rest on bridges by means of their wheels, and that by using the wheel load and wheel spacings the actual state of affairs on the bridge is transferred to the designer's fundamental calculation sheets.

In the face of this apparently convincing argument the wheel-load system has been applied only in fragmentary manner. The wheel loads of the locomotive and tender have been used for the calculation, but the train wheel loads have not. If this was originally due to the belief that the loads per wheel on freight cars were so small that their action as concentrated loads might be ignored, as compared with that of the engine concentrations, traffic developments have long ago made this view inapplicable, for the heaviest railway cars now have load concentrations not far below those of the locomotive, and, as the spacing of the car wheels is greater than that of the engine wheels, the argument for maintaining the distinction between concentrated and uniform load is greater for the train than for the engine.

Apart from this one phase of the question, however, certain other facts enter in. First, the railway engineer generally takes account of an outward spread of roadbed loads, downward from the rail head, by assuming several ties to distribute the concentrated effect of a wheel. In the case of bridges he omits this step, but it is quite likely that the load effect as it reaches the structural members of a bridge corresponds more nearly to that of a distributed load than to that of a concentrated load. Moreover, inequality of loading which results either from the construction of a locomotive or from conditions developing in its framework or in the track, may frequently produce a difference between the actual locomotive effect and the assumed ideal concentrated-load effect as great as any that would be introduced by the assumption of distributed loading.

Most important, perhaps, is consideration of the fact that wheel spacing and wheel arrangement change from one engine to the next, so that the theoretical beauty of exact correspondence between the real engine and the ideal of the bridge loading diagram can never be maintained for more than an instant. From a sufficiently distant viewpoint, it ought to be immaterial whether a train is hauled by this or by that locomotive, of the same general weight and motive-power effect; the railway mechanical man takes the same view, and we are half inclined to think that the bridge engineer should do likewise, on the ground that the action upon the bridge itself is not very different, present beliefs to the contrary notwithstanding.

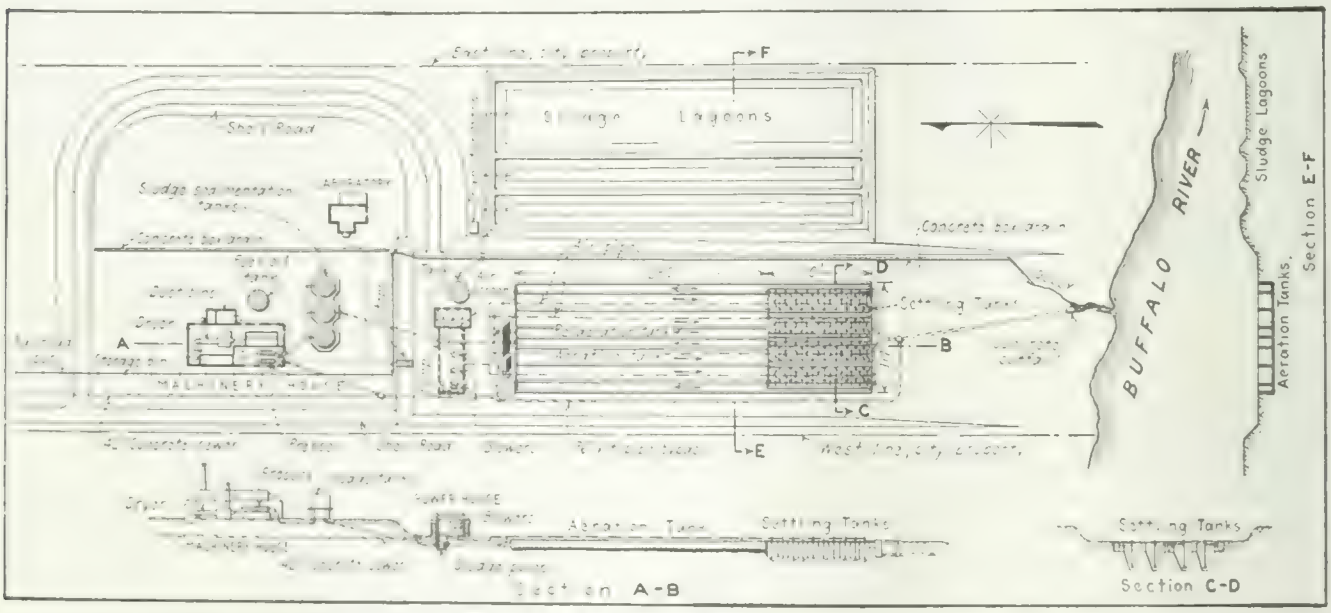
There are reasons, to put the matter briefly, for giving unprejudiced reconsideration to the question of whether it is necessary, or wise, to continue the apparent refinement of wheel-load calculation in bridge practice. The occasion of the paper noted above enables this question to be discussed in detail, and gives opportunity for an important and lasting addition to the bridge engineer's art.

Operation and Dewatering at Largest Activated-Sludge Plants at Houston, Texas

Ten- and Five-M.G.D. Sewage-Works—Filtros Plate Cleaning and Resetting—Operating Curves and Costs for 1920 and 1921—Sludge Dewatering Plant and Acid Conditioning Tests

WHAT is still the largest activated-sludge plant in the world was put in use by the city of Houston, Tex., in May, 1917. It has a capacity of 10 m.g.d. On Aug. 10, 1918, a unit of half the size to serve the remainder of the city began service. Both plants have been operated successfully since, with sludge disposal by lagooning. In October, 1917, small-scale experiments on treating the sludge with soda ash and sulphuric acid were begun, but the results were not sufficiently promising to warrant the adoption of the process. In January, 1918, a contract was let for a dewatering plant to treat all the sludge from the north-side or larger plant by (1) further sedimentation, (2) pressing and (3) drying, so it could be sold after pulverizing as a fertilizer base. Various obstacles delayed completing this plant and putting it into operation until January, 1921, and during 1921 so many difficulties were met that the dewatering plant, although run on a working-scale basis, was not operated at full capacity. Besides testing the presses, conveyors and dryer on a working scale, the 1917 experiments on sludge conditioning were resumed in 1921, using sulphuric acid in one set of tests and sulphur dioxide and steam in another. Final conclusions on sludge conditioning not having been reached at the close of 1921 it was decided to extend the experiments into 1922. (See supplementary note at the end of this article stating that on July 8 it was believed that the dewatering problem had been solved and that the dewatering plant, with the use of sulphuric dioxide gas, and without steam, and with a continuous roller press would go into continuous full-time operation.—EDITOR.) Through the courtesy of J. C. McVea, city engineer of Houston, and G. L. Fugate, principal assistant engineer, we are enabled to present herewith many data from descriptions of the Houston activated-sludge plants, a general review of their operation to the close of the year named and more detailed facts and figures for the years 1920 and 1921 prepared by Mr. Fugate for Mr. McVea's 1921 annual report.

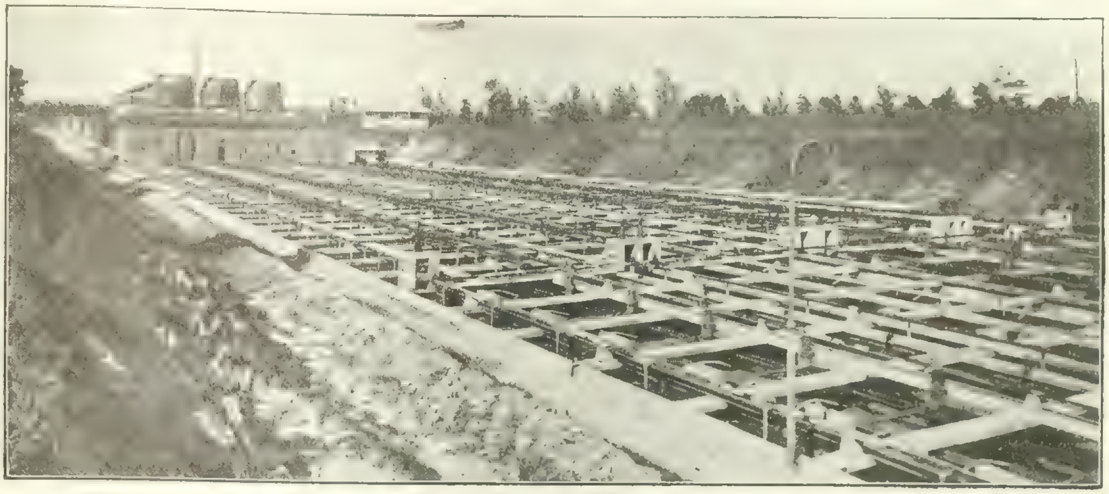
It should be noted that the investigations leading to the adoption of the activated-sludge process for Houston and the designs of the two plants were made by E. E. Sands, city engineer of Houston before Mr. McVea assumed that office. The larger or north-side plant was described by C. L. Williford, an assistant engineer of Houston, in *Engineering News-Record*, Feb. 8, 1917, p. 236; a staff article on operating experiments based on a visit to Houston, appeared Dec. 11-18, 1919, p. 1,103; and a reproduction of the forms used for records, Jan. 8, 1920, p. 75.



LAYOUT AND SECTIONS OF ACTIVATION, SETTLING AND RE-AERATING TANKS, POWER HOUSE AND DEWATERING PLANT

Houston had a population of 78,800 in 1910 and 138,276 in 1920. In the latter year, 14,420 premises had connections with the sewers and there were about 15,000 "box closets," cesspools and small septic tanks. It was estimated that 100,000 of the population had sewer connections. Night soil collections are dumped into the sewers. In general, the sewers are on the separate plan, with storm-water overflows because of illegal roof connections and manhole perforations.

Pumping and Preliminary Treatment—The sewage treated at each plant has first been pumped and then passed through outfall sewers. Before pumping the sewage flows through bar screens spaced 1 in. in the clear, while in addition that going to the north-side or larger plant passes through a grit chamber at a ve-



GENERAL VIEW: POWER HOUSE IN DISTANCE WITH DEWATERING PLANT ABOVE AND BEYOND

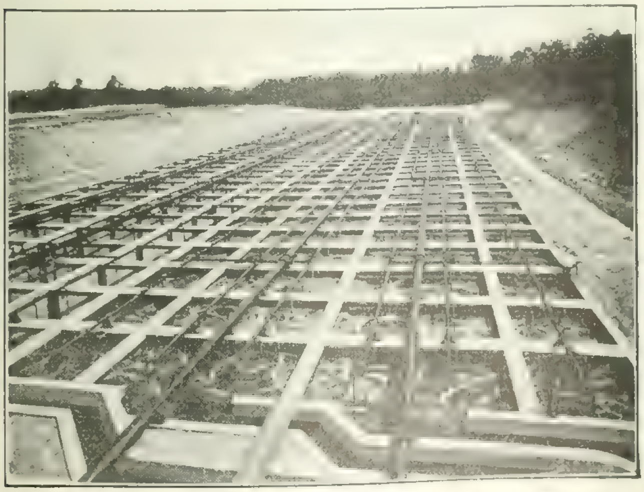
locity of 23 ft. a minute. The screenings in 1921 averaged 3¼ cu.ft. per million gallons of sewage at the main pumping plant delivering sewage to the north-side or larger works and 2.9 cu.ft. from the sewage going to the other works. Some of the screenings are burned in a garbage incinerator and some are used for filling and then covered with ashes from the incinerator. There is no record of the material removed from the grit chamber.

The Two Works—Each of the four 25-m.g.d. units of the north-side plant consists of one aerating channel, 18 x 280 ft. in plan with an area of 5,040 sq.ft.; 10 settling tanks, 10 ft. x 18 ft. 10 in. in plan, with combined top area of 1,883 sq.ft., a sloping bottom, and a depth of 22 ft.; and one re-aerating channel 9 x 280 ft., with an area of 2,520 sq.ft. In each aerating unit there are 1,050 filtros plates, the ratio of plate to surface area being 1 to 7 and the depth of sewage over the plates being 9.75 ft. The air is supplied by Sturtevant blowers, which have a volumetric efficiency of 71 per cent under best conditions, while the overall efficiency of motors and blowers is 50.5 per cent.

Filtros Plates: Removing Iron Rust and Resetting in Concrete.—The filtros plates are 12 in. sq. and 1½ in. thick, grade S, General Filtration Co. make. Originally the plates were set in cast-iron holders, secured at the north-side or larger plant with sulphur and at the other plant (built later) with cement grout. Iron rust from these holders clogged the plates so badly after a few months use that an average of only 1.3 cu.ft. per minute could be passed through each plate under an operating pressure of 11.5 in. of mercury, while some of the plates were completely clogged. The method of removing and cleaning these plates (smashing and scrapping the cast-iron holders; immersing the plates in a 10 per cent solution of hydrochloric acid; re-setting them with cement grout in concrete holders) was described in these pages, Dec. 11-18, 1919, p. 1,003, while the work at the larger plant was in progress, but the report under abstract contains more complete data. About 25 per cent of the filtros plates at the larger plant were ruined, since, being set in sulphur, it was necessary to break the iron to get the plates free. At the smaller plant, where cement grout was used instead of sulphur, it was possible to chip away the joints by means of an air chipping machine and only 1 per cent of the plates were broken. Plates that broke into only two pieces were made usable again by sealing the break with cement grout. The plate resetting, including the new holders, cost $1,500 a unit at each plant. Three of the four units at the larger and one of the two units at the smaller plant have had the plates overhauled.

Effect of Dust on Filtros Plate—Although the concrete holders seem to have virtually stopped rust-clogging (the velocity of the air through the pipes is so low that it carries to the plates very little of the rust which forms in the pipes) there is still apprehension as to the filtros plates becoming clogged. In fact, local clogging takes place and causes trouble, as the following extract from the report shows:

The cleaned plates have now been in use almost two



AERATING TANKS WITH AIR-SUPPLY PIPING

SLUDGE SETTLING TANKS WITH SLUDGE AIR-LIFT

years and show much more clogging than is evident from the pressure diagram shown on the operating chart. This can especially be noted in the more uneven distribution of air over the tanks and the length of time required to obtain normal pressure after power has been off. Considerable power trouble has been experienced in the past six months; during the month of September (1921) the power was off nine times. Check valves are not provided in discharge lines, consequently when power is cut the blowers are reversed by the uneven pressure, thus creating a partial vacuum in the air lines. This causes sludge to settle in a compact mass over the plates and creates more top clogging than ordinary sedimentation would create.

It is proposed to install check valves to prevent vacuum forming, and also to design a machine to grind off about ¼ in. from the top of the plates. It is believed that this will prolong the life of the plates at least one year. When it becomes necessary to replace with new plates the air lines should be thoroughly cleaned of any rust and an air washer installed.

The location of the plant is such that a minimum amount of dust is held in the atmosphere. The air before reaching the blowers is screened through 8-oz. duck with a total area of 750 sq. ft. Tests show that this does not remove small particles of dust and is effective only for screening out large particles and insects which would otherwise be drawn into the blowers and transmitted to the air distributing system. These tests were run by inserting canton flannel discs in the 2-in. supply pipes. The discs would become so badly clogged with fine matter in about two weeks that the air supply would be practically cut off. The dust collected was high in carbon.

One plate was placed in an individual holder and used for nine months in one of the aeration tanks. This was removed, carefully dried, and broken. A dark discoloration was evident for about one-fourth the distance through the plate from the bottom side, similar to clogging material caught on the flannel discs. About ¼ in. on the top showed considerable clogging from sludge. The coarse matter collected in the holder under the plate weighed 4¾ grams, 21 per cent of which was volatile.

The general operating results in 1920 and 1921 for the north-side or larger plant are shown by the accompanying diagram. [The smaller plant, Mr. Fugate states, has given good results, with not a single sample of effluent showing less than 99 per cent relative stability, and with the effluent containing more dissolved oxygen than is necessary to satisfy the five-day bio-chemical demand. The volume of sewage treated is way below the full capacity of the plant.—EDITOR.]

Relative Value of Chemical Analyses—Under this head the report says:

The composition of the raw sewage with an increment of increase in strength is fairly constant and tests need be run only occasionally as a check, except that the tests for nitrogen as free ammonia, bio-chemical oxygen demand and suspended solids should be run each day.

The test for free ammonia is one of the most important tests for controlling the operation of the plant. The free ammonia of the effluent varies widely, depending upon the sludge condition. If the sludge is in the best condition there will be only 2 to 5 p.p.m. and it is desirable to keep the value below 10 p.p.m. There are also rather sharp changes in the amount of free ammonia which are without explanation, and very often if the operation is continued in exactly the same manner, the ammonia will come back to a low value.

The test for nitrites is a fairly good indication of the condition of the effluent. In the best working conditions the nitrite value is very low. The test is easy to make and may be taken each day with very little trouble.

The nitrate test is, if anything, more important than the free ammonia test. It has been noticed that in the very best condition of the sludge the value of the nitrate should be about 40 per cent of the value of the free ammonia in the raw. It is desirable to keep the value above 2 p.p.m. The effluent usually has good stability if the value of the nitrates is above 2 and the value of free ammonia below 10.

The oxygen consumed test is not considered of any value in the operation of the plant and will be discontinued this year. The test for suspended solids is of more value as a matter of record and in making certain computations.

As a final analysis the relative stability records both by the methylene blue tests and the bio-chemical oxygen demand tests are certainly necessary and give a good indication for the final object in the operation of the plant, but are of little value in control operation as the time required is too great for immediate results. The sludge changes very quickly and the tests for free ammonia and nitrates give the results at once and if necessary a change in operation can be made.

The increase in the strength of the sewage during the past two years, as measured by suspended solids, free ammonia and by bio-chemical oxygen demand, and by the screenings, is attributed by Mr. Fugate to an increase in night soil collection and a decrease in both per capita water consumed and ground water infiltration, the latter because of the dry year.

Construction and Operating Costs—The cost of each activated-sludge plant not including land or the $82,787 paid for the north-side dewatering equipment, together with a summary of 1921 operating costs, is shown by Table I.

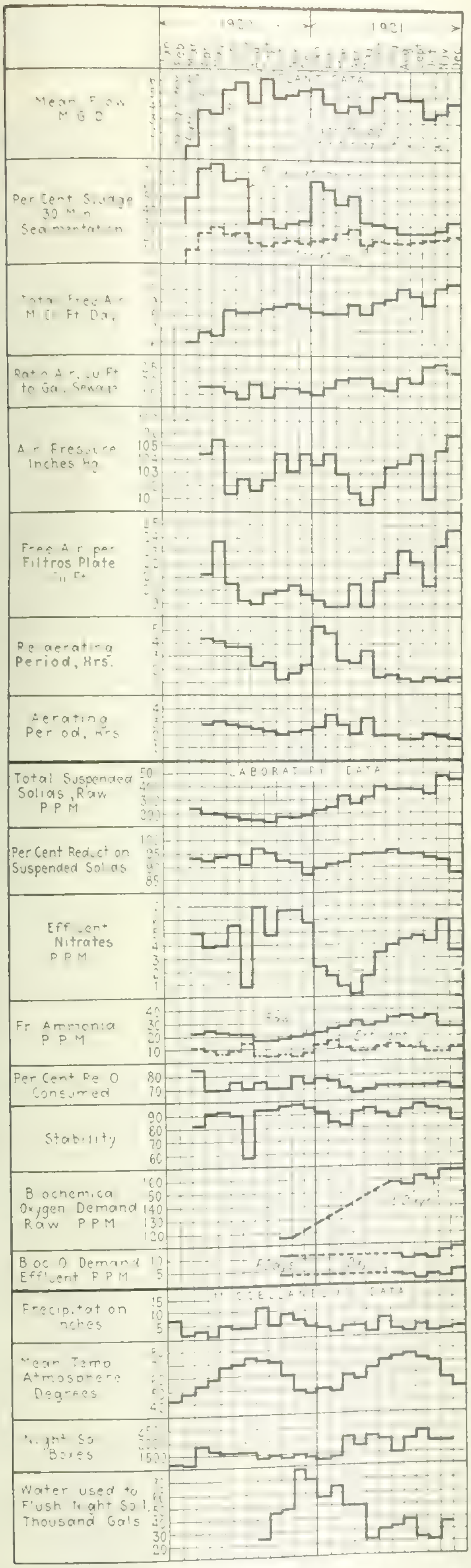
TABLE I. CONSTRUCTION AND 1921 OPERATING COSTS FOR HOUSTON ACTIVATED SLUDGE PLANTS

	North Side	South Side
Construction Cost*		
Excavation	$25,822	$6,361
General contract...	194,405	87,789
Crane	1,125	1,125
Motor and blowers	7,245	6,199
150 hp. Diesel engine	7,646	
Sludge pump and motors	526	525
Wayne oil tank	86	43
Concrete fuel oil tank	1,200	
Well....		1,350
Elevated steel tank		1,917
Water pump and motor...		373
Filtros plates	6,439	3,219
Miscellaneous	82	18
Total	$244,576	$108,919
Engineering and incidentals	10,095*	7,656*
Grand total	$254,671	$116,575
Cost per m.g.d. cap.:		
Without engineering, etc	$24,475	$21,784
With engineering, etc....	25,467*	23,315*
Operating cost in 1921:		
Monthly salaries..........	$6,938	$5,297
Weekly salaries	4,223	2,172
Power	11,134	2,535
Supplies and maintenance..	3,813	366
Total	$26,108	$10,370
Cost per m.g. treated	$16.30	$15.20

* From the article in *Engineering News-Record*, Dec. 11-18, 1919, p. 1003, based on notes obtained at Houston, the preceding November by a member of the editorial staff of that Journal, it appears that the construction cost figures include no allowances for 50 acres of land bought by the city at the north-side and 15 at the south-side works, of which only some three acres is used for works purposes in each case. The items for engineering and incidentals have been taken from the article named above, as they are not included in the report on which this article is based.

Sludge Lagooning—At both plants the sludge has been satisfactorily lagooned, without creating any nuisance, Mr. Fugate states. Deep lagoons have been used at both plants, but at the south-side or smaller plant it is proposed to construct and try three shallow ones, about 2 ft. deep and an acre in area in the hope that the material will dry "sufficiently to be hauled away by farmers." As to the quantity of sludge produced, Mr. Fugate states that measurements have not been possible (it is hoped that they may be in the future). He submits the following estimate:

By taking the number of hours the sludge pump was run in November and December, 1921, using an estimated capacity for the pump and the average moisture in the sludge, and checking against the quantity of suspended solids in the raw sewage, the result for November would indicate a digestion of 54.8 per cent and for December, 48.6 per cent. Using the average solids in suspension for the year 1921, a quantity of 1,518 lb. of 10 per cent moisture sludge per million gallons sewage is derived. However, it is believed that these figures should be used with caution as possibly the pump rating may have been in error due to changing conditions between the observations from which the average capacity was estimated.



OPERATING RESULTS BY MONTHS IN 1920 AND 1921 AT HOUSTON 10-M.G.D. ACTIVATED SLUDGE PLANT

The amount of digestion in the lagoons, Mr. Fugate thinks, is indicated by the difference in the volatile matter of the fresh and the lagooned sludge, as shown by Table II. The character of the lagoon effluent may be judged from Table III.

TABLE II. ANALYSIS OF FRESH ACTIVATED SLUDGE AND OF SLUDGE FROM LAGOON EDGE, NOV. 26, TO DEC. 4. 1917

	Fresh Activated, Per Cent	From Lagoon Edge, Per Cent
Volatile	70.12	55.42
Fixed	29.89	44.58
Fats (ether soluble, dry basis)	9.28	9.51
Ammonia (dry basis)	5.58	3.95
Phosphonic acid (total, P_2O_5)	1.45	1.29

TABLE III. ANALYSIS OF SLUDGE LAGOON EFFLUENT, DEC. 13, 1917

	P. P. M.
Free ammonia — nitrogen	92.00
Nitrites — nitrogen	00.05
Nitrates — nitrogen	00.40
Organic — nitrogen	12.00
Suspended solids, volatile	50.00
Suspended solids, fixed	16.00

Early Tests of Sludge Acidification—The sludge conditioning tests to be described later were preceded in October, 1917, by tests with soda ash, sulphuric acid and heat, "along the lines of the so-called flotation process." Sludge from the re-aeration channel was settled one hour in 50-gal. barrels, the supernatant liquid siphoned off, the settled sludge heated to the desired temperature in galvanized-iron tubs over an open fire, and soda ash added and stirred to effect a complete solution. The sludge was then transferred to a barrel fitted with a valve at the bottom, the acid added with stirring and the contents allowed to separate for various lengths of time.

In this process (1) the acidification of the soda ash (sodium carbonate) frees large volumes of carbon dioxide which are entrained in the sludge and reduce its specific gravity; (2) the excess of acid over that required to neutralize the soda ash produces a chemical and physical effect upon the sludge. The soda ash used contained 58 per cent of sodium carbonate and the sulphuric acid had a specific gravity of 66 deg. Bé.

The tests showed that the best results were obtained with 105 lb. soda ash and 268 lb. sulphuric acid per ton of dry sludge at a temperature of not less than 45 deg. (113 deg. F.) . At and above this temperature the acid changed "the color of the sludge from an olive to a light brown, apparently causing it to floc in large aggregates," while the "water separated more quickly than from the untreated sludge."

Acidulation increased the percentage of ether-soluble fats from 12.91 to 14.19 and of nitrogen from 6.59 to 6.82. "The fats obtained were liquid and dark brown, in appearance like crude petroleum or heavy lubricating oil," so poor a product as to make fat recovery by this method not feasible. As to this dehydration process as a whole it was concluded that it "would not be successful, but may have some merit as a conditioner before some other final method." With chemicals in the amounts stated just above, and at a price of $3.60 per 100 lb. for soda ash and $22 per ton for sulphuric acid, the soda ash-sulphuric acid-heat method of sludge treatment would cost $6.70 per ton of dried sludge, with no allowance for heat, labor and capital charges.

Sludge Dewatering Presses and Driers—Mr. Fugate's description of the plant installed at the north-side or larger works to produce a commercially marketable sludge, the difficulties met and apparently not yet wholly

overcome in operation, and the tests on sludge conditioning with (1) sulphuric acid and (2) sulphur dioxide gas and steam is given in full below, and is supplemented by an important statement written by Mr. Fugate on July 8, all as follows: [Side heads here and elsewhere inserted by the editor.]

Early in 1918, a contract was entered into with the Simplex Ejector Co. of Chicago to furnish rams, presses and compressors, and with the Buckeye Dryer Co., Columbus, Ohio, to furnish a rotary dryer, conveyors and elevators, the object of this equipment being to dehydrate the sludge to a moisture content of not over 10 per cent, the resulting material to be used as a nitrogenous base for fertilizer. Due to the unsettled conditions brought about by the war and the period immediately following its close, the entire equipment was not furnished until in December, 1920.

First Stage: Further Sedimentation of Sludge—In this process of dehydrating the sludge, the first stage is to pump the sludge from the re-aerating channel to three 50,000-gal. cypress sedimentation tanks supported by a concrete platform about 16 ft. above the surface of the ground, the maximum head against which the pump works being 50 ft. This pump is a specially designed Worthington, 5-in. double suction, horizontal, split case, bronze impeller volute pump, 500 gal. per minute capacity, direct-connected wth flexible coupling to a 10-h.p. General Electric 220-volt, 1,200-r.p.m. motor, set on an extended base.

Considerable trouble has been experienced with the stoppage of this pump by small sticks, matches and fibrous materials, but this has been partly overcome by inserting cutting blades in the casing around which the impellers revolve.

The sludge as it comes from the re-aeration channel contains 99.6 per cent moisture. This is reduced by sedimentation in the cypress tanks to 98 to 99 per cent, depending upon the condition of the sludge and time settled. The tanks are supplied with a pipe grid aerator, so that sludge can be aerated during the pressing time, and also with piping for drawing off the supernatant liquid.

Second Stage: Filter Pressing—In the second stage, the settled sludge flows by gravity to two 500-gal. Simplex rams, or ejectors, where a varying pressure passes the sludge to the filter press. A maximum pressure of 140 lb. has been used, but apparently there is but little advantage gained by using a pressure of over 110 lb. There are two Simplex filter presses, each having 120 33x33-in. center-feed plates, designed for cake 1 in. thick. The solids are retained upon the filter cloths, while the filtrate is returned to the aeration tanks. The air pressure for operating the press is furnished by two Gardner horizontal two-stage 8x4x6-in. compressors, maximum pressure 250 lb., speed 300 r.p.m., belt-connected to a 20-hp. slip ring, 220-volt, 3-phase, 60-cycle Ideal motor, speed 1,140 r.p.m. After pressing the cake is dumped upon an inclined platform and raked into a storage bin fitted with twin-screw conveyors; by these conveyors it is delivered to the feed end of the dryer where the third stage of dehydration takes place.

Third Stage: Heat Drying, Followed by Pulverizing—The dryer is a Buckeye type A, 5 ft. in diameter and 40 ft. long, known as a direct-indirect heat rotary dryer. The heat is produced in an oil burning furnace which is fitted with a relief stack. The dryer complete has all necessary elevating, conveying and transmission machinery to deliver the dried sludge from the dryer to the pulverizer, storage bins and railroad cars. A conveyor is also installed to pass cake that is not sufficiently dried back from the discharge to the feed end for redrying. The best results are obtained usually by passing back a small quantity of dried material, mixed with the wet, thus making the cake handle better through the conveyors and dryer. The vapors are exhausted by a No. 60 Garden City fan, speed 430 r.p.m. The vapors pass through a baffled dust chamber fitted with a water spray condensor.

A line shaft, speed 300 r.p.m., driven by a 40-hp. General Electric, 2,200-volt, 3-phase, 60-cycle motor, drives the fan for the vapor chamber, screens and all elevating and conveying machinery, also the fuel oil pump. A counter shaft belted to the dryer and a Williams Pulverizer is driven by a 25-hp., 2,200-volt, 3-phase, 60-cycle, Allis-Chalmers motor.

The construction cost of the dehydrating plant was: Building, $22,980; presses, $29,945; dryers, $21,353; tanks, $1,993; motors, $826; railroad spur, $5,689; total, exclusive of land, $82,787.

Operating Problems and Conditioning Experiments—In January, 1921, the plant was put into operation. At once various problems began to arise, and instead of the process being simple it was found to be very complex. With no precedent for a guide, the decision was reached to operate the plant on large-scale experiments with a small crew of operators and not attempt the full operation until the trouble was found and remedied if possible.

The experiments have included the full dehydration of sludge in all conditions likely to be encountered in ordinary operation of the plant. The conditioning of sludge by acidification with sulphuric acid and also with sulphur dioxide gas mixed with steam has been tried and a careful comparison with unconditioned sludge has been made.

Filter Cloth Troubles—The presses as received from the manufacturers were fitted with radial ribs in the cake chamber. Drier cake could be obtained with these ribs, but the wear on the clothes made their use prohibitive. During a number of pressings 50 per cent of the cloths would be ruined for further use, even with first-run cloths. Without the ribs the cloths last better but tear around the edges. This is a mechanical fault of the press that has not been overcome. Most of the pressings have been made with 11-oz. duck, but several materials have been tried. The 11-oz. duck gives the best rate of filtration, but hose cloth lasts longer. A specially imported jute cloth has been tried, also several grades of burlap. The life of these is greater than duck, but the filtration rate is much lower and the sludge adheres in larger quantities, making the cloths more difficult to launder. The cloths are most important in pressing and one of the big items of expense.

Pressing results with unconditioned sludge have varied between wide limits. The lowest moisture content of cake was 85 per cent and time of pressing 3¼ hours. The average of all pressings is shown in the first column of figures in Table IV.

The maximum evaporation made in any one run was at the rate of 1,751 lb. of water per hour with a 15.2 ratio of water to oil containing 19,000 B.t.u. The average of the three highest runs was: evaporation, 1,722 lb. per hour; ratio, 12.8.

Sludge Conditioned with Sulphuric Acid—It was found that by adding a small amount of acid to the sludge more water could be removed by sedimentation, pressing time reduced, and a better cake obtained. In the early experiments it was thought that the less water to be filtered the less time would be required for a pressing. However, this was found to be true only within certain limits. Experiments to determine the amount of acid required for the minimum moisture with one to three hours sedimentation showed that with 0.01, 0.02, 0.03 and 0.04 of acid the corresponding moistures were 98.71, 97.96, 98.43 and 98.72.

In practice the sludge was settled in the 50,000-gal. tanks and after drawing off the supernatant liquid the acid was added, thoroughly agitated, and pressing begun immediately. The average results obtained are shown in the second column of figures in Table IV. The moisture could not be reduced in the large tanks as low as in the laboratory, due to the difficulty of removing the supernatant liquid as efficiently as in the laboratory.

This shows that considerable advantage is gained in pressing by using acid, but is partly lost in drying. It has been observed that acidified sludge when introduced into the dryer has a marked tendency to roll up in balls

TABLE IV. PRESSING RESULTS AT THE HOUSTON ACTIVATED-SLUDGE PLANT WITH UNCONDITIONED AND WITH CONDITIONED SLUDGE

	Unconditioned	Sulphuric Acid*	Conditioned With Sulphur Dioxide Gas and Steam†
Moisture of sludge, %	98.48	98.70	98.88
Moisture of cake, %	87.37	82.64	85.58
Volume of sludge required to press, gal....	5,850	10,400	11,900
Cloths broken per pressing, no..	14	10	28
Av. maximum pressure, lb	106	110	99
Av. pressing time, hr. and min	4-42	3-20	3–30
Av. quantity of cake per press, lb	3,280	3,390	3,108
Cake produced of volume of press, %	72.2	75.4	70.7
Quantity of dried sludge per pressing, lb.	335	392	448
Ammonia in dried sludge, %.......	3.6	4.6	4.6
Sludge lost during drying, %.....	19.5	33.0	2.2‡
Ratio of evaporation, water to oil	9	6.2	5.8
Evaporation per hour, lb................	1,250	1,025	850
Volumetric efficiency of entire process, % **	58.7	50.2	69.9

* Using 0.01% of acid.
† Using 102 lb. of sulphur and 925 lb. of fuel oil per pressing.
‡ Mr. Fugate states by letter that the number of runs made with sulphur dioxide gas and steam was relatively low.—Editor.
** Percentage of final dried sludge to the theoretical volume that should be produced per press. "Dried sludge" means the final product of the dewatering process.

of different sizes, ranging from that of a small pea to several inches in diameter. As the drying advances the sludge reacts differently according to its character. It may break into flaky particles or form small balls with a hard, smooth surface. The latter condition is found to prevail with a sludge of a relatively large fat content, say between 9 and 12½ per cent. The untreated sludge after drying contains about 3.5 per cent of fats.

The reason for better dehydrating qualities of raw cake, as compared with acidified sludge cake, lies probably in the fact that the addition of sulphuric acid raises the fat content of the cake, and that the coagulated colloidal matter gives up its moisture less readily; also that the presence of any free sulphuric acid with its low volatility would retard the drying process.

Advantages and Disadvantages of Acid Conditioning—The advantages of using acid are in the lower moisture content of the cake, less time to press, and the increased nitrogen content; also the cake keeps better and dries with less odor. Odors, however, are not offensive if the cake is dried immediately after pressing.

The disadvantages are the lower evaporation ratio, a greater loss in drying, the drying process more difficult to control, more or less personal danger in handling the acid, the probable deteriorating effect upon the plant, and the increased fat content. About 10 per cent of the dry sludge is collected as dust from the dust room, and this amount seems to be the same with either unconditioned or conditioned sludge.

In the experiments described, the acid was applied to the total quantity of sludge to be pressed. A period of three or four hours would elapse from the beginning of the pressing to the close, during the latter part of which the sludge had a tendency to become alkaline. Equipment is being installed to apply the acid to each charge of sludge just before reaching the press and to use the hydrogen-ion concentration as control. It is believed that much better results may be obtained this way, as the sludge will reach the filter immediately after being acidified, thus doing away with the time element in pressing; also drying immediately after pressing may increase the drying efficiency.

Sludge Conditioned with Sulphur Dioxide Gas and Steam—In co-operation with the MacLachlan Reduction Process Co. of New York City, experiments have been made by gassing the sludge with sulphur dioxide mixed with steam immediately before pressing. (See last column of Table IV. for comparative results.)

Advantages and Disadvantages—The disadvantages of this method are: The bad effects of the sulphur fumes upon the operators, cost of oil used for producing the steam, and the low rate and ratio of evaporation. But there seem to be certain advantages and it is expected to continue the experiments with the view of eliminating the undesirable features mentioned. Based on these experiments, a comparison of costs of the different methods has been made showing the probable cost to operate the present plant. (See Table V.) [The figures have been combined in a single table for ease of comparison, as also some of the other figures given in this article.—Editor.]

Sludge Tests in 1922: Sulphur Dioxide Gas Without Steam and Continuous Roller Press Believed to Have Solved Dewatering Problem and Reduced Pressing Cost from $40 to $5 per Ton of Dry Sludge—A letter from Mr. Fugate, dated July 8, contains the following significant conclusions as to the results of the 1922 dewatering tests.—EDITOR:

The experiments with sulphur dioxide gas, which we have carried into 1922, are giving most promising results. The process, which has been developed in co-operation with the MacLachlan Reduction Process Co., consists of gassing the raw sludge without the use of steam, the gas being transmitted from the generator by a positive presser blower, and the gassed sludge passing through a continuous roller press, giving to date a cake of 78 per cent uniform moisture. The operation being continuous, there is no laundering of filter cloths. This method also does away with expensive delays which were experienced with the plate filter press. We are sure that we can produce cake of 78 per cent moisture for about $5 a ton, dry basis, thus reducing the pressing costs from about $40 to $5 a ton.

We now feel that our dewatering plant will be put in continuous full-time operation and the dewatering problem satisfactorily solved, and hope to have within the next thirty days or so a report giving complete details.

TABLE V. COMPARATIVE COST OF DEHYDRATING ACTIVATED-SLUDGE FROM RE-AERATION TANKS (1) RAW, (2) CONDITIONED [illegible] SULPHURIC ACID; (3) CONDITIONED WITH SULPHUR DIOXIDE GAS AND STEAM

	Raw Sludge—422 Tons per Year		Sulphuric Acid Gas: 706 Tons Sludge per Year		Sulphuric Acid Gas: With Evaporation Ratio of 12 and Rate of 1,535 Lb per Hr.*		Sulphur Dioxide Gas and Steam: 810 Tons Sludge per Year†		Sulphur Dioxide Gas and Steam: 600 Tons per [illegible]
	Pressing	Drying	Pressing	Drying	Pressing	Drying	Pressing	Drying	Pressing
Superintendence..........	$4.45	$4.45	$2.70	$2.70	$1.50	$1.50	$2.35	$2.35	$3.15
Labor...	13.55	9.60	8.10	8.90	4.55	5.00	10.20	7.80	11.20
Power	3.70	1.45	2.30	1.30	1.25	.70	1.95	1.20	1.60
Filter cloths	8.50	....	5.10	....	2.85	.	4.45	..	6.0[illegible]
Repairing filter cloths......	4.20	....	5.10	...	2.85		5.30	..	2.6[illegible]
Laundering filter cloths....	2.40	....	1.45	..	.80		1.25	.	Included [illegible]
Sulphuric acid...........	....	....	8.50	....	4.70	....	....	....	.
Sulphur	....	....	...		.		4.60		4.60
Fuel oil	....	9.20	....	11.00	.	5.10	11.60	10.05	[illegible]
Miscellaneous...	1.20	1.20	.85	.85	.40	.40	.60	.60	
Totals................	$38.00	$25.90	$34.10	$24.75	$18.90	$12.70	$42.30	$22.00	
Total cost per ton.......	$63.90		$58.85		$31.60		$64.30		$70.20
Probable wholesale value...	12.60		16.80		16.80		16.80		16.80
Net cost................	51.30		42.05		14.80		47.50		
Net cost, retail value......	$38.90		$33.85		$6.60		$39.30		$45.[illegible]

* Individual runs produced results that warrant the introduction of cost figures on this basis. † Assuming dryer can be forced to 1,135 lb. evaporati[illegible] hour.
‡ Assuming 850 lb. evaporated per hour.
All the cost figures, with the exception to be noted, are based on the following rates paid in 1921 for salaries, wages and power at the pump[illegible] plants. Operators, $145 to $160 per month; laborers, $3.75 to $4 per 8-hr. day (some of the labor estimates in the table are based on a rate of [illegible] 0.6c per kilowatt-hour.

FROM JOB AND OFFICE

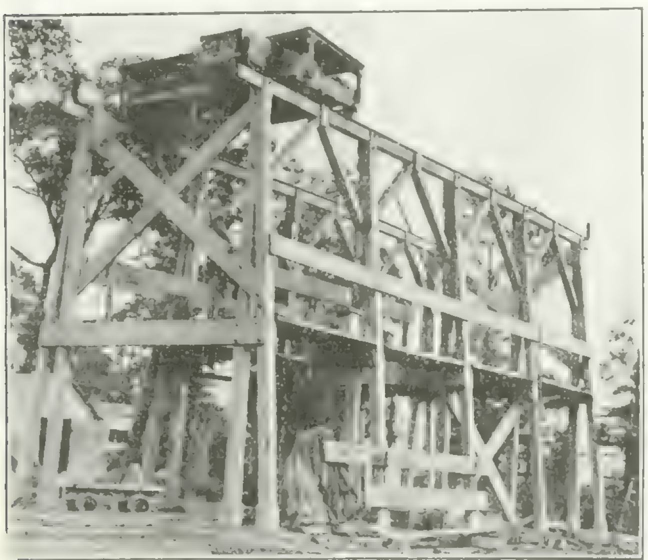
Hints That Cut Costs and Time — *For Contractor and Average Engineer*

Traveling Bridge Crane Used to Handle Sewer Construction Materials

By J. H. McGinn
Detroit, Mich.

A TRAVELING bridge crane of the type commonly used in machine shops, is being successfully used for handling material into and out of sewer tunnel shafts in Detroit, Mich. Being electrically operated, there is with this equipment a freedom from smoke and noise which is much appreciated by residents along the work. With the headframing put together, for quick dismantling, the outfit is also easy to shift with the frequent changes of shaft location required on small sewers with short drifts.

The headframe centered over the tunnel shaft is built of 6 x 6-in. timbers, is 18 ft. high and has a span of 10 ft. between rails. The bents are 8 ft. apart.



BRIDGE CRANE ON SHAFT HEADFRAME

Each upright is stiffened with a 6 x 6-in. batter timber offset 1 ft. 6 in. on the sill and mortised in at the top. All joints are mortised and bolted together. The operating platform is 7 ft. above the ground sills. The rail timbers are held by scab plates and supported at the centers of bays by 4 x 6-in. knee braces.

The trolley, which is of a standard design built by the Whiting Corp., Harvey, Ill., is equipped with two 3-phase, 60-cycle, a.c. General Electric motors. The hoist motor has a lifting speed of 165 ft. per minute, and the horizontal travel speed is 150 ft. per minute. Both motors are controlled and operated from the floor by pendant hand chains attached to trolleys. The 3-ton capacity hoist drum is equipped with two separate cables winding simultaneously on the drum, giving a direct lift and eliminating all pulley blocks.

With its hoist and travel motions the crane takes the dirt from the bottom of the shaft and dumps it into trucks, which back in under the operator's platform. It also easily handles all material from the ground level to the shaft bottom. A chain fastened to the trolley frame is hooked into rings in the center of the bottom edge of the spoil boxes and by lowering away on the hoist motor the spoil boxes are made self-dumping. One man operates the crane and dumps all spoil boxes. Ease of erection and dismantling is secured by means of an A-frame of 8 x 8-in. timbers, 22 ft. high, which fasten alongside of four of the uprights of the crane frame and are cross-braced parallel to the sides of the crane, but not transversely, and have a head piece bolted on top. By means of chain falls the electric trolley is lifted from the rails; a section of the rails and supporting timbers is then removed and the trolley is lowered to a truck for moving.

This crane equipment was developed by Raymond A. Mercier, Detroit, Mich., on whose sewer contracts it has been in successful use for some time.

Culvert Form Is Made of Sand

By H. K. Palmer
Engineer, U. S. Indian Irrigation Service, Los Angeles, Cal.

IN BUILDING a concrete-lined ditch on the Fort Independence Indian Reservation, Cal., it was found necessary to cover about 40 ft. to provide a passageway for sheep. The ditch has a bottom width of 18 in., is 12 in. deep and has side slopes of $\frac{1}{2}$: 1, making the top width 30 in. On account of the small size a wood form for the cover would be difficult to remove, and one of sheet metal which could be left in place proved too expensive, on account of the high cost of material in this out-of-the-way location. The method adopted is shown on the drawing.

An inverted trough made of two 1 x 6's was laid in the bottom of the ditch, but raised off the bottom by means of 1-in. blocks spaced about every 5 ft. This was covered with sand to near the top of the ditch and the sand was compacted and shaped to form the centering for an arch. A sheet of building paper laid on top of the sand prevented any water from washing cement out of the concrete, and completed the form.

SAND FORM FOR SMALL DITCHES

After the concrete has set the sand was removed by turning a stream of water through the inverted trough. The trough being raised on blocks gave the water a chance to undermine the sand and in a few moments to carry all of it, with the trough, out from under the top. The grade of the ditch was about 2 per cent and the whole form was removed in four minutes.

In another instance where the culvert was shorter but the ditch had a much smaller grade it took a little longer, but every time it has been tried it has worked so successfully that the method has been made a standard for building bridges or culverts across small ditches.

High Stockpiles Built Up with Heavy Trucks

By H. B. Jay
Superintendent of Construction, Illinois Division of Highways Cobden, Ill.

By MEANS of portable runways, a very satisfactory method of stockpiling road materials with heavy trucks was devised by the writer and is in use south of Carbondale, Ill., on day-labor construction. Runways in 10-ft. units are used. They are so constructed that all are interchangeable and are of such weight that two men can handle one unit.

Each runway unit consists of two 4 x 4-in. timbers laid parallel on 12-in. centers to which are spiked 2 x 12 x 16-in. planks, the ends of the planks being flush with the 4 x 4-in. timbers. On top of these planks, at the outside edge of the runway, a 4 x 4-in. timber is bolted to act as a guide for the truck wheels. The units are fastened end to end by means of $\frac{3}{4}$-in. hooks and eyes, and are fastened together laterally by the same method except that these hooks are of a length to give the proper gage of track.

TRUCK BUILDING HIGH STOCKPILE

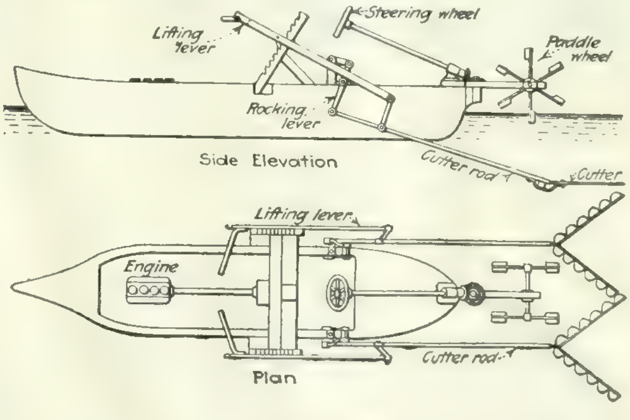
Care must be taken that the runways are supported in their entire length by the stockpile material, as they are not designed to act as bridges. They are easily and quickly assembled, and as easily taken apart and installed at a different stockpile. By them crushed stone is being stocked in piles 100 ft. long and 15 ft. high, and the piles could easily be made higher if necessary. Even though the weight of the loaded trucks averages 18,000 lb., no difficulty is experienced with the runways sliding, tipping up, or moving out of line.

TIMBER TRACK FOR TRUCKS PILING CRUSHED STONE

Weed-Cutter for Canals and Lakes

An ENGLISH device for clearing rushes, water lilies, weeds and other growth from drainage and irrigation ditches, rivers, lakes and ornamental waters consists of power-driven cutters operated from a small motor boat of 12-in. draft. Each cutter consists of a steel blade V-shaped in plan with a wavy or scalloped cutting edge and having the apex attached to a long rod. There is a rod on each side of the boat, as shown in the accompanying drawing, the upper end being attached to a rocker arm and also to a link on a lifting lever by which the cutter is raised and lowered as desired. The rocker mechanism is driven from the launch engine and as the boat moves forward the cutters are given a rapid oscillating motion, so that they engage the weeds at high velocity and strike them with a diagonal cut.

In shallow water the cutters trail on the bottom, being provided with spring shoes to keep them out of the mud and to guide them over logs or other obstructions. In deeper water they are set usually to cut at a depth of 4 to 6 ft. It is stated that in ordinary service the boat will clear as much as four acres in an hour. A small double paddle wheel is used for propulsion as it will not be clogged with the weeds. This wheel serves also as a rudder, being carried by a pivoted frame which has a radial movement in a horizontal plane. For small ditches, a rowboat or a scow pulled by tow lines may be fitted with a single hand-power cutter, the oscillating mechanism of which is operated by a crank handle.



POWER DRIVEN WEED-CUTTER ON MOTOR BOAT

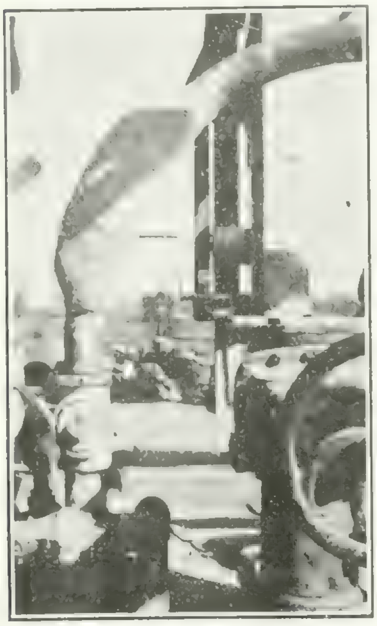
This weed-cutting device has been used extensively in England and also in India, Egypt and Australia. It is built by the Saunderson Tractor & Implement Co., Bedford, England.

A Record in Pile Driving

With a 3,200-lb. drop hammer and a crew of nine men, the W. S. Randle & Son Co. drove 138 pine piles averaging about 51 ft. in length in 10 hours, in Norfolk Harbor, Virginia. The piles were hoisted from the water, hauled 1,000 ft. and delivered to the driver as they were driven. The points and butts had not been previously made. To drive this number of piles, amounting to a total of 7,004 ft., or 1.32 miles, of timber, necessitated the handling of one stick every 4.3 minutes during the entire ten hours. This time includes that which was required for moving the driver.

Concrete Takes Sand Blast Abrasion in Bend of Ejector Pipe

A 4-in. pipe used in the construction of the Sacramento filtration plant for blowing sand out of a tunnel under air pressure of 80 lb. per square inch, was subjected to excessive wear at bends. Steel pipe of ordinary thickness wore out in about two weeks. After some experiment a patch made of rich concrete reinforced with wire mesh was put over the points where wear occurred, making the patch of generous proportions and extending it entirely around the pipe, as shown in the accompanying illustration. When the work shut down this bend had been in service for a month without giving any outward indication of wear.



CONCRETE PATCH OUTWEARS STEEL PIPE

Time Saved by Arrangement of Time and Pay-Roll Forms

By W. N. Connor

Aberthaw Construction Co., Boston, Mass.

In construction accounting all forms which are used together should be, as far as possible, similarly ruled and of the same size. In the practice of the Aberthaw Construction Co. the timekeeper's field sheet on which the men's numbers and hours are shown is ruled and numbered identically with the pay-roll sheet. When transferring the time each day from the timekeeper's field sheet to the pay-roll it is only necessary to place them so that the lines coincide, and then copy the time from the right-hand column of the time sheet to the adjacent pay-roll column.

Another help is to have the employees' numbers shown on the extreme right of the pay-roll. This expedites paying off and lessens the chances of error. The pay clerk need only look from the amount column to the number column—a distance of less than three inches. When the numbers are shown on the extreme left, which is usually the case, and the amount at the extreme right, it slows up the paying and offers a greater chance of error.

Ventilators for Concrete Reservoir Roof

When waterproofing is applied in concrete reservoirs that are roofed over with concrete, difficulties of the work are greatly increased by the lack of ventilators to provide a means of escape for the dense smoke that arises from tar or asphaltic compounds. According to contractors who do this work, means for quick ventilation would reduce the time and cost of waterproofing.

FROM JOB AND OFFICE

Hints That Cut and Time

Worn-Out Sheet Asphalt Pavement Renewed by Surface Treatment

By R. D. Budd

City Engineer, Petersburg, Va.

Having had considerable success in the treatment of sand-clay and gravel roads with liquid asphalt by building up from year to year an asphalt mat surface an inch or more in thickness, which has withstood moderately heavy road traffic, it occurred to us that worn-out sheet asphalt pavements might be benefited by such treatment. Inquiry failed to disclose where such a surface treatment had been tried out on old sheet asphalt pavements, and replies were more or less skeptical as to the success of such treatment for sheet asphalt. It was decided, however, to make this experiment, and we are entirely satisfied with the results. The street which was treated during the early part of 1921 was originally constructed in 1901. Since that time it has continuously been subjected to a very heavy traffic.

The material applied in this treatment was Texaco asphalt—with the following physical characteristics: Gravity, Beaumé, 16 to 19; loss after heating 5 hours @ 325° F., 25 per cent; asphaltic content of 100 penetration, 60 per cent.

Method Employed—The street was first cleaned and traffic excluded. The asphalt cement was heated in an open kettle to a temperature from 105 to 115 deg. F. and applied to the pavement in buckets by pouring and spreading with brooms. Dry sand was then spread to a thickness of ½ in. and the pavement rolled with a 10-ton roller and thrown open to traffic.

The rolling, we now believe, is unnecessary. Only about half of this work was rolled, and there is no difference in the appearance of the two types of work. The first street was covered with sand dried in an asphalt plant and applied hot; the balance of the work was covered with cold sand dried in the sun. We can see no difference between the work covered with heated sand and that dried in the sun. The amount of asphalt applied was approximately 0.2 gal. per square yard, and was all that could be held on the surface of the pavement without running into the gutters; the surplus was broomed ahead on the untreated work. The sand used for covering the work was retained on a 50-mesh screen, passed a ¼-in. mesh screen, and had been washed free of organic matter.

The work was done by a foreman and four laborers, none of whom had any experience in asphalt construction. The cost of the treatment was 7½c. per yard for labor and materials. The results have been entirely satisfactory. A ¼-in. wearing surface has been added to the thickness of the pavement, and what is more important, the old pavement has been revivified to its former elasticity. By occasional treatments we believe that we can maintain this street in its present condition.

Within the next year it is planned to surface-treat about 25,000 yd. of sheet asphalt pavement substantially as outlined above.

FROM JOB AND OFFICE

For Contractor and Average Engineer

How to Figure Grade Compensation for Metric Curves

BY C. K. CONARD
Northport, N. Y.

IN THE use of the metric system on railroad work there are certain formulas that, having origin in the English system, may cause confusion. We are prone to use "rule-of-thumb" methods, and sometimes fall into error through failure to consider the origin of a rule.

Take, for instance, curvature compensation. We are so accustomed to arriving at the grade correction by multiplying the degree of curve by the compensation constant, 0.03, 0.04 or whatever figure has been decided on, that we forget that the underlying principle is really to give to each degree of central angle the allowance of 0.03 or 0.04 of a foot, to be deducted from the total rise of the grade. We grow to think of the compensation as a rate of grade.

Now apply this rule of thumb in the metric system. The first inclination is to multiply the degree of curve by the accustomed compensation. Twice the writer has seen this tried. The first time *he* had to wrestle with the obvious error. The second time he was able to laugh at the other fellow. If you think the matter simple, before reading further work out the proper compensation for a 5-deg. metric curve, using 0.03 ft. for the rate of compensation. After reducing 0.03 ft. to the metric equivalent you *may* remember that the metric curve has five times as many degrees of central angle, per one hundred units of distance, as the English system. Anyhow, you will have done some thinking.

TABLE OF GRADE COMPENSATIONS FOR METRIC CURVES

	Compensations					
	For 0.03 Ft. Per Deg. Use 0.01 Meter		For 0.035 Ft. Per Deg. Use 0.011 Meter		For 0.04 Ft. Per Deg. Use 0.012 Meter	
Deg. of Curve	Per Deg. of Curve	Per Deg. Of Central Angle	Per Deg. Of Curve	Per Deg. Of Central Angle	Per Deg. Of Curve	Per Deg. Of Central Angle
1	0.05	0.01	0.055	0.011	0.06	0.012
2	0.10	0.02	0.110	0.022	0.12	0.024
3	0.15	0.03	0.165	0.033	0.18	0.036
4	0.20	0.04	0.220	0.044	0.24	0.048
5	0.25	0.05	0.275	0.055	0.30	0.060
6	0.30	0.06	0.330	0.066	0.36	0.072
7	0.35	0.07	0.385	0.077	0.42	0.084
8	0.40	0.08	0.440	0.088	0.48	0.096
9	0.45	0.09	0.495	0.099	0.54	0.108
10	0.50	0.10	0.550	0.110	0.60	0.120
11	0.55	0.11	0.605	0.121	0.66	0.132
12	0.60	0.12	0.660	0.132	0.72	0.144
13	0.65	0.13	0.715	0.143	0.78	0.156
14	0.70	0.14	0.770	0.154	0.84	0.168
15	0.75	0.15	0.825	0.165	0.90	0.180
16	0.80	0.16	0.880	0.176	0.96	0.192

It simmers down to this:

For the metric system, to figure a compensated rate of grade, multiply the degree of curve by five, and the product by the metric equivalent of the compensation per degree of central angle, and deduct the result from the rate of grade used on tangents. Or, $G_1 = G - (D \times 5 \times C)$, in which G_1 equals the compensated rate of grade; G = grade on tangents; D = degree of curve; and C = compensation in metric system, per degree of central angle.

It should be borne in mind that in the metric system there are two ways of referring to compensation. This is due to the unfortunate use of an unwieldy unit. The extreme length of a hundred-meter chain having led to the adoption of 20 meters as the chord length in figuring degree of curve, the simplicity of the metric system fails. In speaking of compensation, therefore, we have to define whether the compensation is per degree of curve, or per degree of central angle. The former is of course five times the latter. It is almost as awkward as the Englishman's method of referring to grades as a rise of one in sixty, or one in eighty, etc. The American civil engineer does not often realize how fortunate he is, with his decimal system that allows the office use of a scale one unit long, and the field use of a measure one hundred times this unit.

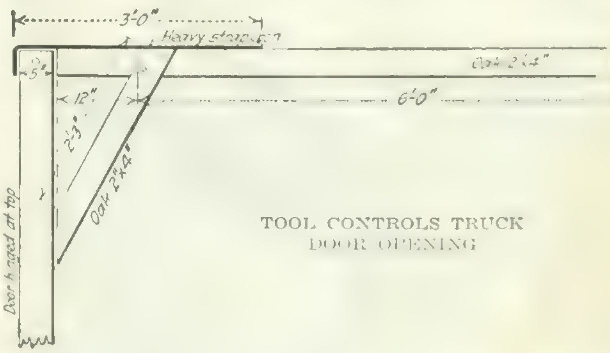
While it seems an unnecessary refinement to use many decimal places for working out rates of grade, there is one certain advantage. That is in checking up long compensated grades. Instead of checking each grade, from curve point to curve point separately, it is much shorter to work out the total rise as obtained by multiplying the total distance by the rate of grade on tangents, and from this deduct the product of the sum of the central angles of the curves, multiplied by the compensation per degree. The remainder gives the difference of elevation of the two ends of the grade.

This method may be used where spirals are employed by making the compensation extend from the down-hill point of spiral to the up-hill end of the regular curve. That is, the length between these points equals the length of a regular curve of the same total central angle.

The following table of compensations has been worked out for metric curves, giving values for 0.03, 0.035 and 0.04 feet per degree. These are the rates most commonly used. The metric equivalents of these rates are sufficiently close for practice.

Job-Made Tool Controls Truck Door For Spreading Stone

A TOOL made of two oak scantling, a piece of strap iron and a few spikes is used successfully in holding truck doors open the proper width to spread crushed stone or gravel for road construction in Virginia. As indicated by the sketch the strap iron is



TOOL CONTROLS TRUCK DOOR OPENING

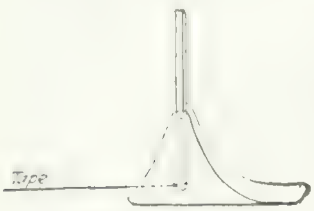
hooked over the top of the end door and the short arm of the lever bears against the rear side of the door so that an operator on the long arm of the lever can hold the door open at any width desired.

As used in Virginia, the tool is handled by one of the stone spreaders and it is stated that the men, usually negro convicts, become very skillful in its use. The sketch and description have been fu[illegible]ment Tingley, Blacksburg, Va., Virginia State Highway Commission.

Two Hints for City Surveying

By Hugh C. Mitchell
Mathematician, Division of Geodesy, U. S. Coast and Geodetic Survey, Washington, D. C.

TWO interesting details have been recently developed by the U. S. Coast and Geodetic Survey in running a line of precise traverse which extended nearly the length of one of the Middle States. Both of these developments may prove of value to the engineer who is running a traverse of any class through city streets. One is the satisfactory use on city streets of a piece of ordinary adhesive plaster as a tape-end station. The plaster is simply attached to the smooth pavement, and the tape end marked thereon with a hard pencil. Such a mark will remain in place several days.



TAPE STRETCHER

The other development is a simple tape stretcher, which permits holding the tape close to the ground. It was designed by J. S. Bilby of this Bureau. It can easily be constructed of sheet metal of ordinary weight, cut and bent into shape and fitted with a handle held in place by a bolt. The accompanying drawing gives a better idea of how to construct it than can be put into words, and its method of use is most obvious.

Batch-Box Trains Employed for Winter Stockpiling

YEAR-AROUND industrial railway operation was successful in building, in 1920-21, an 11-mile concrete road in Palo Alto County, Iowa. About 28,000 cu.yd. of pit-run gravel were required for aggregate One-half of the gravel was hauled from pit to mixer for the first 5½ miles of road, and the other half was hauled from pit to stockpile and then from stockpile to mixer for the second 5½ miles.

At the pit, as is illustrated, a cableway dragline placed the gravel in a pile from which a mechanical loader put


CHARGED BOXES AT PIT

it into batch boxes on industrial cars. About 2 miles of road were built in 1920, the hauling of aggregate for this section being direct from pit to mixer. Then paving was shut down because of cold weather. During the winter the material for the stockpile for the second half of the road was excavated at the pit, loaded into batch boxes, and hauled to the stockpile. Here the material from the boxes was unloaded by a traveling crane into a pile 250 ft. long, 115 ft. wide and 13 ft. high, containing about 14,000 cu.yd. When warm weather came in 1921, pavement laying was resumed, the hauling of aggregates being again direct from pit to paving mixer.

In this way 3½ miles were paved, bringing the work up to the stockpile. Pit operations were then discontinued and the loader and industrial railway outfit were transferred to the stockpile. The loader started at one corner of the pile and worked along the 115-ft. face cutting a swath 22 ft. wide and loading directly into the batch boxes. Ten-car trains were run with two 22-cu.ft. batches per car. When a cut along the face was completed, the industrial truck and loader were moved up and the loader worked back, taking out another 22 ft.

The contractors were the Brereton & Bauck Co., Emmettsburg, Iowa.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Semi-Removable Centers for Concrete Bridge Arches

By Howard G. Peterson
Assistant Engineer, Miami Conservancy District, Dayton, Ohio

THE necessity of keeping falsework under the completed arches until all seven were poured, led to the design of semi-removable centers for the Black Street Bridge at Hamilton, Ohio. The plan was to remove the lagging, stringers, caps and the batter posts, shortly after the concrete had set. The undisturbed skeleton structure which remained then took the vertical load from the green arches and also supported the spandrel walls and cantilever sidewalks. The parts which were removed were reused on the new arches.

The arches are each 38 ft. wide and 93 ft. c. to. c. of piers. Five bents supported each arch. They were placed about 16 ft. apart to permit flood waters to pass.

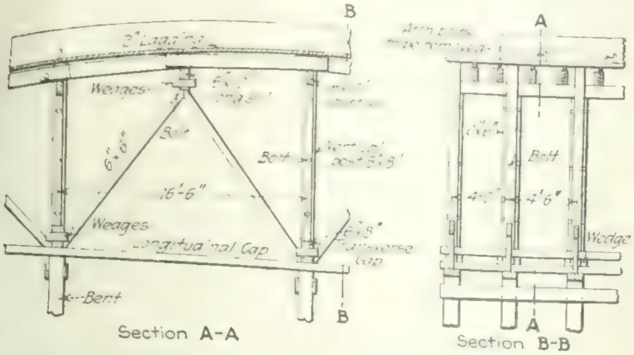
A deck of longitudinal timber was placed on top of the bents on a line with the tops of the piers. This deck helped brace the bents and also took the side thrust from the batter posts. Caps were placed on top of the deck, one over each bent, which supported the wedges for the vertical posts and also acted as heels for the batter posts. The vertical posts were placed 4.5 ft. on centers and extended to within about 2 in. of the intrados of the arch. Pieces of lagging were placed over them and provided with bolts which would fasten them to the arch when it was poured. Their purpose was to brace the posts after the stringers and much of the bracin had bee removed. A strip of 2 x 6-in. lumber was bol d to the side of each post; these strips carried short caps between the posts which in turn carried the stringers. When the stringers were to be removed, the strips were unfastened and sprung out of plumb, thus lowering the short caps. The batter posts were placed entirely independently of the vertical posts and were provided with wedges at the top. The stringers and

FROM JOB AND OFFICE

For Contractor and Average Engineer

lagging were placed in the ordinary way. Only three sets of the removable parts were used.

The bridge was built by the Miami Conservancy District for the city of Hamilton, since the construction of



CENTERS FOR BLACK ST. BRIDGE, HAMILTON, OHIO

the bridge was so interlinked with the channel improvement that the district's forces which were on the site could easily handle the work for the city. The falsework was designed by the writer and R. M. Reigel who was then designing engineer. The construction work was under the direction of C. H. Eiffert, division engineer and William Roush, superintendent.

Sand and Air Dryers for Cement Gun Work

In the construction of the gunite conduit at Tacoma, Wash., described on page 906, June 1, 1922, W. A. Kunigk, Superintendent of Waterworks, found it necessary to dry the sand and the air used in the cement gun. He describes the devices for that purpose as follows:

The sand-dryer was built by supporting a $\frac{3}{16}$ in. x 6 ft. x 10 ft. plate over a firebox and circulating duct built into the ground and lined with 1:3:6 concrete, connecting with a 10 in. sheet-iron stack. For fuel, slabwood in 4 ft. lengths was used. The screen consisted of a 2 ft. diameter by 6 ft. long steel wire drum having four meshes to the inch. This drum was fastened to a central shaft by three spider frames with the shaft supported in boxing resting on a wooden frame in a slightly inclined position. The screen was operated by a small gas engine connected to the screen with a belt and beveled gear.

On some previous work on which a cement gun was used by the water department during extremely wet weather, considerable trouble developed on account of the moist air condensing in the air line leading to the gun. This condensed water would get in the bottom of the gun and mix with the cement and sand and choke up the feed wheel about every half hour, thereby stopping, of course, all operations. The writer came to the conclusion that if dry air could be supplied there should be no trouble in operating the gun regardless of weather conditions. An air-dryer was therefore made, consisting of a welded tank of No. 12 gage steel 20 in. in diameter and 4 ft. 6 in. long provided at each end with a $2\frac{1}{2}$ in. pipe connection and at the bottom with a $\frac{1}{2}$ in. pet-cock and a hand hole on top. Near the outlet end a $\frac{1}{4}$ in. mesh screen of galvanized iron had been inserted before welding this end. This tank was filled through the hand hole with coke and then out into the air feed line near the cement gun with the pet-cock left slightly open for the purpose of blowing off the accumulating water. No trouble has been experienced by the writer in using the cement gun in wet weather wherever this simple device was used. The reduction in air pressure from use of the dryer was negligible.

The Length of Columns

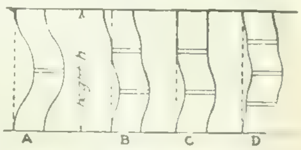
BY DAVID C. COYLE

Gunvald Aus Co., Consulting Engineers, New York City

When two columns more than one story high stand separated from other framework in a building, the question of their effective length is sometimes solved in a more casual way than the situation warrants. Every engineer realizes that they may possibly fail together instead of bracing each other, and the fact is generally recognized that if they are only joined by light members, such as a 6-in. I-beam or a pair of angles, these members will have practically no effect in shortening the column length. It is not always so obvious, however, that a stiff brace, say a 10-in. I-beam with top and bottom connections, may be of no value; and that several such braces may produce less stiffening effect than is expected.

Sketch A in the drawing herewith shows the action of a pair of columns with a brace between them at mid-height. In the absence of any force capable of holding the mid-point against lateral displacement, it is evident that the columns can fail together without deforming the brace in any way, and consequently without bringing it into action. Of course, if the two columns, on account of initial bending, tend to buckle in opposite directions, the brace will be of use; but such a condition is entirely a matter of chance. Where there is a curtain wall, or a floor connected to other framing, built in place before these columns get their load, they may stand as solidly as if they were properly braced; but the fact remains that this construction leaves more to the element of luck than good practice usually requires.

Sketches B and C show the effect of two stiff braces. If the tops of the columns are secure against lateral motion, the length of each column may be taken as practically equal to thirds of the total, or the distance between any two alternate braces. Incidentally, it may be noted that a single brace, if not placed at mid-height, would necessarily have some effect in stiffening the columns, since they could not fail together (as at A) without bending the ends of the brace; also, the actual depth of any brace is of course subtracted from the effective height of the columns.



HOW HORIZONTALLY BRACED COLUMNS MAY BUCKLE

But it is not justifiable to put one brace at the point and take $\frac{2}{3}h$ as the effective height, for sket shows that the second brace has a necessary part to play in keeping the top section straight.

A possible mode of failure with three b shown at D, which indicates that the colu may be greater than the distance between tw braces. The natural conclusion seems to situation of this kind one must either external means of lateral stiffening, o bracing, or figure the column length as b two-thirds the total height. For even th h, as in case D, very little actual column bending may get past a given brace, the lateral displacement may be such as to throw an extra load on one colum, tending to increase with increasing deflection, and thus acting to

produce an effect similar to that due to a greater length.

The same reasoning applies to another case, that of two angles acting as a compression member in a truss. It is often necessary to insert washers and tack-rivets to prevent such a strut being weaker in detail than as a whole. A single washer halfway between the gussets will have no effect whatever. It is even possible for a case such as that of sketch D to arise, in which, without shearing any of the tack rivets, a larger buckle can occur in the middle than would be due to a length equal to the distance between alternate tack-rivets. This fact may help to account for an occasional failure otherwise inexplicable. Ordinarily, of course, the safety factor covers a multitude of theoretical sins. The theory does, however, indicate the desirability of inserting enough tack-rivets so that the detail length between alternate rivets shall be markedly less in proportion to radius of gyration than that of the member as a whole

Where compression members are battened the situation may be even worse, because of the longer lever arms and greater possibility of lost motion. The theory indicates the comparative value of latticing or else of unusually close battening, where members are to take compression. Tests made by the American Railway Engineering Association in 1917 bear out this theory. Their report, dated February, 1918, states, "where distance center to center of outer rivets on adjacent battens is fixed so that the $\frac{l}{r}$ distance for the individual channel is about the same as for the column as a whole, the column is weaker than when this distance is reduced. In all cases columns with battens failed at an ultimate strength of 6,000 to 9,000 lb. per sq.in. less than columns with lacing." Their conclusion is that "columns with batten plates do not develop the strength of the section and should not be used."

No attempt is made here to treat these factors analytically, as the results of a careful analysis might easily be masked completely by some inaccuracy of shop work or, in the case of light members, by some hardly noticeable defect due to injury in handling. It seems reasonable to say, however, that the long-suffering safety factor ought not to be obliged to carry any other load than that due to such accidental weaknesses. The nominal character of the floor loadings and column formulas required by law, as well as the cost factors involved, will render it absurd to go too deeply into mathematics in a discussion of this kind, but it does not follow that no consideration at all is necessary in such cases as those mentioned above. The means commonly used for reducing the length of compression members require very careful scrutiny, or it may easily happen that such members will be in reality twice or three times as long as they actually appear to be.

FROM JOB AND OFFICE

Hints That Cut and Time

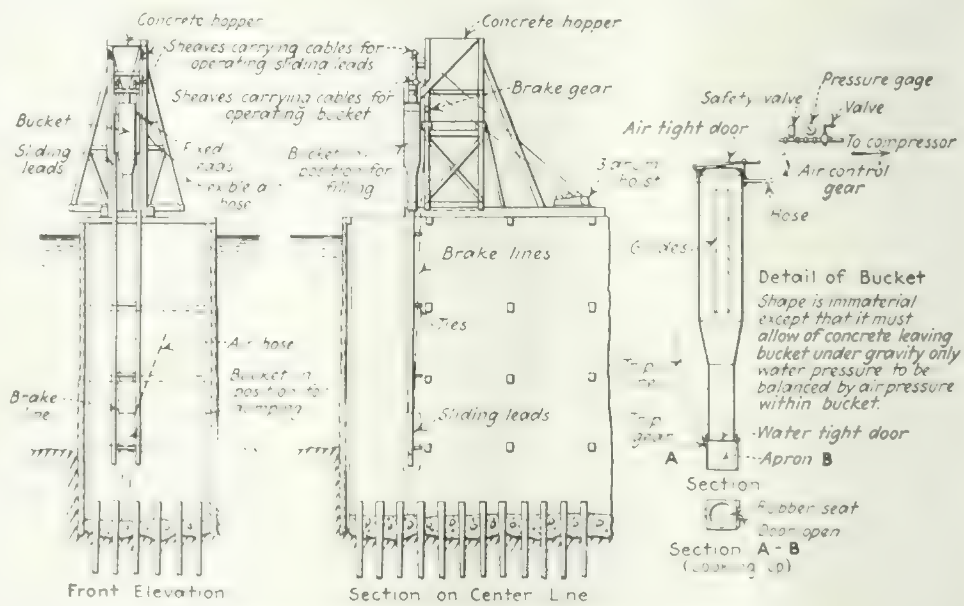
Underwater Concrete Laid by Unique System

IN THE construction of the Jackson Street bridge, Victoria, B. C.—a combined railway and highway bridge across the inner harbor built by the City of Victoria with the help of the Canadian Pacific Ry. and the provincial government—the method used for underwater concreting was entirely new. The system was devised by F. M. Preston, city engineer of Victoria. Mr. Preston has applied for U. S. patents for his device, the Preston "Underwater Concrete Bucket."

As described in *Concrete and Constructional Engineering*, London, the principle involved in this new manner of underwater concreting is the depositing of concrete from a watertight bucket by displacement of air instead of water.

As shown in the accompanying sketch, concreting by this method is done in this particular instance from the top of the pier caisson. The concreting equipment is mounted on a decking which supports a more or less simple frame containing the concrete hopper. Motive power is supplied by a three-drum hoist. The sliding leads extend down into the water the required distance and in these leads the bucket operates.

The bucket used in the construction of the Victoria bridge held 1 yd. It received its charge of concrete in



PRESTON UNDERWATER CONCRETE BUCKET

its upper position, the doors were then closed and the bucket lowered to its correct position under the water. An internal air pressure sufficient to balance the water pressure on the outside was maintained, the lower door released from the surface and the contents then discharged and the operation repeated. The work was carried out continuously until completed.

The actual entire labor cost of mixing and placing was approximately $1.50 per cu.yd. Water was afterward pumped out from the caissons with no difficulty and the concrete found to be of excellent quality after removing from 3 to 18 in. of laitance.

FROM JOB AND OFFICE

For Contractor and Average Engineer

A Wrongly Braced Guy-Pole and Other "Practical" Errors

BY CHARLES S. STEWART
Milwaukee, Wis.

NO DOUBT the man who designed the guy-post reinforcing shown by the accompanying view considered that what would strengthen a simple beam would also stiffen a cantilever. While it is true that the truss will reduce the deflection of the guy post any slight gain in that direction is nullified by the deep notching of the base to allow for setting in four vertical bars and the heavy band for anchoring the lower end of the truss rod. This is one of a number of similar installations in the system of a large public-service corporation.

INEFFECTIVE TRUSSING

Perhaps other readers of *Engineering News-Record* have seen examples of construction of as low efficiency as this, but as a rule these cases are not exposed to public view. I once saw a foreman who insisted on placing tension reinforcement in the top of a concrete slab to avoid bending the bars on account of transverse beams. He argued that the bars were as stiff in the top of the concrete as in the bottom; also that the slab was only a cover for a coal bunker and would never be loaded. When I saw it next the slab was carrying a load of fire brick piled three feet high.

The young engineer on construction work has frequent opportunity to see the difference between theory as worked out in the engineering office and practice as carried out by the so-called "practical" man in the field. If he offers a suggestion or remarks about these inconsistencies, he is likely to be told that these matters are not in books but must be learned from experience.

After a building is erected alterations are often made, and sometimes large additional loads are applied without regard to the original design. I have seen cases where kneebraces and even main members of roof trusses have been removed. However, due perhaps partly to calculated loads being larger than actual loads, the structure did not collapse. But sometimes a structure fails under stresses due to construction loads, and loss of life ensues. More often, probably, the error is in the other direction and results only in a waste of money, as in the case of the guy post.

Timber Serves as Line and Grade in Jetting Piles Into Place

JETTING into place about 4,000 reinforced-concrete piles that form the foundation for the reinforced-concrete boardwalk being constructed along the Coney Island beach, New York, necessitated the use of the most expeditious method of doing the work. The extreme depth of the sand at this location makes jetting a relatively simple matter. In jetting the piles approximate line and grade was furnished by a heavy timber resting upon two short wooden piles driven into place ahead of each concrete pile bent. This timber, which was ordinarily 12 x 12 in. was placed on the short piles so that its outer face was plumb and set back from the center line of the concrete pile bent half the width of the piles.

Blocks were spiked to the side of the timber to serve as guides to the pile and to insure proper alignment.

JETTING INTO PLACE REINFORCED-CONCRETE PILE

Heavy iron dogs were used to clamp the timber to the piles and additional braces were usually used. By means of a level the relation of the upper surface of the timber to the grade of the pile was established. The proper distance was marked off on the concrete pile so that when the mark coincided with the top surface of the timber the pile was at the proper grade.

In jetting, the piles were set flush against the face of the timber, and the pile lowered between the blocks that serve as guides. By this method there was no difficulty in setting piles within an inch or so of the proper grade and within close to a half-inch of the proper line.

Underpinning Lincoln Memorial, Terrace and Approaches

Spread Footings Which Settled with Subsidence of Surrounding Fill Replaced by Concrete Piers Built in Open Sheeted Pits Carried Down to Bed Rock—Steel Supporting Girder System Under Approaches

BY D. L. WEART
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Assistant to Executive Officer, Lincoln Memorial Commission,
Washington

LOCATED on filled ground in what was originally a shallow bay or arm of the Potomac River, the Lincoln Memorial was originally planned to be supported by cylinder piers sunk to rock, a depth of 50 to 65 ft. Subsequent loading tests on the subsoil of the fill gave such satisfactory results that it was considered permissible to found the terrace wall and approaches, accessory to the main building, on spread footings. The construction was carried out accordingly, the main building being founded on cylinders driven to rock while the auxiliary structures were placed on spread footings. Even during the course of construction of the approach and terrace wall, however, settlement of larger amount than expected was observed, and ultimately the masonry work of these portions became cracked and displaced. As the settlement continued, a restudy of the problem led to the conclusion that it would be necessary to underpin all the spread footings by foundations carried to rock. This underpinning, described in the following, has just been completed, and the finished structure, as formally inaugurated on Decoration Day, rests on rock foundation throughout. The foundation work for the main structure was described in *Engineering News*, May 7, 1914, p. 1019 and March 23, 1916, p. 558.

Conditions at Site—Filling of the bay or marsh at the present site of the Lincoln Memorial began in 1882, and up to 1900 about 4 ft. of hydraulic fill had been placed. The remainder of the fill to the present grade, about 3 ft., was placed in 1908. A typical boring on the site shows:

El. +16 to +12, sandy soil
+12 to + 4, sand and marsh sand
+ 4 to —10, sand and gravel
—10 to —36, marsh sand
—36 to —38, rotten rock
—37 down, blue gneiss

Several tests were made in 1913 to determine the bearing power of the soil. In these tests loads of 3,500 to 4,500 lb. per square foot were applied. The settlement amounted to 8 in. in four months, with no settlement during the following two months. Later load tests, made in 1917, confirmed these results.

Foundations of Main Building—The memorial building is a structure of pure Grecian architecture, similar in design to the Parthenon. It is 201 ft. 10 in. long by 132 ft. wide at the outside of the bottom step of the stylobate course, or 181 ft. by 111 ft. 2 in. along a line running through the center of the columns of the colonnade, and is 57 ft. high from the floor of the hall to the bronze beams of the ceiling. It is largely built

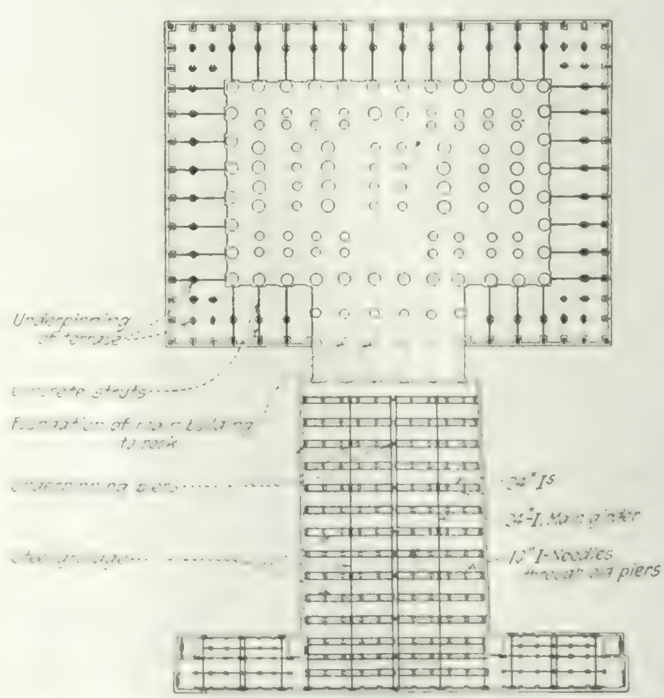


FIG. 1—DIRECT UNDERPINNING OF TERRACE COLUMNS AND STEEL GRILLAGE SUPPORT OF APPROACHES

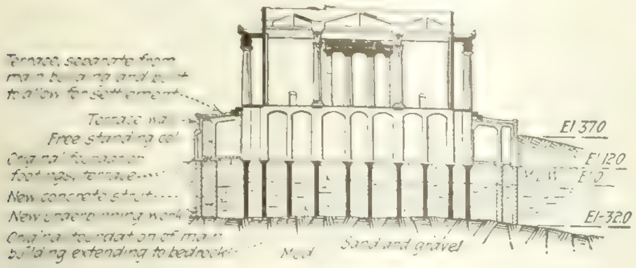


FIG. 3. TERRACE UNDERPINNING IN CROSS-SECTION

of marble and granite, and thus is an unusually heavy structure.

The foundations consist of two separate portions: The portion below the original level of the ground, known as the subfoundation, and above this level an upper foundation consisting of concrete columns about 45 ft. high connected at the top by arches poured integrally with them.

The subfoundation consists of 122 concrete piers formed in steel cylinders driven to rock, ranging from 49 to 65 ft. long and from 3 ft. 6 in. to 4 ft. 2 in. in diameter. The steel shells were sunk to refusal by heavy weighting, assisted by water jetting; the earth was then removed from the interior of each cylinder, the bed rock was excavated 2 ft., and the entire shaft was filled with concrete reinforced with twelve 1-in. square twisted bars set vertically around the periphery. At the ground level the tops of the cylinders were splayed out to rectangular shape and connected by a mat of reinforced concrete 12 in. thick.

Terrace and Approach Foundations—The original plans for the memorial called for the foundations under the terrace wall to be carried down to rock in a manner similar to the foundations of the main building. After the bearing power of the soil had been determined, the scheme of putting the terrace wall on spread footings was investigated.

It was found that the pressure under the proposed footings would be practically the same as the pressure on the original soil due to the weight of earth fill, about 2,300 lb. per square foot. As the ground appeared to be stable under this load, and as the loading tests had indicated a bearing power of more than 3,000 lb. per square foot, it was decided to adopt the spread foundation, and to design the wall to allow for a settlement of about 8 in., which was the settlement developed in the load tests.

Accordingly, the beams supporting the deck slab were designed to act as struts between the top of the retaining wall and the building, so as to prevent the wall being forced inward by the outside earth pressure. The ends of these struts were placed in slots in the wall of the main building (without rigid connection) so that they could move and adjust themselves to settlement of the terrace wall, but would yet hold the wall outward.

In preparing for the construction of the approaches, which were built under a separate contract, the conclusions already reached for the terrace wall foundation were applied, and spread footings were decided upon.

Serious Settlement During Construction—Work on the terrace wall began in the latter part of 1917. Construction was started at the south buttress of the main steps, and extended progressively around the memorial to the north buttress.

When work stopped in December, 1917, the wall and slab deck had been poured entirely on the east side and the wall about one-third completed on the south side. During November and December, 1917, the backfill was made on this portion of the wall. Levels taken at the southeast corner in March, 1918, showed a settlement of 0.11 ft. At this time the wall had nearly all of the load it would have to sustain. The deck slab at the southwest corner was poured in June, 1918, and up to September the settlement at that point was 0.26 ft. When the backfill was made at this corner the settlement became much more rapid, so that by November it had reached a total of 0.59 ft. During this settlement the wall maintained its alignment, and the horizontal joints of the granite were not affected.

Similar conditions to the above held true during the remainder of the construction. The average settlement to July, 1921, when work was started on underpinning, was a little over 1 ft. This settlement of the terrace walls and approaches was not a settlement of the structures themselves with respect to the surrounding ground on which they were placed, but was part of a general subsidence of West Potomac Park, due to the slow compacting of the hydraulic fill placed there between 1882 and 1908.

In 1920 a thorough investigation was made of the effect of the settlement on the deck, walls and approaches. The structures were taking up the settlement as they were designed to do, but it would not be safe to permit the settlement to go on indefinitely. As there was no indication that the settlement would stop in the near future, it was decided to underpin the foundations.

The scheme for underpinning contemplated sinking steel cylinders between the columns supporting the wall and the deck to bed rock, filling them with concrete, and carrying the load by means of transverse steel beams resting on the columns and carried in under the foundation footings. Before work was commenced, however, the scheme was changed to provide for concrete columns being placed directly under the piers supporting the wall and terrace, thus eliminating the beams. The foundations of the approaches were to be supported on a system of steel girders resting on concrete piers carried to bed rock, with steel needle beams

FIG. 4. NEEDLE AND GIRDER SUPPORT OF APPROACHES

through the columns; this plan was carried out unchanged.

Method of Underpinning—The free-standing columns were shored up with 12 x 12-in. timbers before excavation was begun. Access pits 6 ft. square and 12 to 14 ft. deep were then sunk between these columns and the terrace wall, by driving sheet piling and excavating within. Their bottoms were concreted, and a sump 18 in. deep, which extended below groundwater, was constructed in one corner of each. Suction lines of the pump system were connected to each sump.

Pier excavation was started from near the bottoms of the sides of the access pits by cutting the timber sheeting adjacent to the terrace wall and to the columns and drifting horizontally under the foundation footings to the exact positions of the new piers, which were carried down to rock in extension of the original piers. The shafts were 2 ft. 6 in. x 4 ft. 10 in. in horizontal dimensions, and were lined with 2 x 12 horizontal sheeting in sets placed as the excavation went down, cross-braced in the narrow direction every 8 ft. in depth.

Excavation was done by pick and shovel, and the water was kept down by air pumps. The shafts were carried down through sandy loam for 8 or 10 ft., then through stiff mud to about 3 ft. above bed rock. Here decayed rock, which was very soft and after removal appeared very much like coarse sand, was encountered. Sometimes large boulders were found just above the soft rock. The surface of the bed rock, found broken off at various angles without any relation to the strata or fault planes, was drilled off level or, if one portion of the surface was higher than the other, was cut in steps so that the bearing was level. When a suitable bottom had been obtained with all dirt and water removed it was passed upon by an inspector. The shafts varied in depth from 40 to 60 ft.

Immediately after a shaft was inspected, concreting started. The pouring in each shaft was continuous except for the time required for removing the braces and spading the concrete; it took 4 to 8 hr. (14 to 20 cu.yd.). The concrete was poured to within 6 in. of the bottom of the old footing, any laitance on top was removed and the pier was allowed to set for seven days. The 6-in. space was then filled with a very dry mixture of concrete, of which a small amount was rammed in at a time, to make it wedge as compact as possible. The pier was then allowed to take the load.

After the piers took the load the walls continued to settle for a time. This was due to the compacting of the mass in the long newly constructed columns. If the piers could have set for 28 days instead of 7 before the load was applied it is not believed that this settlement would have occurred.

As each set of adjacent piers under the columns and the terrace wall was completed, the access pit was filled with earth. Concrete struts 12 x 24 in., reinforced with four ¾-in. rods, were constructed, extending from the foundation wall of the main building to the free-standing columns and from these columns to the terrace wall. These struts are supported on the original footings of the columns, and at the building and terrace wall the rods were grouted into the old concrete.

Operations were carried on simultaneously under every second set of free-standing columns and terrace-wall footing. After these had been completed, work was commenced under the intervening sets.

Underpinning the Approaches—A different method of underpinning was employed for the approaches. Fewer piers were sunk, and the columns were supported on a system of steel girders with steel needle beams as shown in Figs. 2 and 4.

A longitudinal system of 24-in. I-beams (*A* in Fig. 4) supported on 2 x 4-ft. concrete piers extending down to rock, similar to those used under the terrace wall, was constructed. Some of the concrete piers are in the open, so that the steel rests directly on them, but the majority are under the old existing column footings, and here the beams are supported by concrete pedestals built up to the proper height on these old footings. On the longitudinal beams was placed a transverse beam system of pairs of 24-in. I-beams (*B* in Fig. 4), one beam on either side of a line of columns. The transverse beams in turn carried needle beams (*C* in Fig. 4) passing through the columns. These are short lengths of 10-in. I-beam, and take the load of the concrete piers.

The cavities between the needle beams and the columns were filled with dry concrete rammed so as to fill all voids. Special care was taken to insure a good bearing between the columns and the needle beams. All of the steelwork was finally encased in concrete, to protect it.

Plant Used in Underpinning—The plant used for the work comprised pumping, compressing, concrete mixing, hoisting, transportation, and electrical equipment, besides minor auxiliaries. Its chief items were:

For pumping, two 10-hp. electric pumps with a combined capacity of 30,000 gal. per hour, connected with a pipe system which had intakes at various points throughout the work and discharged through a 3-in. line to the river; and five small air-driven pumps for keeping the pier shafts clear of water. For air supply, a 10-hp. compressor which supplied 600 cu.ft. per minute to drill pile drivers, augers, and the small pumps. For concrete mixing, a ½-yd. motor-driven mixer fed by gravity. For handling the spoil buckets in the pier shafts, six 5-hp. electric hoists. For transport, an industrial railway connecting all parts of the work; dump cars of ½-yd. capacity carried the concrete, while flat cars served for other material, the cars being pulled by a cable operated by a 15-hp. electric hoist. For electrical supply, a 220-volt generating plant for power service and a 110-volt plant for lighting, carrying 300 lights.

The total value of the construction plant was about $25,000, including an installation cost of $5,000.

Summary—A total of 176 piers, 68 struts, and 210 tons of steel, was required to complete this work. The cost was $215,000. The work was performed by the Terry & Tench Co., Inc., of New York, for the Lincoln Memorial Commission, under the direction of Lt.-Col. C. O. Sherrill, executive officer of the commission.

Japanese Plan 1922-23 Railway Construction

Construction of 331 miles of new railway complete and ready for traffic is included by the Japanese government in its program for the government railways during the financial year 1922-23. The work is to be distributed over 35 lines and contemplates the completion of 29 of them.—*Commerce Reports.*

Belle Isle Bridge Steelwork Placed by Floating

Umbrellas for Concrete Cantilever Spans Assembled on Pile Bents Near Shore and Moved to Place on Scows

CONSTRUCTION work on the steel and concrete cantilever-arch bridge of the city of Detroit, connecting the mainland with the city park on Belle Isle, has been in progress since last fall, and a number of the concrete piers have been completed by the contractors, Greiling Bros. The Wisconsin Bridge & Iron Co., contractor for the steel ribs, has begun erection, and several of the umbrellas, consisting of the adjoining halves of two spans, have already been set in place. In this work the interesting expedient of assembling the umbrellas near shore, at some distance from the site, and floating them to the bridge by scows has been adopted, by which means all questions of falsework at the bridge site are eliminated.

As described in *Engineering News-Record* of March 17, 1921, p. 452, the bridge is about 2,200 ft. long over all and consists of arch-shaped spans of lengths 74 ft. to 135 ft. center to center of piers, with rise ranging up to about 25 ft. for the longest spans. Each span consists of two cantilever arms and a short suspended span in the middle. The steel framework, of the general arrangement shown in the sketch herewith, is proportioned to carry its own weight and that of the forms and concrete of the ribs, while the load of the deck structure, pavement, and traffic will be resisted by joint action of the concrete and the steel.

For assembly of the steelwork, the contractor secured the use of a small portion of the upper end of Belle Isle. The steel is received by rail at a gravel dock on the Detroit side of the river, where a self-propelling derrick running along the dock is available for transferring it to barges. A derrick set up at the assembly yard here unloads the barges and stores the steel.

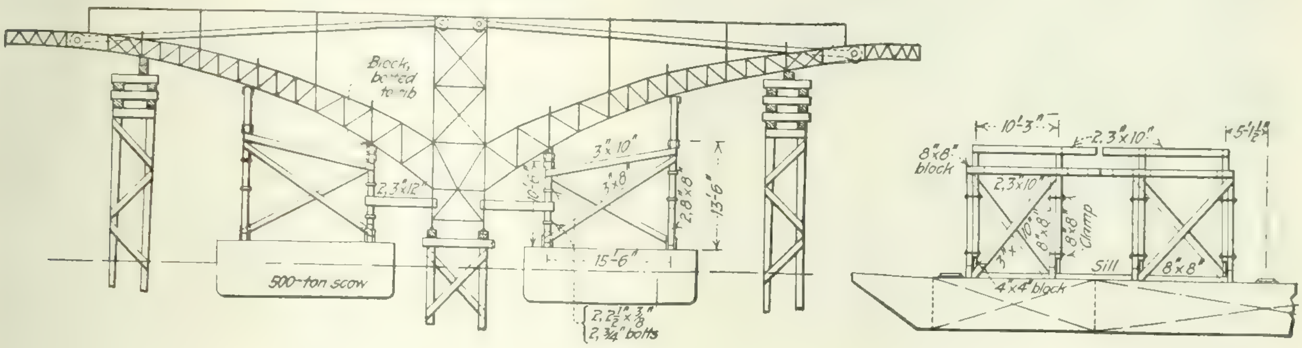
A unit or umbrella comprising the steel tower over a pier and the two abutting half ribs is assembled on pile bents as indicated by the heavy lines in the sketch. The tower is first set in place on the central pile trestle, and is bolted up complete with its bracing. Next, the preassembled half ribs are swung to place individually, connected to the tower, and supported near their outer ends on the outer falsework tower. The latter was built low enough to take the smallest span, and blocking is used to make the proper height for the longer spans. The eyebar backstays are then connected by their pins on the tower end, and when all in place are connected pair by pair at the outer pins. Finally the deck framing and bracing are placed and bolted up and the unit is ready for floating to the site. All the work at this stage is bolted, no riveting being allowed at the assembly yard under the order of the engineers, Esselstyn-Murphy, of Detroit.

For floating to the bridge site, two 102-ft. scows are placed transversely under the haunches of the half arch ribs. Two sets of adjustable bents on each scow form a support for blocks bolted to the ribs. The scows are flooded sufficiently to give a lift of about 3 ft. When placed under the ribs they are fitted to bearing against the steelwork by raising the adjustable bents and clamping them in position, and then the scows are pumped out. As soon as the steelwork comes to bearing, small posts are put under the adjustable sections of the bents to take the load, and then the pumping is continued until the scows lift the steel clear of the falsework.

After a two-scow unit is floated to the bridge site, it is swung around above the pier on which it is to be set and permitted to float down slowly with the current under control of the tug and tag lines until the steel tower is directly over the anchor bolts. The unit is then settled slowly into place by flooding the scows, one end being allowed to go down somewhat ahead of the other to facilitate the entering of the anchor bolts. As soon as the steel is landed the scows are sunk clear, pulled out from under, and pumped out for return to the assembly yard for the next unit.

The scows are flooded by pumping water into the compartments with gas pumps, of which one is provided on each scow. Three-inch natural siphons assist in the early stages of the work. Unwatering is done by means of the gas pumps.

The units of steelwork range from about 100 to 230 tons in weight. It is found an easy matter to assemble, float, and land two units in ten days. For this rate of working four men are required on the assembly work and a small gang is taken from the work at the bridge to assist in landing the steelwork on the piers.



SUPPORTS FOR ASSEMBLY OF BELLE ISLE BRIDGE STEELWORK AND ARRANGEMENT FOR FLOATING

Italy to Spend Large Sum on Railroads

It has been recently announced that the Italian Government in the next four years will spend 1,750,000,000 lire for state railway renewals and replacements that were deferred by the war and by the difficulties encountered since. Of the sum to be expended, 450,000,000 to 500,000,000 lire have been allotted for shops, buildings, and repairs to the line. At the instigation of the Treasury Ministry, the government, in electrifying the railways or improving them extensively, is inclined to take much of the material and equipment needed from Germany by way of reparations.—*Commerce Reports.*

Patrol Maintenance Practice in North Carolina

Organized by Districts—Patrolmen and Floating Gangs Combined—All Operations Motorized—Central Office Inspection and Planning Gives Uniform Inter-District Practice

North Carolina has within a period of 15 months by well planned maintenance put over 5,000 miles of inadequately maintained main highway into excellent condition to serve traffic. The accompanying notes on the organization and the methods employed are based on an inspection trip by automobile of about 600 miles supplemented by records of practice and costs furnished by Frank Page, state highway commissioner, and Charles M. Upham, state highway engineer.

MAINTENANCE was the first work organized in undertaking the fifty-million-dollar bond issue highway improvement program in North Carolina. Within four months after the creation by law of the state highway commission a state system of 5,500 miles of roads had been taken over and put under maintenance. The object of this quick action was twofold. It gave immediate results in improved conditions of travel and it permitted time to be taken, without challenging criticism, for the greater improvement of new construction to be adequately planned. Incidentally it went far toward converting the people and the newspapers, who had doubted the wisdom of assuming so great an indebtedness for highway improvement.

Previous to state organization, all maintenance of the main roads forming the 5,500-mile system had been carried on by the counties each operating independently. Commonly the results were inadequate and always there was no inter-county uniformity of standards. While this gave state direction an opportunity to make its greater effectiveness quickly visible, it put it to a heavy burden of expense and effort in recovering a large mileage from a condition of bad repair. In many instances virtual reconstruction was required to bring the old road to a condition for maintenance as that process is commonly comprehended. This fact has to be kept in mind in appraising some of the records of extra crew operations and some of the mileage costs which will be presented.

For all state highway improvement—both construction and maintenance—North Carolina is divided into the nine districts enumerated on the outline map. In each district there is a district engineer in charge of all state roads. Under him there are a construction engineer and a maintenance engineer, the latter being in immediate charge of maintenance. This form of organization is that of Maryland and differs from that common in most states and universal in the middle west, which provides for a state construction engineer and a state maintenance engineer responsible only to the highway commission and its chief engineer and having authority independently of each other. The theory of the North Carolina plan is that the district engineer being responsible both for construction and for maintenance after construction, will direct construction with more attention to the cost and efficiency of its future maintenance.

While the district engineers are responsible for the maintenance work in their districts and in a considerable degree independently responsible, there is such control from the state highway commission and engineer as is needful to maintain standards, regulate costs and insure inter-district uniformity in practice. For example, patrol maintenance is universal and district organization and equipment are substantially uniform. Reports from the districts keep headquarters informed of operations and costs and results are checked by frequent inspection from headquarters. Ultimately it is planned to have headquarters maintenance engineers, as there are new headquarters construction engineers, experts in their calling, who will travel continually from district to district, checking results and giving advice on methods and practice.

Topographically North Carolina consists of the eastern coastal plain, the rolling hilly Piedmont section and the rugged mountain section in the west. Maintenance conditions are quite different in these three geographical regions. Practice as disclosed in five districts representing all three sections of the state are epitomized as follows:

District 2 (Coastal Plain)—There are 512 miles under maintenance exclusive of 108 miles under construction and 20 miles not yet accepted for maintenance. The types of road are as follows:

Asphalt	69.4 mi.	Surface treatment	21.1 mi.
Brick	29.0 mi.	Shell	2.5 mi.
Concrete	6.0 mi.	Top soil	102.2 mi.
Dirt grades	33.4 mi.	Unimproved	144.8 mi.
Sand-clay	235.6 mi.	Total	640.6 mi.

The maintenance force consists of two supervisors, two roadway floating gangs, one bridge floating gang, one shop crew and 27 patrolmen with 60 helpers. Each roadway floating gang consists of 1 foreman, 11 laborers and 1 cook and the bridge floating gang has 1 foreman, 5 laborers and 1 cook. At the shop there are 5 mechanics, 1 blacksmith and 1 laborer. The equipment consists of 3 tractors, 36 trucks, 19 road machines, 30 drags and 6 portable shanty houses.

From these figures it follows that the average miles maintained is 19 for each patrolman and 8.5 miles for each patrolman's helper. There are two supervisors covering each 256.2 miles.

District 5 (Piedmont)—There are 701 miles of road in the district all but 120 miles of which is being maintained. The types of road under maintenance are:

Unimproved	93.9 mi.	Surface treated	14.9 mi.
Top soil	360.1 mi.	Concrete	26.1 mi.
Gravel	57.2 mi.	Asphalt	28.5 mi.

The maintenance force consists of 3 supervisors, 39 patrolmen, 57 laborers, 3 foremen for floating gangs, 1 chief mechanic and 5 mechanics. Their equipment is 8 shanties, 42 trucks, 39 drags, 13 road machines, 4 tractors, 10 mules and 12 trailer dump wagons. Each patrolman keeps up an average of 15 miles of road but the patrol sections vary from 12 to 20 miles long.

District 6 (Piedmont)—Including detours, 696.4 miles are being maintained in 43 patrol sections averaging 16.2 miles each. There is one patrolman and one helper on each

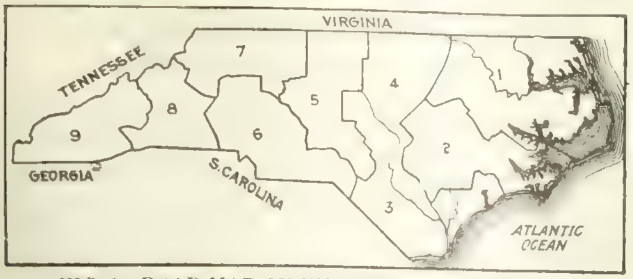


FIG. 1—ROAD MAP OF ENGINEERING DISTRICTS

section. Each patrol has a motor truck, a drag and small tools, and one road machine is allotted to each two patrolmen. The types of roads and the cost of maintenance averaged for nine months are:

Dirt	94 mi	$121	Surface treated	12 mi	$52
Top soil	399 mi	120	Penetration	69 mi..	77
Sand-clay	73 mi	103	Asphalt......	10 mi..	25
Macadam	90 mi.....	130	Total	697 mi..	

The cost per mile of field truck repairs has been $14; of sundry and repairs, $5 and materials, $3. An average of about 30 trucks have been used showing an average field expense of about $327 each, not including oil, gas or central shop repairs.

Section 7 (Mountain)—There are 680 miles of road in this district; Table I shows the types and the costs of maintenance. The force consists of 3 supervisors, 49 patrolmen, 150 laborers, 2 mechanics, 1 sign painter, 2 sign erectors, one material clerk, 2 office men and 1 stenographer. For equipment there are 45 trucks, 2 teams, 2 tractors, 2 heavy and 20 light road machines and 42 drags.

Section 9 (Mountain)—About 410 miles are under maintenance by 3 supervisors, 26 patrol crews and three extra crews at an average total cost of $433 per mile and an average labor cost of $214 per mile. The types of road and the cost per mile are:

Unimproved	73.4 mi.....	$219	Concrete	14.1 mi.......	$846
Dirt	154.8 mi.......	423	Top on Mac.	22 mi.......	626
Gravel	50.0 mi.......	165	Top on Conc	18.1 mi......	216
Bit. Mac.	13.0 mi.......	17	Shale	24.7 mi......	302
W. B. Mac.	13.5 mi.....	159	Sand-Clay	16.3 mi......	566

The maintenance equipment consists of 33 trucks, 2 tractors, 22 road machines, 5 motorcycles, 10 trailers and 24 army wagons.

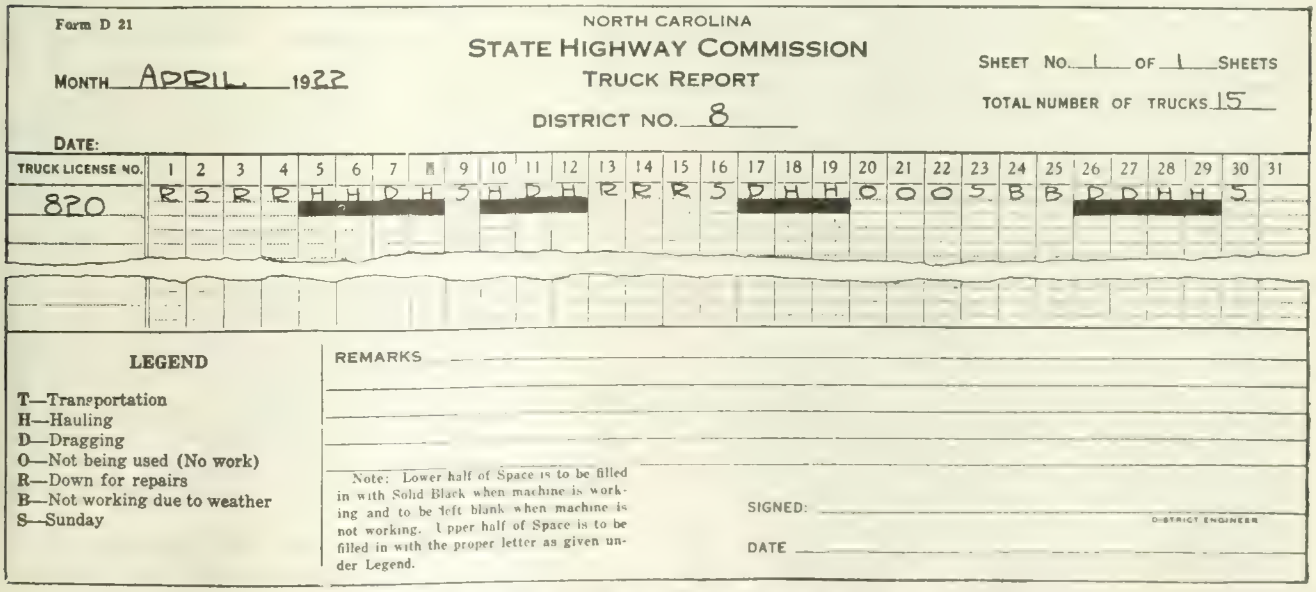
There is little to be gained from the cost figures except the broad fact that in taking over road for high-class state maintenance an extra expenditure for re-

TABLE I—MAINTENANCE COST PER MILE PER YEAR
District 7, 679 8 miles

	Top Soil	Un-improved	Dirt	Dirt	Pene-tration Macadam	Concrete
Mileage	329 9	172.8	98.7	45.7	22.0	10.7
Labor...........	$176.83	$86.00	$216.47	$216.47	$121.62	$00.00
Gas and oil..	38 05	00 00	38.05	00.00	38.05	38.05
Admistration.	12.55	12 55	12.55	12.55	12.55	12.55
Equipment..	47.75	47.75	47.75	47.75	47.75	47.75
Bridges..........	8 28	8.28	8 28	8.28	8.28	
Truck expenses	9 70	0 00	9.70	0.00	9.70	9 70
Repair-Supply	10 29	10 29	10.29	10 29	10.29	10.29
Material purchased	6 56	6 56	6 56	6.56	6.56	6.56
Repair-supply.....					80.10	
Material purchased					111 26	.
Total..........	$310 01	$171.43	$349.65	$301.90	$446.16	$133.18
Total less equip.	$262.26	$123.68	$301.90	$254.15	$398.41	$85.43
Total dirt roads deducting $10,000 paid out of Maint. funds for Const. work Blowing Rock Turnpike and equipment.... ...	..	....	$232.65	$184.90	.... ..	......

FIG. 2—EXAMPLE OF TOP-SOIL ROAD MAINTENANCE

covering neglected maintenance has to be counted on for the first year or two. In district 9, for example, the excessive cost of maintaining paved road was due to the condition of disrepair in which they had fallen under local maintenance. It may reasonably be expected that the mile-cost of maintenance will begin



Form D 21

NORTH CAROLINA
STATE HIGHWAY COMMISSION
TRUCK REPORT

MONTH APRIL 1922

SHEET NO. 1 OF 1 SHEETS

TOTAL NUMBER OF TRUCKS 15

DISTRICT NO. 8

DATE:

TRUCK LICENSE NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
820	R	S	R	R	H	H	D	H	S	H	D	H	R	R	R	S	D	H	H	O	O	O	S	B	B	D	D	H	H	S	

LEGEND

T—Transportation
H—Hauling
D—Dragging
O—Not being used (No work)
R—Down for repairs
B—Not working due to weather
S—Sunday

REMARKS

Note: Lower half of Space is to be filled in with Solid Black when machine is working and to be left blank when machine is not working. Upper half of Space is to be filled in with the proper letter as given under Legend.

SIGNED:
DISTRICT ENGINEER

DATE

FIG. 3—MOTOR TRUCK EMPLOYMENT RECORD CHART
Similar charts record the service of drags, road-machines and tractors

to show a decrease in another year both because there will be fewer bad repair roads to be restored and because the efficiency of the maintenance organization will be increased.

Standing out sharply in the practice disclosed by the examples given, is the fact of motorized maintenance. With the exception of a rare team patrol, all maintenance equipment is operated by trucks or tractors. There is virtually one truck to every patrol section and two to four 10-ton tractors to every district. This complete tractor operation is reflected in the length of sections maintained which averages upwards of 15 miles and reaches as high as 20 miles. With teams the number of sections would be approximately doubled. As the labor of restoring bad repair roads is completed and the equipment can be restricted to current maintenance it is anticipated that either a lengthening of the sections will be possible or higher standards of maintenance can be maintained.

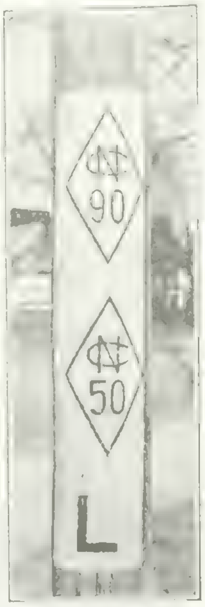


FIG. 4 — ROUTE AND DIRECTION MARKS ON POLES

Summarized, the lessons of North Carolina's experience in assuming state control of a large mileage of highways for extensive improvement are: (1) Establish intensive maintenance at once; this gives immediate service to traffic and allows time in which to plan the greater improvement of new construction; (2) place responsibility for maintenance as well as construction in the hands of the district engineers; (3) establish standards of performance and uniform practice maintained by orders and inspection from commission headquarters; (4) adopt patrol maintenance assisted by floating gangs for special operations; (5) employ motor trucks and tractors for all patrol operations.

French Trans-Sahara Railway Project

The project for a railway across the Sahara desert to connect the French colonies of northern Africa with those of eastern and equatorial Africa and the Congo region has been revived again by M. Fontaneilles, a French engineer, who bases his plans on the report made early in 1914 by the engineers Legouez and Jullidiere. He proposes to build southwest for 1,980 miles from the Algerian railways to a point on the Niger River where connection would be made with the railway extending from the port of Dakar on the west coast. The railway would then turn eastward toward Lake Tchad with a view to connect with the railways of East Africa and South Africa, eventually completing a north and south route between Algiers and Cape Town, as well as an east and west route between Dakar and Mombasa. In 1914 the cost of the Trans-Sahara line was estimated at $32,000 per mile, exclusive of electrification, which was considered necessary on account of lack of water. M. Fontaneilles estimates the present cost of construction at $96,000 per mile, with $32,000 additional for pipe lines to supply water for steam locomotives. Auxiliary expenses would make a grand total of $160,000 per mile, at normal rate of exchange.

Some Further Notes on Railway Electrification in Chile

With ample hydro-electric power available and a coal supply dependent largely upon importations the Chilean Government Railways in 1921 adopted a policy of electrification of the principal lines not only on account of operating economy but also to permit of increasing the traffic capacity by heavier loads and higher speeds than are practicable with the present steam locomotives. A contract was awarded for the equipment of the main line between Valparaiso and Santiago, 116 miles, and the 28-mile branch which connects with the narrow-gage Transandine Railway. These two lines have a gage of 5 ft. 6 in. The contract covers the overhead wiring, substation equipment and 39 locomotives, but current will be purchased from present hydro-electric plants. A note of this work was given in *Engineering News-Record* of Dec. 15, 1921, p. 976, but some additional information is given here in regard to the characteristics of the lines and their operation.

In crossing the mountains there is a 12-mile grade of 2.25 per cent against southbound traffic and a 6-mile grade of 1.81 per cent against northbound traffic. Curves of 10 deg. are numerous in the rough country. The track is laid with 80- and 85-lb. rails on Chilean oak ties mainly in stone ballast, but 75-lb. rails are used on the Los Andes branch. In the six tunnels, three of which are on the 2.25 per cent grade, the headroom is ample for the new electric equipment. Transmission lines from the hydro-electric plant will serve five substations delivering 3,000-volt direct current to the trolley wire. The catenary suspension system is used, with a ⅜-in. cable in spans of nearly 200 ft. between the poles, carrying the trolley wire at a height of 19½ ft. above the rails, except in the tunnels.

Pantagraph collectors on the locomotive will take current from this wire. Regenerative braking will be used on the express passenger engines and the freight engines, but not on the local passenger engines as these will not operate over grades heavy enough to make this equipment advisable.

Through passenger trains on the main line range from 200 to 300 tons behind the tender, and the heavier trains require pusher engines or double headers on the heavy grades, but the 126-ton electric locomotives are designed to handle these trains without assistance and at higher speeds. The present time of the fastest trains is 3 hr. 40 min. but it is expected to reduce this to 3 hr. 15 min. for the 116-mile run. The lighter engines for local trains will handle loads of 260 to 350 tons on the main line and 300-ton trains on the Los Andes branch.

For a daily tonnage averaging 3,600 tons each way the freight trains generally weigh about 550 tons behind the tender and require pusher engines on the heavy grades. But the 112-ton electric locomotives are designed to handle 770-ton trains, requiring pushers only on the long grade of 2.25 per cent. In this way the present number of trains will be reduced about 25 per cent, while handling the same amount of traffic and at higher speeds.

This electrification contract was awarded to the Westinghouse Electric Manufacturing Co., Pittsburg, Pa., at about $7,000,000.

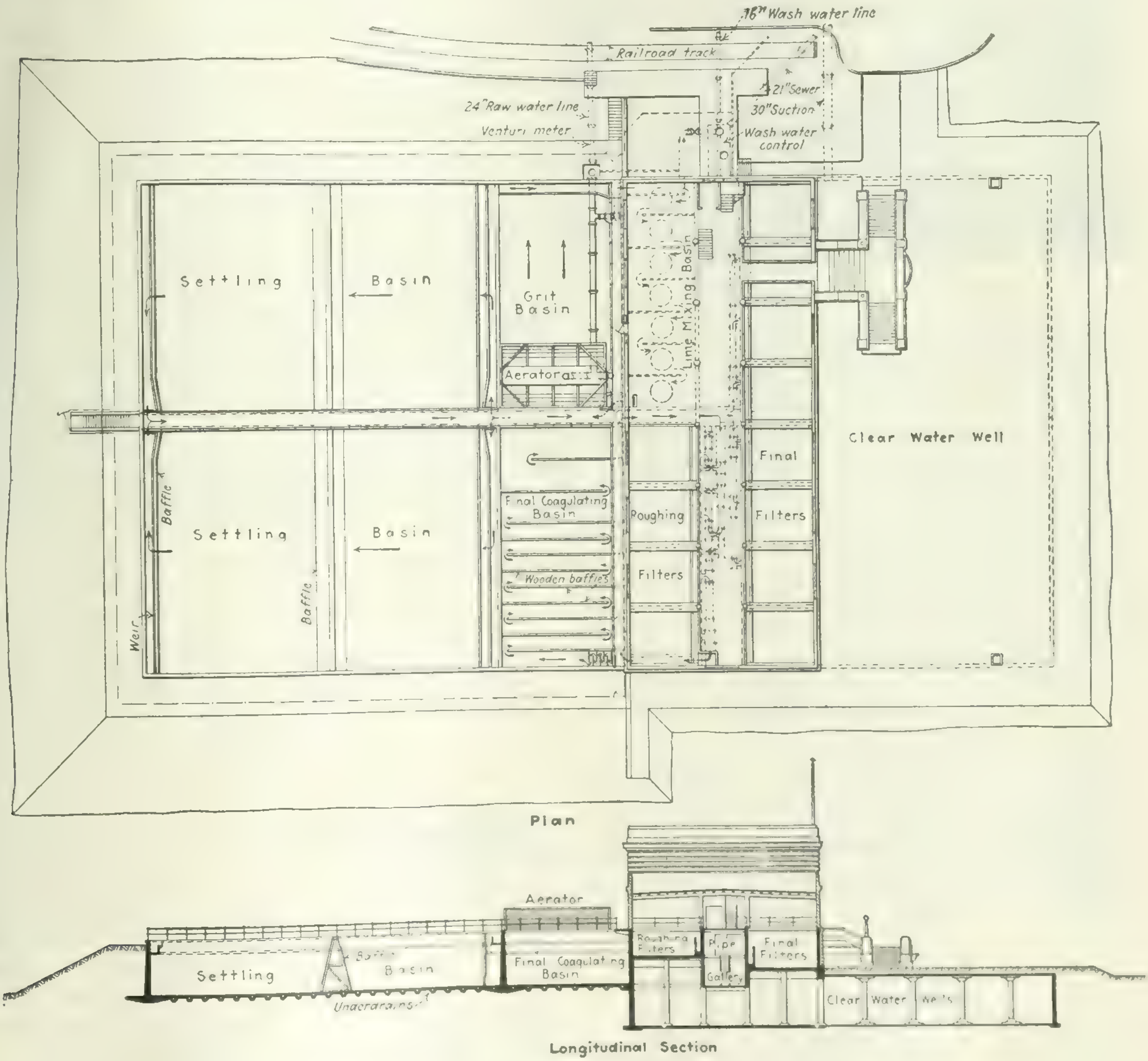
New Water Purification Plant for Topeka, Kansas

Eight Steps in Treatment-Aerators, Grit Chamber, Settling Basins, Roughing and Final Filters, Lime, Alum and Chlorine

ROUGHING filters of the same form as the final filters, underdrained settling basins and multiple-pan aerators are features in the new 8-m.g.d. water purification plant of the Topeka, Kan., water-works recently put into operation. The works will settle, soften, coagulate, double filter and chlorinate the Kaw River water supplanting a harder, insufficient well-water which had previously been purveyed. Before starting on the purification program exhaustive studies following examinations of both river and well supplies were made. The conclusion to treat the turbid river water was reached mainly because of the limited quantity of water further well development would produce economically, the greater cost necessary to soften it and the necessity for a tunnel to carry the water under the river.

NEW WATER PURIFICATION PLANT FOR TOPEKA

Although the river water is not so hard as the well water, ranging from 120 to 580 p.p.m. with a mean of 250 p.p.m. of total hardness, it still needs softening, and in addition the turbidity, which ranges from 13 to 3,385 p.p.m., must be eliminated. The total relative



GENERAL PLAN AND SECTION OF TOPEKA WATER PURIFICATION PLANT

cost per million gallons of treatment of the two supplies, exclusive of high-service pumping, was estimated at $40 for river water and $62.50 for the well water. While the river fluctuates considerably in depth at the intake, with an ordinary suction lift of 20 ft. the low-water flow has only once reached a minimum flow of 60 m.g.d.

Topeka has a population of 52,000 and uses only 70 gal. per capita, as it is fully metered. The average daily consumption in 1920 was 3,600,000 gal. with a maximum in July of 4,700,000 gal. It is expected that the filtered water will lead to an increase in consumption both on account of its better quality and its unlimited supply. A nominal 8-m.g.d. plant was constructed with filter equipment installed for 6 m.g.d. The grit, coagulation and settling basins were constructed for 10-m.g.d. ultimate capacity.

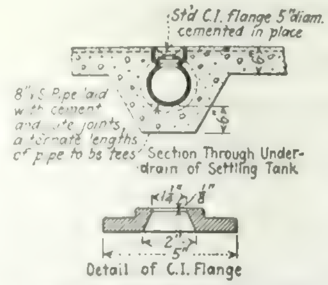
The plant consists of a double-chamber concrete intake pier, pan aerator, grit chamber, baffled lime mixer with motor-driven agitators, underdrained set-

FINAL FILTER PERFORATED-PIPE UNDERDRAINS

tling basin, high-velocity wash roughing filters, coagulant basin, final filters, a 2,000,000-gal. clear well, chlorine plant and an elevated steel wash-water tank.

The intake is founded on shale rock 32 ft. below normal low-water level and is connected to the shore by a 124-ft. steel foot-bridge. Duplicate openings with sluice gates are provided with bottoms 6 and 4 ft. below and 8 ft. above normal low water. The capacity of the intake, 8 m.g.d., was determined by the size of the intake gates, which will pass 10 m.g.d. at a velocity of about 1 ft. per second. Two 24-in. cast-iron pipes carry the water to low-service centrifugal pumps which lift it to the aerator where the elevation is 21.25 ft. above the normal level in the clear well.

Multiple-Pan Aerator—The aerator consists of a series of steel pans, 3-in. deep, set one above the other, giving drops of 15-in. each at the top and 18-in. at the bottom. The total length of weir is 900 ft., giving a nappe of $\frac{3}{32}$-in. or less, or 0.026 sec.-ft. per foot of weir, which is in accordance with the tests made by C. C. Young at Excelsior Springs, Mo. (see *Engineering News*, March 2, 1916). The lower trays provide more drop than those at the top so as to insure a free circulation of air. Tests have indicated an increase in dissolved oxygen of from zero p.p.m. to saturation with several aerators of this type constructed elsewhere, and reductions of CO_2 as much as 60 per cent.



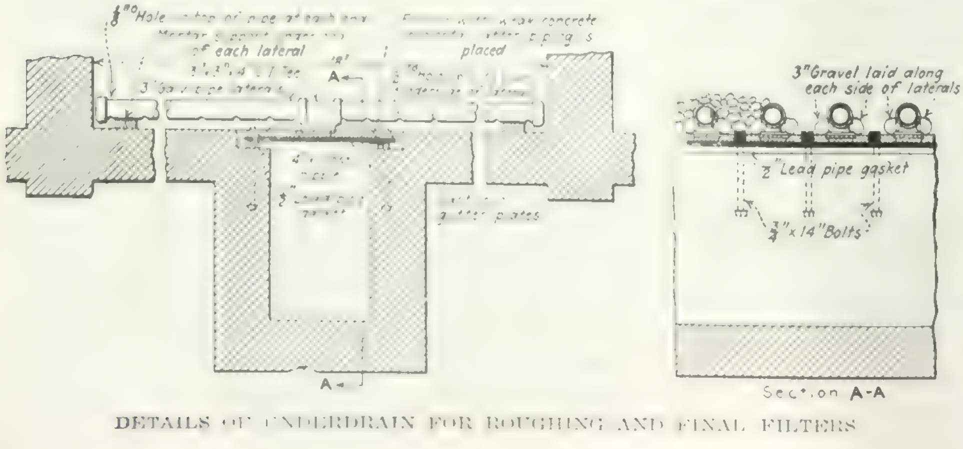
SECTION THROUGH UNDERDRAIN OF SETTLING BASIN

A grit chamber having a nominal capacity of one hour effects a horizontal velocity of 1.16 ft. per minute. It follows the aeration. At the rate of 8 m.g.d. the lime mixers will retain the water for 0.5 hour and the forward velocity, maintained by cement-plastered metal-lath baffles, will be 4.65 ft. per minute. The lime will be thoroughly mixed with the water by motor-driven agitators.

The 6-hour settling basin has a cross-section of such dimensions as to produce a nominal velocity of 0.32 ft. per minute. Since the basin is to remove the heavier sediment from the lime treatment and must handle a heavy load, a series of 8-in. vitrified-pipe underdrains are buried in the floor and have 1¼-in. openings in the concrete spaced at the corners of 5-ft. squares. If the mud angle of repose is as steep as 1 to 2 the maximum depth at the center of the squares will be but 15 in. The 5-ft. spacing is the same as used in similar basins at Lawrence and Emporia, Kan. The relation of the opening in the concrete to the area of pipes is 0.363. It is planned to open the valves on the end of each underdrain for a few seconds each day.

Diaphragms in this basin are for stiffening and were calculated on the same basis as stiffeners at bridge portals, with the steel stressed considerably higher than is usual. The filling rate is controlled by two 8 x 12-in. openings which will permit a maximum rate of 4 m.g.d. each, making a head of 1 ft. only possible on the baffle.

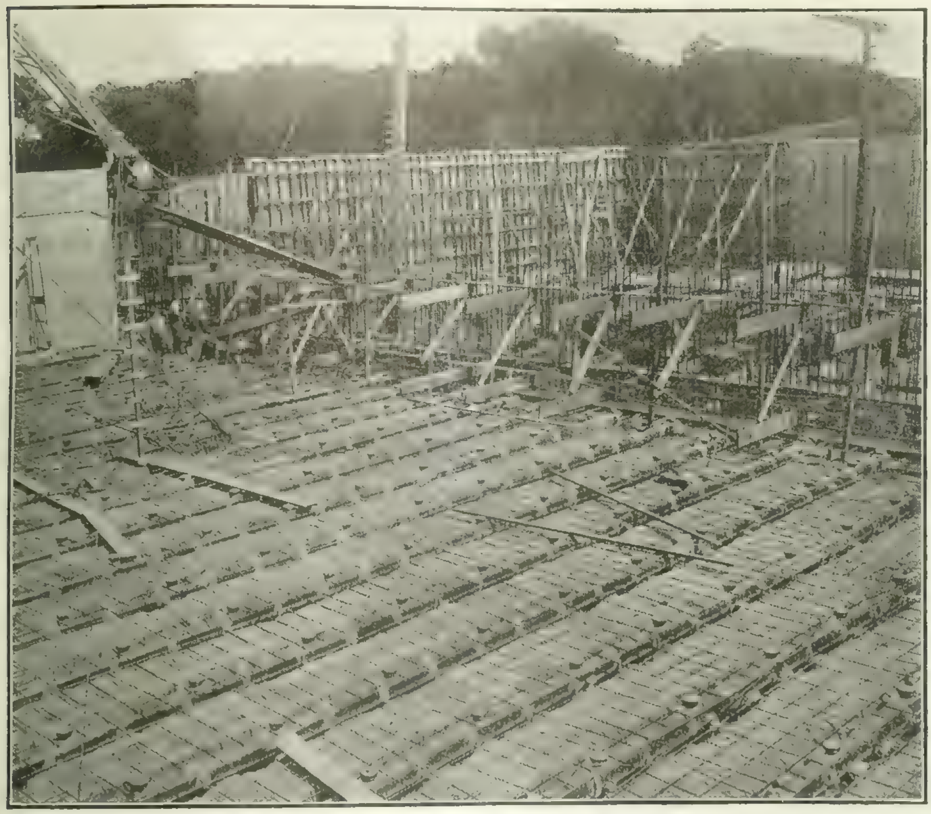
Roughing Filters—In the roughing filters, which have the same construction and same type of underdrains as the regular rapid filters, 18 in. of Joplin chats passing a ¼-in. mesh screen have been placed. The chats are supported on gravel layers made up of the same size and thickness as in the final filters noted below. The rate is 250 m.g.d. per acre, double the ordinary rapid-filter rate. The chat filters present points of contact on which the after-deposits of carbonates may collect, as well as remove further sediment and the chemical precipitate. Expe-



DETAILS OF UNDERDRAIN FOR ROUGHING AND FINAL FILTERS

rience at Lawrence with chats as a roughing filter material indicated that after-deposits could be eliminated. That plant lacked sufficient washing facilities to keep the roughing filters in good working order, so it was decided in the Topeka plant to duplicate the washing facilities of the regular filters.

Final Filters—The final filters are of the conventional type, 18 x 20 ft. in plan, with underdrains of 3-in. galvanized perforated-pipe laterals, spaced on 12-in. centers with ½-in. holes on the under side spaced on 6-in. centers. The ratio of length to diameter of laterals or L/D=36 and the ratio of orifice opening to filter area is 0.502, the size being increased largely because of the high rate of filtration through the roughing filters and the high rate of wash, 2 ft. per minute vertical rise. These figures are in line with the Sacramento experiments but are higher than have ordinarily been used. The U-shaped concrete wash-water troughs are spaced 4.5 ft. from weir to weir. Sand was prepared on the job from that found nearby in the river. As placed in the filters it had an effective size of 0.4 m.m. and a uniformity coefficient of 1.6. The depth of the sand is 30 in. The distance from the surface of the filter medium to the wash-water weirs is 20 in. in both roughing filters and final filters. The supporting gravel has the following thickness and sizes: Up to top underdrain pipe laterals, 2½ to 3 in.; 5 in., 1¼ to 2½ in.; 3 in., ¾ to 1¼ in.; 3 in., ½ to ¾ in.; 3 in., ¼ to ½ in.; 4 in., 10-mesh to ¼ inch.



UNDERDRAINS IN SETTLING BASIN BEFORE CONCRETING
Wooden plugs in holes will be knocked out after construction is completed

Between the roughing filters and the final filters is a coagulant basin holding a supply of one hour. A stirring velocity of 0.75 ft. per second is maintained in a baffled section from which the water slows down to 9.4 ft. per minute at the beginning of the settling portion of the basin. At the end the speed is still further reduced to 4.7 ft. per minute.

The Topeka purification works were designed and the construction carried out under the direction of Black & Veatch, consulting engineers, Kansas City, Mo. C. I. Dodd was the resident engineer. The Unit Construction Co., St. Louis, Mo., held the general contract.

Costs of Steel, Concrete and Brick Stacks

Relative costs of smokestacks for power plants up to 600 hp. are given in the report of the committee on modernization of stationary power plants at the annual meeting of the American Railway Association (Mechanical Division). The accompanying table and notes are summarized from this report:

Steel stacks increase in cost directly in proportion to the boiler horsepower of the plant, this being due to duplication of stacks for the larger plants. The cost is much lower for small plants, but gradually approaches that of concrete and brick as the size of the plant increases. Concrete stacks decrease in cost per boiler horsepower as the size of the plant increases, the cost being slightly higher than that of brick for the same size of plant above 500 hp., and less for plants below 500 hp. Brick stacks also decrease in cost per boiler horsepower as the size of the plant increases, but in greater proportion, the cost being slightly less than that of concrete for the same size plant above 500 hp. and more when below 500 hp.

Maintenance and depreciation amount to 2½ per cent of total cost for concrete stacks per year, 3 per cent for brick stacks and 16 per cent for steel stacks. This may be variable, depending upon local conditions, design and proper maintenance, but appears to represent a basis of comparison which is comparatively accurate. There is practically no appreciable upkeep to a concrete stack. Brick stacks require pointing up from time to time, while steel stacks require painting annually or bi-annually.

COST OF SMOKESTACKS

Top Diam., In.	Height, Ft.	Boiler, Hp.	Cost Dollars	Cost Per B.H.P. Dollars	Annual Maint. and Depreciation
		STEEL			
34	85	150	569	3.79	91.00
36	75	150	600	4.00	96.00
38	90	200	·758	3.79	121.00
34	85	300	1,138	3.80	182.08
		BRICK			
42	100	200	2,900	14.50	87.00
	Average	200	2,750	13.75	82.50
54	100	400	3,100	7.75	93.00
	Average	400	2,950	7.37	88.50
66	100	600	3,300	5.50	99.00
	Average	600	3,150	5.25	94.50
		REINFORCED-CONCRETE			
42	70	200	1,675	8.37	41.87
	Average	200	3,492	12.46	62.29
54	106	400	2,450	6.12	61.25
	Average	400	2,883	7.21	72.08
66	100	600	3,400	5.66	85.00
	Average	600	3,233	5.38	80.83

Propose Interstate Agreement on Reciprocal Licensing

State Engineering Examiners Will Consider Plan for Recognition of License in Other Than Issuing States

ARTICLES of agreement as to reciprocal registration of engineers have been formulated by the reciprocal registration committee of the Council of State Boards of Engineering Examiners and will be submitted to the Council at its next regular meeting in October with the recommendation that they be adopted and put into effect by the several state boards of engineering examiners.

In view of the fact that several states have separate license laws for engineers and architects, and that in some cases the license laws apply only to surveyors, the committee did not attempt to formulate a uniform reciprocal standard for either architecture or surveying, but confined itself strictly to professional engineering. An engineer applying for reciprocal registration must be licensed in some state which is a Council member.

The committee was unanimously of the opinion that the standard for reciprocal registration should be set so high that it will be considered a credit to any engineer to have reciprocal registration. It invites attention to the fact that the method of reciprocal registration provided does not conflict with any state law but asks by mutual agreement an additional recognition without cost.

Present membership in the Council of State Boards of Engineering Examiners includes Colorado, Florida, Illinois, Indiana, Iowa, Louisiana, Michigan, Minnesota, North Carolina, and Oregon.

The proposed articles of agreement are as follows:

Article 1.—Qualification for reciprocal registration shall be determined upon the basis of professional record, thorough consideration of which shall constitute examination.

Article 2.—Engineering experience gained by the applicant prior to his reaching the age of 18 years shall not be deemed of sufficient importance to be counted as a part of such professional experience.

Article 3.—Applicant's professional experience shall be considered as beginning when he emerges from the apprenticeship, or artisan class, into a position which requires original thought and responsibility.

(a) In civil engineering, experience shall begin at the point where the applicant reaches the responsibility of, or equivalent to, that of actual transitman.

(b) In other branches of engineering, experience shall count only after apprenticeship, foremanship, inspectorship, or other subordinate positions, unless the work done specifically shows that the applicant possesses originality of design and has had responsibility in his subordinate positions.

(c) In the drafting room, experience shall begin to count at the point where the applicant ceases to do merely tracing, lettering, or purely mechanical work, requiring for its performance only manual dexterity, and enters a position of responsibility where he begins actual design.

Article 4.—The applicant shall show ten years of experience of the character indicated above as evidence of qualification for reciprocal registration, and his experience record shall show progressive advancement in the character of the work performed, without disqualifying evidence. Each case shall be considered on its merits, and the experience record must be given in such complete detail that the Board of Examiners can accurately determine the class of work performed by the applicant.

Article 5.—Graduation from an engineering school of recognized standing shall be accepted as the equivalent of two years of such practice. The intent of this clause is to recognize engineering schools which exact the equivalent of a high school or a preparatory school diploma as an entrance requirement, and demand the equivalent of a four years course in engineering for graduation.

Article 6.—Where the experience record of an applicant shows that he has done exceptional work of much higher character than that implied in Articles 3 and 4, he may be granted reciprocal registration upon a record of seven years experience, of which graduation from a recognized school of engineering shall count as two years.

Article 7.—The submission of a detailed professional record, properly attested, and accompanied by references as to character and qualification from three reputable, registered, practising engineers, shall be considered as the equivalent of examination, and need not be presented by the applicant in person.

Article 8.—Making reciprocal registration operative between the states shall be done by means of certification from one state to another of the applicant's qualification, and by the affixing to the license or registration certificate, renewal certificate, or annual card, of a seal, which shall bear the name of the board of examiners issuing same, together with the words "Reciprocal Registration." This seal shall be in addition to any other seal required by state law to be affixed to such papers.

Article 9.—Whenever an applicant applies to a state board for registration, if his qualifications fully comply with the standard for reciprocal registration herein provided, he shall be entitled to the reciprocal registration certificate and seal. Those who have previously been granted registration in their own states, upon applying for reciprocal registration, shall be granted same, if fully complying with the standard herein provided.

Article 10.—The aforesaid reciprocal registration certificate shall be prima facie evidence of qualification for license in any state, member of this council. Upon presentation thereof, together with the legal fee required and such information (other than evidence of qualification) as may be requested for the records of the board to whom the application is made, such board shall issue license or registration to the applicant.

Article 11.—Any reciprocal certificate may be revoked by the state issuing same upon presentation to its board of examiners of good and sufficient evidence of gross incompetence or that the applicant's character warrants such revocation.

Article 12.—Should any questions or disagreements arise, or should any points in the above agreement appear to require interpretation, such questions shall be referred to the Council for action at its next regular meeting; or in case more expeditious action shall be necessary, they may be acted upon by the Council by letter ballot. If by letter ballot, such ballot shall be conducted through the office of the secretary of the Council in the customary manner, and the votes shall be counted not later than sixty days after forwarding from his office, by registered mail, of the questions at issue. The secretary of Council shall thereupon immediately certify to the various member boards the roll call and results of the vote, and the determination of the questions at issue, and consequent action shall be in accordance with the majority of the votes recorded.

Plan Railway Extensions in China

Extension of the Peking-Suiyuan Railway 100 miles farther west is about to be begun, according to an article in the *Peking Leader* forwarded by the United States commercial attaché at Peking. The survey for this line had been finished for some time and most of the grading completed when financial stringency compelled a suspension of work. This is the first Chinese line to be built entirely by native engineers. It was originally estimated to cost $6,746,000 but under present plans a temporary type of construction will be used lessening the cost.—*Commerce Reports.*

Completion of Barrett Dam Wins Close Race With Water

For Months Steadily Rising Reservoir Threatened to Overtop Structure—Value of Water Saved Exceeds Cost of Dam

SOURCES OF WATER supply serving the city of San Diego are being developed and additional reservoirs are being provided to store enough water to fulfill the city's rapidly increasing requirements over a period of several years of subnormal rainfall. Temperature and aridity conditions in that region are such that the evaporation from open reservoirs is about 5½ ft. per year, thus adding materially to the storage requirements. The latest addition to the system is the Barrett Dam, just completed, which was built to store water on the Cottonwood River about 36 miles east of San Diego. This work has required the excavation of 75,000 cu.yd. of material and the placing of 140,000 cu.yd. of masonry. The construction layout used on Barrett Dam was described in *Engineering News-Record*, Oct. 27, 1921, p. 695.

The rainfall in the city of San Diego for the month of December, 1921, was 9.26 in. and for a 24-hour period during December 25-26, it was 3 in. These exceed all previous records for 30-day and 24-hour periods respectively. Unusually heavy rainfall continued in the vicinity of San Diego for the spring months of 1922, bringing the total precipitation for the winter of 1921-22 to about 200 per cent of normal; the second heaviest in seventy-five years. This came after a flood-producing storm at the beginning of the season and fortunately was distributed uniformly over a period of five months.

At the beginning of this five-month period work was well advanced on Barrett Dam and enough concrete had been poured to bring the structure above the level of the storage required in the reservoir to hold an average season's full run-off. The first heavy run-off of the winter immediately increased the level of the water in the reservoir from El. 50 ft. to 106 ft. From that time on the level of water in the reservoir raised at the maximum rate it was possible to bring up the concrete structure. By concentrating every effort on the work plus remarkable good luck, no water was lost and in addition to retaining all the run-off that came from its own drainage basin, Barrett Dam took care of 1⅓ billion gal. that overflowed from Morena reservoir which is farther up in the same drainage basin.

Figured on the wholesale rate of 10 cents per 1,000 gal. plus the pumping cost and fixed charges which the city has been paying for unfiltered water to supplement its own supply, the value of the water stored behind Barrett Dam by the time the structure was completed exceeded the entire cost of the dam. However, loss by overflow during construction would have been much more than the value of the water in dollars and cents. Overtopping at any time during the last five months of the work would have put out of commission the concrete hoisting and spouting system and flooded the sand pits, thus probably making it impossible to complete the dam this season and losing the opportunity to create and utilize the full storage capacity for this season's run-off.

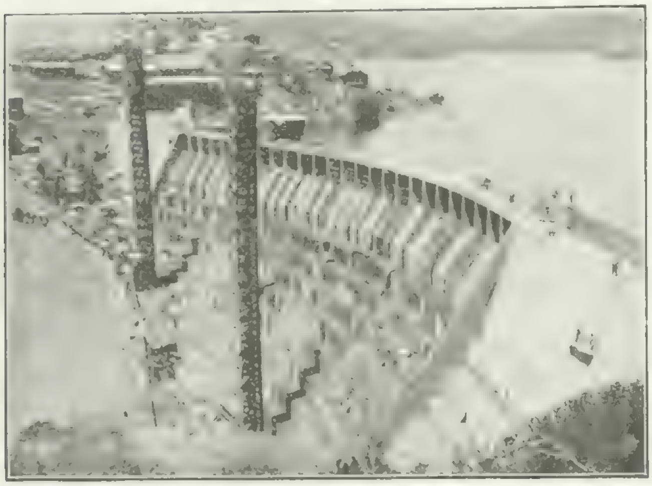
With construction going on under these conditions any risk of mere plant, materials or fresh concrete was

DAM CREST DURING THE RACE WITH HIGH WATER

Note that the water is being held back by the weight of freshly poured concrete held by cribs in the form of piers between which panel-forms serve as flash boards. The downstream side at times was below reservoir level.

considered justifiable if it enhanced the prospects for keeping the dam above the rising water level. Except for the loss of freshly poured concrete there was little or no risk of damage to that part of the structure already completed because both ends were advanced as soon as possible and kept above the center so that in the event of an overpour the abutments would be protected. In anticipation of emergency requirements a number of temporary sluiceways fitted with stop planks were maintained continuously through the central portion of the top of the structure as the masonry was carried up.

From Dec. 26 to the completion of the work some five months later, the reservoir level not only kept up on the stop planks in the sluiceways and was continuously very close to the crest of the uncompleted structure but repeatedly and frequently threatened to overtop it and during practically all of the time was higher



BARRETT DAM COMPLETED TO FULL HEIGHT

"Stepping" the downstream face saved labor by (1) making workmen more efficient than when working on the face of a sheer drop and (2) facilitating dressing at any level.

than some sections of the uncompleted masonry. Overpour at times was prevented only by upstream forms backed up by a little fresh concrete hurriedly placed and sloping rapidly down and away from the forms to a level 10 ft. below that of the water in the reservoir. At other times when the crest of the uncompleted dam had been brought up, as was the general practice, a few feet higher on the downstream side than on the upstream side the impounding water actually came up on to and part way across the top of the structure. At such times the concrete that was placed with feverish haste on the upstream half of the crest to keep the dam above the rising water level, had to be deposited under water.

Because of the necessity for concentrating time and effort on more essential work, form panels often had to be set up hastily and left without being aligned to a nicety. About one-third of the upstream panel forms were lost by being submerged before they could be removed. These, however, were considered mere incidentals in the consummation of the main objective of saving the water.

One of the factors that increased the risk of losing the race was the difficulty in delivering cement to the job. Despite the fact that there were 10,000 bbl. of cement stored at the dam when the rainy season came on (all available cement storage space being filled) there was a shortage of cement for several weeks during the critical period. This was because the 14-mile road over which cement normally came from the railroad by motor truck became impassable after several weeks of unusual and unexpected rainfall and another route 25 miles long had to be used. There were times during the critical period when all the trucks available, loaded with cement, were stuck in soft spots along this 25-mile route.

The rainfall at Barrett Dam was 33.2 in. in the five-month period. The good fortune of the equable distribution, together with the success in keeping the dam above the rising water level, has put the city in an unusually favorable position in regard to quantity of stored water. In addition to the 12½ billion gal. now stored in Barrett reservoir, Morena, Upper Otay and Chollas Heights reservoirs are completely filled, and Lower Otay practically so, bringing the total amount of water stored in the city's system to over 42 billion gal.

The construction of Barrett Dam has been under the direction of H. N. Savage, hydraulic engineer for the city of San Diego. W. A. Stebbins was construction engineer resident at the dam.

Summing Up the Ford Proposal

Extract from the majority report of U. S. Senate Committee on Forestry and Agriculture on the various offers for the water-power and nitrate plants at Muscle Shoals on Tennessee River.

THE wonderful propaganda that has been carried on over the country in favor of the Ford offer has led the people to have an entirely erroneous idea as to what the Ford offer really is. It is difficult to harmonize our idea of Mr. Ford's fairness with his silence on this subject, when his name is so often used in exaggeration and misrepresentation as to just what he does offer to do. The country has been given to understand that Mr. Ford has guaranteed to reduce the cost of fertilizer by one-half. He has done nothing of the kind. He has made no guarantee of any kind in the way of the reduction of the cost of fertilizer. The country has been given to understand that he pays the Government 4 per cent interest on its investment in the two dams. He does nothing of the kind. He has not made any such offer and no such proposition is included in his bid. Giving his corporation credit for every dollar that it pays, he will be paying to the taxpayers less than 3 per cent on the money which he uses out of the Treasury of the United States, and when we consider that this loan runs for one hundred years, it requires even the stretch of the imagination to understand the enormous profit that his corporation secures in this one item alone.

Assuming that a fair interest rate in the commercial world is 6 per cent, this would give his corporation during a hundred-year period a total gift of cold cash of $236,250,000, and if this money were compounded as Mr. Ford asks the Government to compound what he pays, the profit to the corporation at the end of the one hundred-year period would be $14,500,000,000. This is more than half our total cost of the World War.

The country has been given to understand that the Ford offer provides for the repayment to the Government within the one hundred-year period, the entire investment that the Government has made. His offer does nothing of the kind. On the other hand, the total payments include in the offer of both interest and amortization, amount to less than 3 per cent on the investment and he never pays one dollar of the principal. The people of the country have been led to believe that the Ford offer means a reduced price for electricity to consumer. It means nothing of the kind. He has not agreed to furnish a single kilowatt to any home or to any manufacturing concern except his own. The great city that is to spring up as if by magic will probably have its streets and its homes lighted by electricity, gen-

erated from coal that is shipped in on the railroads. The mighty power at Muscle Shoals will be devoted entirely and exclusively to the use of the great corporation which Mr. Ford will organize.

When we bring together the results that must follow from these two divisions of the Ford offer, the mind is dazed at the unreasonableness of the proposition, at the enormity of the gift. With the expenditure of no money, there is turned over to a corporation property of the value of more than one hundred million dollars, and the right and privilege to extort unjust profits from the citizens of this country without limit. Money is furnished by the unwilling taxpayers of the country to construct improvements of millions in value and to finance operations on the most gigantic scale in history, not for the benefit of the people, but entirely and exclusively for the benefit of one corporation. The inheritance of our children and our children's children is mortgaged, and the resources of our country are not only given away, but with the gift is tied up cheap money, obtained at the expense of the taxpayers, and the right to use it with but little recompense, for one hundred years' time. There is nothing in the history of the world with which this can be compared. Civilization is without a precedent. If the Ford offer is accepted, then the fight for conservation that has been waged by public spirited and patriotic men and women all over the country is not only lost and given away, but those who are unwillingly compelled to make the gift are to be taxed one hundred years to make the gift more profitable. It is the greatest gift ever bestowed upon mortal man since salvation was made free to the human race.

Bark Left on Underground Part of Creosoted Piles

IN THE new State Pier being built by the Directors of the Port in Portland, Maine, (*Engineering News-Record*, April 27, 1922, p. 691) the piles forming the main part of the substructure are being furnished with the bark on for the bottom 30 ft. so as to save in the cost of creosoting. The specifications in this particular read as follows:

"The bark and inner skin shall be removed except for a distance of 30 ft. from the tip. . . . Each pile shall be so treated as to contain not less than 16 lb. of creosote oil per cubic foot of the peeled portion of the pile unless the engineer is satisfied that the largest practicable volumetric injection has been obtained with a lesser amount of oil."

In explanation of this, Fay, Spofford & Thorndike, the engineers for the pier, say:

The above specifications are for southern yellow pine, either long-leaf or short-leaf, and are applicable to approximately 5,500 piles of which 2,200 are from 85 to 89 ft. in length and 1,500 of the remainder are over 70 ft. in length. The object of the specification was primarily to reduce the amount of creosote required to impregnate the pile, the bark acting as a partial barrier to the impregnation of the creosote on the portion of the pile which is to be driven into the ground and which would, therefore, be free from the attack of the limnoria which are, so far as known, the only marine worms giving trouble in Portland harbor. The expense of the creosoting is a highly important factor in the total cost of the piles—about one-half of the total cost of the piles as delivered at the shipping point. There would also be a minor saving resulting from the fact that the bark would not have to be peeled from this portion of the pile.

In carrying out the provisions of these specifications, it was necessary, in order to determine the proper amount of treatment to ensure 16 lb. of creosote per cubic foot in the peeled portion of the pile to make an assumption as to the amount of creosote penetrating the bark. This figure was agreed upon in conference with the creosoting companies as 4 lb. per cubic foot. No exact knowledge, however, exists on this point and it seems to me one which might well be investigated by the Committee of the National Research Council now engaged in the study of the activities of marine worms. We estimate that this provision of the specifications has saved upwards of $10,000 in the cost of the piles for this job.

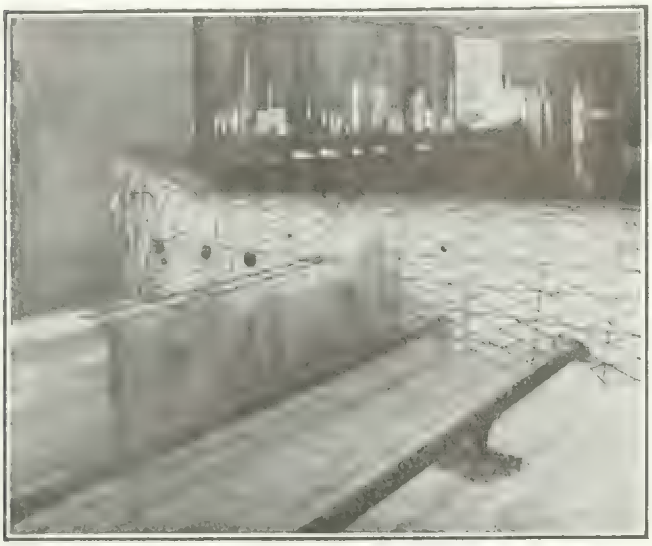
Restoring a Fire Damaged Concrete Building in Berlin

Spalled Reinforced-Concrete Columns and Beams in German Chocolate Factory Re-covered by Cement Gun

AS noted in *Engineering News-Record*, May 11, 1922, p. 795, last January one of the factory buildings of the Sarotti Company, a large chocolate and cocoa manufacturer in Berlin, Germany, was severely damaged by an interior fire which gutted the building of its contents and wrecked a number of the reinforced-concrete members. The building in which the fire took place, as noted in the other article, was five stories high, a beam and girder reinforced-concrete building of an outside plan of 255 x 180 ft. with an interior court about 50 x 70 ft. It was filled with highly combustible material and the fire communicated to each of the five floors through a central well. Damage to the concrete structure was mainly in the spalling off of the concrete over the reinforcement. This spalling varied somewhat with the size of the members but in practically every case the concrete was destroyed to at least the depth

REPAIRING COLUMNS IN BERLIN FACTORY

Column in foreground has been stripped of damaged concrete, new reinforcement placed and gunite applied to lower half. Man applying gunite in rear.

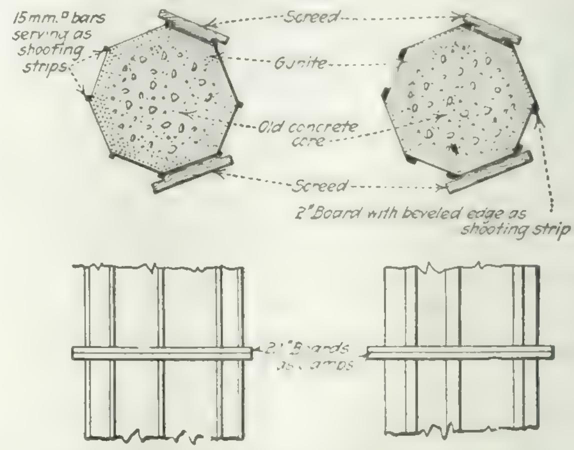


BEAM AND GIRDER CLEANED FOR GUNITE COATING

of the steel and in many cases to a point back of the steel. The full extent of the damage to the concrete was not all discovered until repair was started and then it was found necessary in some of the larger columns to add 12 in. of concrete, and in about half of them 6 in.

In the reconstruction work, which is now under way, the new concrete was applied with a cement gun. Two standard type N-1 cement guns were used on the work, each located in approximately the center of the length of the building but on opposite sides of the interior court. A separate electrically driven air compressor was provided near each machine and with each gun was about 300 ft. of delivery hose. Cement and sand were dumped into the basement and on the first floor level close to each machine and all the shooting to whatever part of the building was done from the one location of the gun. A total difference of elevation of 120 ft. was taken care of.

The general method followed was similar to those followed in this country for the repair of the Edison buildings at West Orange and the warehouse at Far Rockaway, L. I. That is, the spalled concrete was first removed by hammer and later by an air tool until sound concrete was reached. Where the reinforcement had been destroyed by fire additional reinforcement was added, and in the case of the columns and the larger girders new reinforcement to hold the gunite was placed. In the columns this consisted of vertical rods varying in size from ½ to 1 in. long and hoop reinforcement of ¼ in. wide spaced 4 to 6. One of the views shows a column half covered with the gunite and the reinforcement in place.



DETAILS OF SHOOTING STRIPS AND SCREEDS

The first application of gunite was made of a thickness just to cover the reinforcement. After putting on this first application shooting strips, as shown in the accompanying sketch and illustrated in one of the photographs, were placed and a second layer of gunite applied as shown. In the beams the old stirrups were used as supports for reinforcing the gunite and new stirrups of round iron fastened to the old and the expanded metal fastened to the new stirrups.

The beams and the underside of the floor slabs were cleaned after the loose material was removed with hammer and chisel by using a cement gun as a sand-blast machine. First this cleaning was done by hand, using wire brushes, but trials proved that the cement gun would do the work in about a quarter of the time.

The work was started April 4, 1922, and up to and including June 3, or 40 days, the cement guns were in operation 375 hr. moving 2,160 cu.ft. of cement, 353 cu.yd. of sand at an average mixture of 1 to 4½, which means about 4.5 cu.yd. of concrete placed a day of 4.7 hours. The crew for the work consisted of one foreman, one compressor operator, two nozzle men, two laborers and gun operators and 12 laborers wheeling sand and cement, mixing and screening sand and cement.

SHOOTING AND SCREEDING STRIPS IN PLACE

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

From Another Engineer's Wife

Sir—Referring to recent letters from engineers' wives published in your valuable columns, here's an incident that happened to my husband at a hotel table in a small Wisconsin town. My husband is a pretty well known bridge engineer. In the course of conversation with an inquisitive elbow mate, he was asked,

"What business are you in?

"I'm a civil engineer.

"What's that?

"I'm a bridge builder.

"Oh! I see, a sort of a carpenter?

"No! a card player"—and it went.

SIC SEMPER.

Some Questions as to the Oregon City Arch

Sir—The article in your June 8 issue, p. 942, by C. B. McCullough on the Oregon City Bridge brings to mind several interesting questions on design.

The author lays much stress on the injurious effects of the sulphite fumes from the paper mills, which are some 600 ft. distant. The old suspension bridge occupied the same site for the past thirty odd years and did not show excessive corrosion, either on the galvanized cables or the rod hangers. True, the cables became somewhat corroded near the anchors, probably due either to electrolysis or rusting from soil moisture. These points were better protected from the fumes than any other parts of the cables. Nearby vegetation shows no injurious effects from atmospheric pollution. Any structural steel exposed to the Oregon climate should be painted at intervals of four or five years, and the writer does not consider that these intervals will be materially shortened by the proximity of the bridge to the paper mills. Hence the economy of this type of structure over a spandrel braced arch is not apparent.

The cross-section of the arch rib is the second point for consideration. Obviously the rib takes both flexure and direct compression. Why, then, should it not conform to the recognized specifications for both plate-girders and columns? The 6 x $3\frac{1}{2}$ x $\frac{5}{16}$ longitudinal angle stiffeners have a radius of gyration of approximately 1.75 including a portion of the adjacent web plate. This, for the maximum unsupported length of 17 ft. gives a ratio of L to R of 113. The specifications of the American Railway Engineering Association limit the length of unsupported flanges of compression members to 40 R. These angles are too slender to make effective stiffeners. The web plates in themselves are not thick enough to satisfy standard specifications for compression members. Hence the allowable unit compressive stress in the arch rib is limited by these unsupported portions and is much smaller than the rib taken as a unit.

Another point worthy of consideration is the fact that the lower ends of the arch ribs are under water for a major portion of the year, and as much as 15 ft. under water during ordinary spring run-offs. The $1\frac{1}{2}$-in. coating of gunite on the exterior cannot be expected to keep all of the water out of the ribs. Neither will the concrete filling in the ribs adhere to the web plates to protect them from corrosion. An analogous case is one cited in *Engineering News-Record*, Feb. 10, 1921, p. 264 concerning the failure of an arch bridge at Dayton, Ohio, which showed that the concrete adhered to only about 15 per cent of the steel.

R. W. LINCOLN,
Consulting Engineer.

June 20, 1922,
Portland, Ore.

Tie-Treatment a Charge Against Capital

Sir—Referring to various articles in *Engineering News-Record* including that in the issue of June 1, 1922, p. 921, by Earl Stimson, chief engineer of maintenance, Baltimore and Ohio R.R. Co., and F. S. Schwinn, chief engineer, International and Great Northern Ry., and letter of June 9, by J. N. Sunderland, printed in your issue of June 29, 1922; all of these articles relate to the propriety of capitalizing the actual cost of cross-ties treatment.

According to the principles of economics this cost is a proper charge to the capital account. The classification of investment in road and equipment of steam roads, p. 18, Account 8, states: "This account shall include the cost of cross, switch, bridge and other track ties used in the construction of tracks for the movement or storage of locomotives and cars and the cost of additional ties subsequently laid in such tracks; also the excess cost of metal ties used in repairing of tracks over the cost to replace in kind wooden ties removed." The classification of operating expenses, p. 42, Account 212, states: "This account shall include the cost of cross, switch, bridge and other track ties used in the repairs of tracks."

There is no specific reference to the cost of treating ties in any of the classifications. However, the correct economic principle to be followed is to charge "renewals in kind" to operating expenses. It is understood that the bureau of accounts does not approve charging cost of treatment to investment where a few ties are used on each track section, but where a whole district or division has actually been renewed with treated ties it is probable that the bureau would carefully consider any reasonable case presented by a carrier, and approve a proper charge to investment provided the actual cost of treatment had been checked by a representative of the bureau, and the evidence clearly showed that the cost was in excess of the original investment. There seems to be general agreement that the cost of treatment of ties is a proper charge to capital account and the bureau of valuation during the past nine years has inventoried, classified and priced ties exactly as found in the track on the date of valuation.

EDWIN F. WENDT,
Washington, D. C., July 15. Consulting Engineer.

Old Dams Being Inspected in Quebec

Sir—I was interested in the note published in *Engineering News-Record*, June 29, p. 1069, about the inspection of old dams in the State of New Jersey by engineers of the State Department of Conservation and Development.

An investigation of all dams situated in the Province of Quebec is also being made. The work, instead of being done by engineers of the Government, is left to the care of every proprietor. In 1918, three laws were enacted stipulating: (1) "That nobody (corporation, partnership, person) can begin any canal, flood-gate, embankment, dam, dyke, etc., in the water courses running through his property without having previously obtained the approbation of the Lieutenant-Governor-in-Council; (2) every possessor of existing works of this kind is obliged to submit plans and specifications of such works to the Minister of Lands and Forests; (3) all works to be done in the future for the storing of water must be previously authorized, if such works necessitate the taking possession and occupation of public or private property or affect the same in any way."

This covers every case which may exist regardless of the height of the dams, dikes, etc., or of the extent of the drainage area. We estimate that the number of existing dams for the floating of logs only about 1,800. Out of that number, the Department of Lands and Forests has received, since 1918, about 275 plans. We feel well satisfied with this result, considering that the financial situation of many lumber companies has been precarious of late. We have no serious difficulty in getting exact information.

EUGENE ROY,
Engineer, Department of Lands and Forests,
Quebec, Canada.

NEWS OF THE WEEK

New York, July 27, 1922

Connell to Advise Pinchot on Penn. Road Policies

Republican Nominee for Governor is Investigating All State Departments Before Election

A survey of the Pennsylvania State Highway Department has been undertaken to place information regarding fiscal, engineering and other policies in the hands of Gifford Pinchot, Republican nominee who, unless a political upset occurs, will be Pennsylvania's next governor. The investigation is being made through the agency of the Citizens' Committee on the Finances of the State of Pennsylvania, appointed by Mr. Pinchot. William H. Connell, formerly chief of the Bureau of Highways of Philadelphia, has been selected to canvass the state highway situation and submit a report. The survey will include a study of organization, engineering policies, and general conduct of the business of the entire department.

It is understood that Mr. Pinchot, in his capacity as candidate for governor, desires to have this information in hand before election so that, in the event of his choice as the state's chief executive, he will be familiar, at the outset, with the work and policies of the various departments under his jurisdiction. Through the Citizens' Committee, of which Dr. Clyde L. King is chairman, similar studies are being made of other state departments. Dr. King has made for *Engineering News-Record* the following statement in explanation of the committee's work:

PURPOSE OF SURVEY

"The last session of the state legislature in Pennsylvania appropriated at least $30,000,000 in excess of income to the state. The day after Mr. Pinchot was chosen as the Republican nominee for governor he appointed a Citizens' Committee to undertake a survey of the fiscal situation which the next legislature must face. The committee has adopted the policy of having a high-grade expert, the best available in the state or in the country, make a survey of the spending policies of each of the departments of the commonwealth. The idea is to investigate past practices and present situations as a basis for constructive recommendations for a budget, which, in the event of Mr. Pinchot's election, is to be submitted for the first time in Pennsylvania to the state legislature.

"Our whole purpose and plan is to place the expenditures of the state on a business basis. To make the highway survey we have chosen William H. Connell who will associate with him an advisory committee of engineers from outside the state. Mr. Connell made a notable record as chief of the Bureau of Highways in the Blankenburg administration (in Philadelphia). Mr. Pinchot wants to make a survey of the kind that would be helpful to a manager of a large business enterprise, private or public, in order to acquaint himself with the policies and the details necessary for handling his job from the day he lands in office. Most public administrators are educated by their job for their job, and learn it only about the time they are through their public service. Mr. Pinchot sets himself the task of learning about his job before he starts it."

FOR FOOTPATHS ALONG STATE ROADS IN NEW JERSEY

At the next session of the New Jersey Legislature an effort will be made, according to information received from T. J. Wasser, state highway engineer, to amend the State Highway Act in order to provide for the construction of footpaths along state highways. An unsuccessful attempt was made this year to have a bill carrying such an amendment passed. It is the opinion of the State Highway Commission that the footpaths are needed to reduce the number of motor-vehicle accidents to pedestrians. The wording of the proposed amendment to the State Highway Act is as follows:

"Proper footpaths for the use of pedestrians may be constructed on such portions of any state highway where, in the opinion of the State Highway Commission, such construction is necessary and advisable."

Knickerbocker Theater Indictments Thrown Out

Justice Siddons of the Criminal Court of the District of Columbia on July 24 dismissed the indictment for manslaughter against five defendants in the case of the roof collapse of the Knickerbocker Theater, Washington, on Jan. 28. The decision will be appealed to the District Court of Appeals. R. W. Geare, architect; J. W. Ford, steel designer and fabricator; J. R. Downman, building inspector; R. G. Fletcher, subcontractor; and D. M. Wallace, superintendent, were jointly charged with negligence in the indictment, as noted in *Engineering News-Record* of April 6, p. 582.

It is held in the decision that the facts in which the alleged offense of negligence consists are not set out in the indictment with reasonable certainty. The court pointed out that the indictment fails to allege in what respect the plans and specifications prepared by Geare were negligently prepared, and fails to show in what respect he failed to exercise the general direction and supervision of work on the theater; and similarly as to the other defendants.

Court Denies Infringement of Chuting Patent

Holds Callahan Patent on Chuting Apparatus Applies Only to Exact Combination Claimed

A lower court decision on the validity of what has been assumed to be a basic patent on concrete chuting apparatus was handed down by Judge Dickinson in the District Court of the United States for the Eastern District of Pennsylvania on June 13, 1922. The decision, while expressing some doubt as to the validity of the patent in question, does not rule against it, but it does rule that that patent applies only to the exact combination of devices claimed in the patent and on that basis the apparatus complained against was declared to be not an infringement.

The patent in question, U. S. 948,719, issued Feb. 8, 1910, on an application filed Jan. 21, 1909, to one Callahan and afterwards assigned to the Concrete Appliances Co., of Missouri, is for a concrete chuting device, denominated in the suit as an "apparatus for hoisting concrete to a hopper located considerably above the level of the work under construction or permitting it to flow through an inclined pipe to the point of delivery." The claims center around five elements in combination, that is, a tower, a hoist, a hopper, a boom and a conduit carried by the boom. The device complained against, which was used in the building of the Gomery & Schwartz automobile warehouse at 24th and Market Sts., Philadelphia, comprises a chuting tower with trussed chutes, one of them counterbalanced, and of two types, one of which is supported by a boom and the other in which the chute itself constitutes the stiffening horizontal member. Suit was brought by the Concrete Appliances Co. and William H. Insley against John E. Gomery, John C. Schwartz, Michael J. O'Meara and Concrete Construction Co.

The patent had been in litigation several times before, but the principal case was by the same plaintiffs against Meniken, Owens and Curd in Cincinnati. In this suit, decided in the district court, June 19, 1918, and upheld in the circuit court Jan. 6, 1920 (262 Fed. Rep. 958), the Callahan patent was upheld.

NEW EVIDENCE IN SUIT

New evidence as to prior art was advanced in the latter suit, and in recognizing this new evidence Judge Dickinson said: "We are not persuaded that the evidence before us so far differs from the evidence in the former case as to compel a different finding from that then made. We feel, however, that the defendant has a right to the expression of our conviction that had such finding of invention not been made, the evidence before us bearing upon the prior state of the art would have led us to the conclusion that no invention is disclosed by plaintiff's appliance, at least further than to confer upon him the right to a patent limited

to the specific special construction which the patentee devised."

The case then, according to Judge Dickinson, becomes not one of invention but one of infringement, and in investigating this phase the judge decides that the device complained against does not copy all of the details of the patent. For instance, he calls attention to the fact that the patent has claims for a separate conduit and boom, and that where the conduit serves itself as a boom, there is no infringement.

In laying down the general law in this case the judge says that "if an inventor goes to a prior art and takes therefrom five elements, which he puts together in a combination constituting a patentable invention, and another man goes to the possession of the same art and takes therefrom four of these same elements, of which he makes a combination, thereby creating an appliance which will serve the same purposes and do all the work of the first and do it equally well, the two appliances are not the same in a patentable sense. The invention is not in the elements nor in any one or more of them, but in the combination, and the combination is not the same but a different one. The inventions are likewise not the same but different inventions. . . .

"When those who practiced the art used appliances constructed of various combinations of these known elements, and all the patentee did was to devise a special make of apparatus constructed upon the principle of a combination of a given number of these known elements which has the merit of being a better appliance than those made up of fewer or other elements, all that the patent gives is a monopoly of that make of appliance. He cannot force the trade to use his superior make nor levy tribute upon it for the use of appliances which are not his appliance nor deprive the trade of the right before enjoyed of making appliances out of what the art supplied so long as the appliances which were thus made are not his appliance nor the equivalent of it. Chute conditions were in common use. They had to be supported or be constructed of sufficient strength to be self-supporting. Either was expensive and otherwise open to objection. The thought of a boom to carry the conduit was an advance. In many respects the construction was a better construction. This, however, gave the inventor of the construction no property right in a self-supporting conduit construction, and he does not get the right by calling the conduit a boom."

The decision was that the defendant had not infringed and that the bill should be dismissed for want of equity.

TRANSPORT PRIORITIES MAY DELAY ROAD WORK

Priority orders of the Interstate Commerce Commission, which were made effective July 26 to aid the distribution of coal during the emergency created by the current strike, will have a direct effect in interfering with the highway construction programs in many of the states. *Engineering News-Record* has secured the following comment on the probable results of the present transportation emergency:

A. R. Hirst, state highway engineer of Wisconsin, says that the Interstate Commerce Commission's priority orders will probably close down 50 per cent of road construction in that state. A few jobs have aggregate and cement enough on hand to last for six weeks. Sixty per cent of Wisconsin's concrete roads are built from road-side aggregate. Of this year's 440-mile paving program 200 miles are now completed. Anticipating the commission's orders Mr. Hirst has sent three warnings to contractors, the first one having been issued in May.

Frank F. Rogers, state highway commission of Michigan, says 75 per cent of work on that state's 250-mile paving program will close down; only 10 per cent is now completed. On one job it will be possible to haul aggregate and cement by truck.

Of Illinois' 1,000-mile program 240 miles are completed. Last week a record mileage of 37 was built. Illinois will be closed down more completely than Michigan. The flow of cement for the next six weeks, officials say, will be predicated on the supply of box cars.

In the absence of Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, Capt. P. St. J. Wilson, chief engineer, estimated that the priority orders, if effective for a considerable period, would have a serious effect in curtailing road work, especially in the North and East. The effect, he pointed out, would be most marked in those states building high-type, hard-surfaced roads. Any car shortage would be serious, he said, not only in the case of concrete but also of bituminous construction, for in most of the states the supplies of asphalt and tar are not sufficient to tide over a long period.

Wm. Barclay Parsons Made Brigadier General

Col. William Barclay Parsons, commander of the 11th Engineers during the World War, has been promoted to the rank of brigadier general, O.R.C., and will continue to serve as deputy chief engineer, G.H.Q. organized Engineer reserve of the U. S. Army.

Gen. Parsons is a native of New York City and a graduate of Columbia University, of which he is now chairman of the board of trustees. He has been associated with many engineering works of national importance. Among the foremost are the location of the Canton-Hankow R.R. in China, the International Advisory Board of Consulting Engineers for the Panama Canal, the Isthmian Canal Commission, the Royal Commission on London Traffic, the first New York subway, the Chicago Traction Commission and the Cape Cod Canal.

When the United States entered the World War, Gen. Parsons was major in the Engineer Officers Reserve Corps and was assigned as a battalion commander to the regiment that later became the 11th Engineers. Later he went to France in advance of the American army as senior member of a special commission to investigate transportation conditions there. Upon arrival of his regiment he rejoined it as lieutenant colonel and served with it throughout its stay in France. In the spring of 1918 he assumed command of the regiment and was made colonel during that summer. After the armistice, he conducted for the Peace Commission an investigation into the damage inflicted upon Belgian industry and railways by the German army of occupation. For his services in France, General Parsons was awarded the British Distinguished Service Order, the Crown of Belgium, and a citation for exceptionally meritorious and conspicuous services by the commander-in-chief, A. E. F.

In his new position, Gen. Parsons will take an important part in the organization of the Engineer section of the Officers Reserve Corps.

Decision in Bascule Bridge Suit

A suit brought against the Scherzer Rolling Lift Bridge Co. by the Strauss Bascule Bridge Co. on account of infringement of a patent has resulted in a decision favorable to the former company in the Federal district court at Chicago. Judge Page dismissed the case with a verbal statement to the effect that there was no evidence of infringement, but the Strauss company will appeal the case. The patent in question relates to construction of the shoe or bearing surface on the curved rolling heel of the bridge.

Sesquicentennial Resolution Passes Senate

That Congress expects to appropriate liberally to the sesquicentennial exposition to be held in Philadelphia in 1926 was revealed during the discussion of the sesquicentennial resolution in the Senate recently. Though objection was made to the resolution, previously passed by the House, on the ground that to pass it would commit the government to participation without knowing how much expense it would entail, it finally was passed by the Senate.

Senate Votes $100,000 for Study of Columbia Basin Project

The Senate has passed a bill authorizing the Secretary of the Interior to investigate the Columbia Basin irrigation project in the State of Washington, a report to be made by Jan. 1, 1924. An appropriation of $100,000 is provided for in the bill.

Drainage Congress in September

The National Drainage Congress will hold its eleventh annual meeting at Kansas City, Mo., Sept. 25 to 29, and an industrial exhibit is to be a feature of this meeting.

Second Delaware Bridge Caisson Launched

1,700-Ton Structure Takes Water At New York Shipbuilding Co. Yard. —To Carry Camden Pier.

The east or Camden pier caisson for the Delaware River bridge to connect Philadelphia and Camden was launched July 18 at the yard of the New York Shipbuilding Co., Camden, with entire success. The structure is of combination steel and timber construction, with steel working chamber, steel trusses staying its roof, and timber walls above the roof. The dimensions of the caisson are 70 x 143 ft., and its launching weight was about 1,700 tons. It was built in one of the covered building ways of the shipbuilding plant, on the normal launching slope, and was launched on two ways, being held by tie timbers at the inshore end which were sawed through to release it. Jacks were provided to start its motion, if needed, but the caisson started of itself when the timbers had been sawed part way through, tearing the wood. When afloat it drew 12½ ft.

Robert Moore, Former President of Am. Soc. C. E., Dies

Robert Moore, of St. Louis, who was president of the American Society of Civil Engineers in 1902-1903, died July 23, 1922, at a summer resort in Michigan.

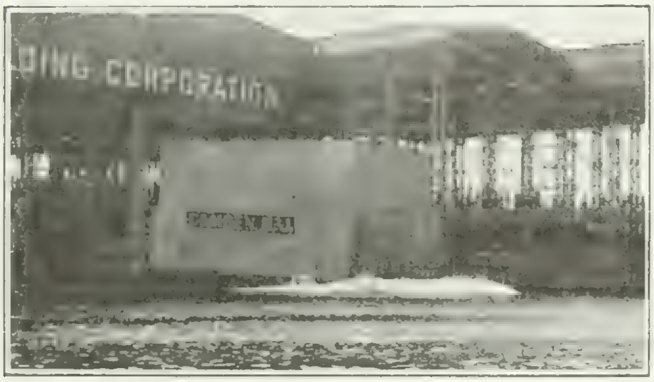
Mr. Moore was born in Newcastle, Pa., June 19, 1838. He went to St. Louis in 1868 and was active in engineering practice in that city until his retirement about five years ago. He took a prominent place in the early engineering development of St. Louis and was a member of the first Board of Public Improvements, in which capacity he did much to establish the high standards which have been the objective of succeeding boards. He was especially interested in educational work and was for ten years a member of the Board of Education of St. Louis which, during his tenure, became one of the city's chief agencies for civic betterment.

Mr. Moore was a past president of the Engineers' Club of St. Louis and, at the time of his death, its oldest living member.

Complete Hazardous Blasting Over Transit Tunnel

Deepening of the channel of the East River, New York harbor, which has been in progress since February 1921, has just been completed in the section over and adjacent to the Clark St. tunnels of the Interborough Rapid Transit Co. As the bed of the river at this point is of ledge, unusual precautions in blasting were necessary to avoid damage to the tunnels, which lie in places less than 30 ft. below the new grade of the channel.

No blasting was permitted during the morning and evening rush hours for tunnel traffic; and a carefully organized system of signalling and inspection was established whereby no blast was fired while a train was passing through. The work is being done by the New Jersey Shipbuilding and Dredging Co., under the direction of Col. Edward Burr, U. S. District Engineer. Chairman McAneny of the Transit Commission has written to the secretary of war to express appreciation of the care taken by Col. Burr to safeguard the traveling public.



EAST MAIN PIER CAISSON LAUNCHED FROM WAYS OF NEW YORK SHIPBUILDING CO., CAMDEN, N. J.

With a ground plan of 70 x 143 ft., the caisson covers a quarter acre of ground. It was built up to a height of 72 ft. at the time of launching; a cofferdam section will be bolted on top later. The caisson shell is timber, but the working chamber and its roof trusses are steel. A false bottom reduced the water impact in launching.

As launched, the caisson had a loose false bottom under the working chamber, to make it enter the water more smoothly and prevent impact against the four transverse bulkheads which divide the working chamber. This false bottom was pulled out from beneath shortly after launching. The interior of the caisson above the working chamber was found entirely dry.

Dredging the pier site to about 35-ft. depth was completed on July 28 and the caisson was towed to place and entered between guide piles ready for concreting to settle it on the bottom. The sinking will go through silt and gravel as on the Philadelphia side, but a layer of clay will also have to be passed through, and rock will lie somewhat deeper than on the Philadelphia side, according to the borings.

The Philadelphia pier substructure is now nearly complete; the work of setting granite for the pier facing is just being started. The construction of this foundation went on rapidly and without interruption or incident. Bids having been received Dec. 19, 1921, a contract for the two piers was signed on Dec. 27 with Holbrook, Cabot & Rollins Corp., who let a subcontract for the construction and launching of the caissons to the New York Shipbuilding Corporation shortly afterward. The Philadelphia caisson was launched April 24 and delivered at the pier site May 6. Concreting started May 9, and the caisson reached the river bottom at El. —42 about two weeks later. Air pressure was put on May 26, and excavation then continued through mud, gravel, and decomposed rock until June 20, when the cutting edge was stopped. Rock was first struck 10 ft. below the dredging plane, or at El. —52 (Philadelphia datum is 2.43 above mean high water), but the caisson was sunk to El. —60.5. Excavation below the cutting edge continued in one place as much as 11 ft. On June 20 concreting in the working chamber was begun, and the chamber was all sealed by July 1, and air pressure was removed on July 3. The highest pressure used during the work was 28½ lb.

Concreting was carried up to El. —12.5, at which level the granite is to start. The material for the pier facing is Georgia granite from the quarry of the Stone Mountain Granite Corp., and much of it is on hand and ready for placing.

Plan to Connect Bayonne and Staten Island

An appropriation of $10,000 has been made by Hudson County, N. J., toward the preliminary engineering expenses for a bridge or tunnel crossing the Kill von Kull, to connect Bayonne and Staten Island. The appropriation is made with the proviso that New York authorities appropriate a similar sum. A crossing at this point has been under discussion for many years. The last definite action concerning it was a report on a bridge crossing at this point by an interstate bridge commission ten or twelve years ago.

International Housing Congress for Rome in September

An International Housing Congress is to be held in Rome, Italy, Sept. 21-26 inclusive. The Congress will deal with all matters pertaining to the housing problems of the various countries, especially as regards inexpensive houses. The Italian executive committee of the congress has decided to publish a fortnightly bulletin dealing with questions which will be discussed in September.

Los Angeles Seeks San Joaquin Power Site

At a hearing held in Bakersfield, Cal., June 15 and presided over by F. H. Fowler, district engineer for the U. S. Forest Service, and H. A. Kluegel, chief engineer of the division of water rights, state department of public works, were heard and protested the application of the City of Los Angeles to establish two reservoir and power plant sites on the south fork of the Kern River in Tulare County.

Los Angeles proposes to construct one reservoir, conduit and power plant above Monache meadows and a second reservoir, conduit and power plant at Rockhouse. The Monache reservoir would have a capacity of 25,000 acre-ft. and would flood 1,700 acres of land. The diversion from the reservoir to the power plant would be made by an open and closed conduit 10 miles long from the east bank of the river, ending in a steel penstock 1.8 miles long. The static drop from tunnel to power-plant turbines would be 1,728 ft. The Rockhouse project consists of the construction of a dam 92 ft. high and 1,350 ft. long, to store 26,000 acre-ft. of water which would flood 714 acres. Diversion would be by a tunnel 9.8 miles long, closed except for 2,500 ft. where the conduit would pass over a stream. The penstock would be 1.56 miles long.

The protestants to the plan, comprising practically every public organization of the San Joaquin Valley, contended that the storage projects planned by Los Angeles could not be carried out without interfering with prior water rights. According to the Hagen-Carr agreement of 1888, the flow is measured at two points on the river during six months of the year, the period of measurement beginning March 1 and ending Aug. 31. Three hundred second feet of the flow at the first point of measurement are diverted for irrigation purposes and the remainder is delivered at the second point of measurement, also for irrigation service. Buena Vista Lake was constructed to receive this "second point" water. The Los Angeles storage plan, according to the protestants, would cut the pro rata of water due "second point" farmers, and would deprive the San Joaquin Valley of the full utilization for power purposes of streams flowing into it from nearby mountains.

To Remove Colorado River Raft

According to the terms of a bill recently introduced in Congress the Secretary of War will be directed to have a survey made of the Colorado River in Texas with the view to removing the great raft that has been forming in Matagorda and Wharton counties, as well as controlling flood waters of the stream under the flood-control act of March 1, 1917. The plan contemplates that government engineers will take charge of the work with such federal aid as may be secured, and with consent of the people of those localities, a few counties to be exempt from state taxation to finance the undertaking further as was done in improvements at Galveston.

The great raft referred to extends up the river for about 60 miles and accumulates at a rate of a mile a year. It is now within 15 miles of Wharton.

The Engineer in Public Life

ARTHUR M. SHAW

In activities affecting the development of New Orleans, Arthur M. Shaw, consulting engineer, has taken a prominent part. For many years he has been identified with the New Orleans Association of Commerce, having served as chairman of its health and sanitation committee and as member of its port facilities and city planning committees. During 1919 and 1920 Mr. Shaw was active in the Child Welfare Association and served as chairman of that body's committee on city sanitation as affecting infant welfare. Mr. Shaw now occupies the post of dean of the School of Engineering at Loyola University, after a professional experience of thirty years in railroad, reclamation, drainage, and municipal work.

Born in Lee Center, Ill., in 1870, he studied civil engineering at Cornell College, Mt. Vernon, Iowa, and in 1891 was engaged as rodman and instrumentman on railway location and construction. During the Spanish-American War, in 1898, he served with the second U. S. Volunteer Engineers as corporal and sergeant. After a period with the Illinois Central R.R., beginning in 1903, he went to Mexico in 1906 as division engineer in charge of the new line of the Mexican International Ry. from Durango to Guadalajara. He returned to the United States in 1908 and specialized on reclamation and drainage projects as consulting engineer, with offices in New Orleans.

During the war, with rank of major, he was in charge of several army-camp construction projects. In addition to his university work, Mr. Shaw engages in private practice at New Orleans, specializing in railway location, land reclamation, and sanitary work. Last year he completed a sanitary survey for the city of San Pedro Sula, Honduras. He is a past-president of the Louisiana Engineering Society and of the Louisiana Section of the American Society of Civil Engineers.

High-Voltage Power Line Built at Purdue

An experimental transmission line for operation at 600 kilovolts, the highest voltage power line in the world, has recently been completed at Purdue University, Lafayette, Ind. The line is approximately a third of a mile long and consists of three 600-ft. strands of steel core aluminum cable which is supported on steel towers sixty-five feet in height.

The line is built to determine the possibilities of transmitting voltages in excess of 240,000 volts over considerable distances.

Affiliated Technical Societies of Boston Formed

Informal meetings held by representatives of the various technical societies in Boston during the past year to consider an affiliation of these societies has led to the organization of the Affiliated Technical Societies of Boston, which was granted a charter last month. The following nine societies are member organizations: Boston Society of Civil Engineers, New England Water Works Association, Plant Engineers' Club; Boston Section, American Institute of Electrical Engineers; Boston Section, American Society of Mechanical Engineers; Northeastern Section, American Society of Civil Engineers; Boston Section, American Institute of Mining and Metallurgical Engineers; Massachusetts Chapter, American Society of Heating and Ventilating Engineers and the Boston Chapter, American Association of Engineers.

The council of the association, which is composed of two representatives from each affiliated organization, has elected the following officers: Leonard Metcalf, chairman; Alfred S. Kellogg and Alexander Macomber, vice-chairmen; Charles L. Hammond, treasurer; W. G. Starkweather, clerk; and J. B. Babcock, executive secretary.

An agreement has been made with the Boston Society of Civil Engineers for the use of its quarters, library and equipment and a similar agreement has been made with the New England Water Works Association, whose quarters adjoin those of the Boston Society.

A. G. C. Issues Agreement Form for Rented Equipment

An equipment lease that constructors are willing to sign as either lessee or lessor has just been issued by the Associated General Contractors of America. Its object is to provide a simplified rental agreement which will insure absolute fairness to both parties. The form adopted is the result of investigations and criticism of members of the A. G. C. extending over a period of two years. It was prepared under the direction of the Committee on Methods, of which A. P. Greensfelder, secretary of the Fruin-Colnon Contracting Co., St. Louis, was chairman, and Ward P. Christie, research engineer. Through use of this form it is believed that many difficulties incident to renting construction equipment can be eliminated.

Civil Service Examinations

UNITED STATES

For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Vacancies in the office of the Supervising Architect, Treasury Department. Computer and estimator, $1,600 to $1,800 per year. Examinations Aug. 23 and 24.

Vacancies in the Public Health Service. Junior assistant sanitary engineer and assistant sanitary engineer, $2,320 and $3,225, respectively, per year. Examinations Aug. 9.

Engineering Societies

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal, Que.; Professional Meeting, Winnipeg, Man., Sept. 5-7.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

The San Francisco Section, Am. Soc. C. E., devoted the regular meeting on June 20 to an informal discussion of the investigation of California's water resources now being conducted under the direction of the state department of engineering with a $200,000 appropriation made by the latest state legislature. Among those who participated were John D. Galloway, A. E. Chandler, T. H. Means, C. H. Lee and Col. R. B. Marshall. All who spoke favored a complete study of water resources before laying out any state development program and the speakers frequently referred to the dangerous features of the proposed $500,000,000 state water and power bill. Water development has already been carried beyond immediate needs in California, it was said, and the more pressing requirements are now more settlers on land already under irrigation and the education of irrigators, particularly in the dangers of water logging. Moving pictures of the parent society meeting at Dayton were shown.

Personal Notes

HOWARD S. REED has been appointed city engineer of Phoenix, Ariz. Mr. Reed was for a number of years in the employ of the U. S. Reclamation Service, being attached to the engineering staff working on the construction of the Roosevelt dam. Since 1913 he has been associated with Sheldon K. Baker in private practice in Phoenix.

C. G. PAYNE has been approved as county engineer of Meade County, Kansas, by the State Highway Commission. Mr. Payne was formerly county engineer of Johnson County.

BRIGADIER-GENERAL T. L. TREMBLAY has succeeded St. George Boswell, resigned, as chief engineer of the Quebec Harbor Commission.

C. F. HINCHMAN has been appointed division engineer of maintenance-of-way of the Springfield division and Indianapolis terminal of the Cleveland, Cincinnati, Chicago & St. Louis Ry., with headquarters at Indianapolis, Ind.

DR. J. A. L. WADDELL, consulting engineer, New York City, has been elected a member of the Royal Academy of Sciences and Arts of Barcelona, Spain.

ROY W. ELLIOTT has resigned as instructor in civil engineering at the University of Michigan, and has accepted the position as superintendent of buildings and purchasing agent for the board of education at Topeka, Kans.

H. A. KUEHMSTED, former assistant engineer of the San Diego and Arizona R.R., has been appointed engineer of way and structures of the San Diego Electric Ry.

COL. GEORGE M. HOFFMAN, Corps of Engineers, U. S. Army, has been nominated by the United States Senate as a member of the Mississippi River Commission.

ARVID SJOVALL, formerly assistant city engineer of New Britain, Conn., has recently become associated with the public-works contracting firm of Edward Balf Co., Hartford, Conn.

MAJOR RAYMOND A. WHEELER, on duty at Fort Benning, Ga., it is expected, will be detailed as assistant engineer commissioner of the District of Columbia, succeeding Major Cary Brown, whose orders transferring him to Camp Humphreys, Va., have been issued. Recommendation for Major Wheeler's appointment has been made at the War Department and it is expected he will assume the office August 1.

Obituary

ANTHONY C. DOUGLAS, who was one of the contractors on the construction of the tunnel through Bergen Hill at Jersey City for the Delaware, Lackawanna & Western R.R., died recently at Niagara Falls, aged 67 years. Mr. Douglas also had some part in the construction of the Croton dam for the water supply of New York City, as well as the construction of the first Niagara Falls power tunnel. Mr. Douglas was mayor of Niagara Falls from 1907 to 1911.

JOHN W. MORRIS, who, associated with J. H. Strobridge, took considerable part in the construction of the Central Pacific and the Southern Pacific Railroads, died recently in Oakland, Cal., where he had lived for the past 65 years. He was 94 years of age. Mr. Morris was born in Pennsylvania but went to California in 1852.

LUTHER WAGONER, consulting engineer of San Francisco, whose professional career carried him into practically every line of engineering and into many countries outside his own, died in San Francisco July 1. Outstanding in his professional career were his positions as chief engineer of the Havana sewer and paving contract, a position to which he was appointed by President Menocal of Cuba in 1916; his journey to Europe in 1907 in a semi-official capacity to study harbor improvements; and his joint authorship of a plan for the complete development of the San Francisco harbor. Mr. Wagoner had been engaged in engineering work since 1866 when he served for a short time as deputy county engineer of Johnson County, Mo. In 1866 he entered the service of the Union Pacific Ry., leaving it to become engineer of the land department of the Texas Pacific. From 1874 to 1877 he was in Brazil on bridge construction, geodetic work and mine development and in 1879 was engaged in water-supply work in Kansas. In 1884 he had charge of the construction of a section of the San Francisco sea wall.

After four years in a general mining engineering practice, from 1896 to 1900, he was given charge of the investigation for a new water supply for San Francisco. In the intervening time he had made plans for the reclamation of Colusa Basin in California and also for dams, canal systems, reservoirs and other irrigation work in various western states. He was past-president of the Consulting Engineers of the Pacific Coast, of the San Francisco chapter of the American Society of Civil Engineers, and a member of several other technical organizations.

Business Notes

A. A. MURPHY has recently been appointed New York City sales manager of the industrial and railway paint and varnish division of E. I. Du Pont De Nemours & Co., Inc., Wilmington, Del.

THE YOUNGLOVE CONSTRUCTION CO., Sioux City, Iowa, has been appointed representatives for the Conveyors Corporation of America for the sale of American trolley carriers in northwestern Iowa and in South Dakota.

THE BINGHAMTON ENGINEERING CO. has recently been organized at Binghamton, N. Y. The company specializes in the design, fabrication and erection of structural steel work. A. L. Gilmore is the president of the concern and George H. Young is treasurer.

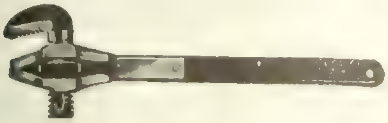
R. P. RAYNSFORD, for the last three years chief engineer of Lockwood, Greene & Co., of Canada, Ltd., on September 1 will join the organization of the Canadian Consolidated Rubber Co., Montreal. He succeeds Frank W. Harding, consulting engineer of Footwear Factories, who is retiring after over 25 years of service.

BEAR TRACTORS, INC., New York City, has announced an increase in field-sales force. CLARENCE STANTIAL, formerly with the Cleveland Tractor Co., will represent the Bear company in the East; W. A. INGALLS, for several years covering northwestern territory for the Hart-Parr Co., will represent the Bear company in that territory; and L. G. MELROSE, former president of the Kirkwood Automobile Co., Kirkwood, Mo., will operate in southwestern territory from headquarters in St. Louis.

Equipment and Materials

End-Opening Pipe Wrench

Only three parts, a handle and jaw in one piece, a movable jaw, and a hardened steel nut, are employed in the Little Giant pipe wrench which has



just been put on the market by the Greenfield Tap & Die Corp., Greenfield, Mass. The wrench has the end-opening feature and among the advantages claimed for it is the ease with which it can handle pipe in corners, close to walls, and in other confined places. The pipe may be set straight on the pipe, like a pair of pliers, without the necessity of fitting the jaws on from the sides. The handle and jaws are drop-forged and heat-treated and all such parts as springs, rivets, frames or pins have been eliminated. The wrench is manufactured in 8, 10, 14, 18, and 24-in. sizes. The 14-in. size, the manufacturers state, has repeatedly withstood stresses in excess of 47,000 in.-lb. without slipping or bending.

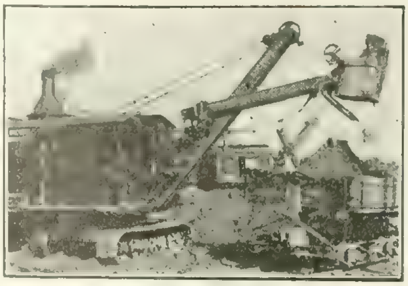
Crawler Crane

To the line of construction plant manufactured by the Link Belt Co., Chicago, has been added a crawler crane mounted on caterpillar treads and with a lifting capacity of 10 tons at 12-ft. radius and 3 tons at 30-ft. radius. Equipped with two independent hoisting drums the machine is suitable both for clamshell and dragline work. Without the bucket the crane weighs approximately 22 tons and exerts a pressure on the ground of 10 lb. per square inch. Power is furnished by a four-cylinder Climax gasoline engine operat-

ing at 800 r.p.m. The boom is 35 ft. long and is made of angle and lattice bar construction. With the exception of the slow-running 7-ft. rotation gear and pinion, all gears, including spur, bevel and worm, have machined teeth cut from solid blanks of steel or bronze. The manufacturers make a point of the fact that there are only 16 gears of all descriptions as against about 30 gears in other types of locomotive crane. If desired, a 40-hp. electric motor may be substituted for the 50-hp. gasoline engine with which the crane is ordinarily equipped.

A ¾-Yd. Universal Shovel Replaces Old Type

A number of new and improved features are incorporated in the 20-ton, ¾-yd. revolving shovel (Type 20-B), which the Bucyrus Co., of South Milwaukee, Wis., has developed to replace its Type 14-B revolving shovel. The new machine is adapted to dragline, high lift, clamshell, crane and other combinations. Among the innovations in its design are the use of a two-part instead of a three-part hoist to facilitate the use of the equipment for dragline work; outside type of dipper sticks and box-girder type of boom as a stronger form of construction than that formerly employed; A-frame directly connected to a steel center casting to



form a more solid support; rounded corners on the dipper which facilitate the dumping of sticky material; an improved and simplified three-lever control.

Rotary Snow Plow

At Big Creek, in Fresno County, Cal., last winter the state highway commission experimented with a rotary snow

plow on a mountain highway where the grades average 14 per cent and the depth of snow varied from 12 to 14 ft. According to a report by J. C. Woodson, division engineer, the highway rotary snow plow can be operated successfully where grades are not excessive and in freshly fallen snow up to 5 or 6 ft. in depth. The California Edison Co. also used last winter a snow plow manufactured by the Winthers Motor Co. of Kenosha, Wis., photograph of which is reproduced herewith. The results indicated that the plow is effective in snow that has not been allowed to pack or freeze. It is understood that the Winthers company is redesigning parts of the plow preliminary to further tests.

Out-of-the-Ordinary Trade Publications

Blasting — The Hercules Powder Co., Wilmington, Del., has issued a 48-page booklet, illustrated with drawings and photographs, entitled "Eliminating Waste in Blasting." The text is by N. S. Greensfelder and presents information of technical value to both engineer and contractor. . The various operations involved in tunneling and quarrying operations are analyzed and time records given for each step for a 16-hole round. A chapter on "Drilling" gives sketches of drill-hole arrangement and data based on studies at the Copper Queen mine. The information deals with such matters as the proper inclination and spacing of drill holes and their length in rocks of different character. A number of valuable points based on experience gained in driving the tunnel for the Hetch-Hetchy water supply system for San Francisco are made. Several pages are devoted to the choice of explosives under various conditions and their best distribution in loading drill holes. Data on firing systems include both fuse and cap and electric firing. The booklet is not a trade catalog but a compilation of practical information drawn from many sources.

Rotary Snow Broom — The Fox Rotary Snow Broom Co., Newark, N. J., in a 12-page illustrated pamphlet, sets forth the features of its device for clearing snow from country highways and city streets. The broom, which can be mounted on any standard motor-truck chassis, is an adaptation of the street-railway broom sweeper. It operates most economically at a speed of 12 miles per hour (400 r.p.m.) in snow 10 in. deep, cutting a swatch 9 ft. wide.

Excavator and Loader—The T. L. Smith Co., Milwaukee, is distributing a four-page leaflet dealing with its excavator and loader comprising a drag-line scraper delivering into the pivoted frame of the machine which elevates and dumps the material into motor trucks. In basement excavation the loader remains at the surface requiring, besides the operator, only one man in the hole. It is also used for sand and gravel pit work and for grading.

Motor Trucks—The Atterbury Motor Car Co., Buffalo, N. Y., has issued a 16-page illustrated booklet giving specifications for its 1½, 2½, 3½ and 5-ton motor trucks together with detailed description of the mechanical features of this equipment.

Copper Roofing — The Copper and Brass Research Association, New York City, has published a 29-page book of information for engineers, architects and roofing contractors regarding the use of copper roofing. After stating some general facts about copper, the text gives a table of comparative weights of various roofing materials, 16 oz. (standing seam) copper weighing 125 lb. and copper shingles from 84 to 100 lb. per 100 sq.ft. laid. The two methods of applying copper sheets to sloping roofs, the "ribbed seam" and the "standing seam" methods are described. In addition, certain fundamental considerations in sheet-copper roof construction are stated, with particular attention to flashings, gutters and eaves troughs. A condensed specification for copper roofing is given and there are four pages of drawings showing all sorts of copper roofing details.

Business Side of Construction

Facts and Events that Affect Cost and Volume

1913 Should Be Retained as a Price Base

E. E. George Estimates Future Price Trend as Perhaps 2 Per Cent a Year

E. E. George, of the Valuation Division of the Department of City Transit, Philadelphia, is convinced that the pre-war bases should be maintained. "The pre-war base for index numbers is now practically an international standard," he writes *Engineering News-Record*, "and although many new index numbers have been designed only within the last few months, especially for the smaller countries, most of them have been referred to 1913 or 1914 as 100 per cent.

"The United States Department of Commerce, the Bureau of Labor Statistics and the Federal Reserve Board all use 1913 as 100. The Reserve Board has recomputed practically every existing index number to the pre-war basis, where the same has not already been done by its authors. Furthermore, the Harvard Economic Service and other statistical services base most of their charts and index numbers on the year 1913

"While there is a general opinion that the new normal level of prices will be about 50 per cent above pre-war, it should be noted that this level is effective only for "All Commodities." The cost of living, the prices of metals, rentals, construction costs of simple structures, and many other important price levels that are currently measured, are far from approximating 50 per cent above the pre-war figures.

"Furthermore, there is no certainty that these index numbers will approach the figure for "All Commodities." The Harvard Economic Service has made a study of the long term trends of prices for the different classes of materials, and finds that the trend of metal prices is downward, while that of food products is upward. Therefore any new normal can only be effective for a single kind of index number, and any shifting of the base only confuses the observer who has been accustomed to the 1913 reference points.

"The future tendency of prices over a long period of years is a highly debatable subject on which the best economists are not agreed. One of the foremost authorities went so far as to say that any man risks his reputation who prophesies on the subject. It is, however, fairly well agreed that the trend up or down will be relatively slight, say not over 2 per cent a year. Of course, due to depressions and booms, the business cycle will cause larger annual changes than 2 per cent, but these are of a periodic or recurrent nature and may be ignored in studying the long-time trend.

"It seems to be generally agreed that there is a fairly definite international price level when foreign trade is normal, and that in any study of the future trend of prices here, one must consider the financial policies of Europe as well as of this country."

Hollow and Common Brick Take Same Tariff Rate

As a result of an opinion by the board of general appraisers, hollow building-brick takes the same rate of duty as does the ordinary brick of commerce. "The ordinary brick of commerce," says the opinion, "is a rectangular block of clay burned in a kiln, the length generally being twice the breadth; but neither the shape nor the dimensions are the essentials of a brick. The brick known to the tariff law is any article of any shape or form made of clay burned to a certain hardness and used as the ordinary brick is used in the construction of buildings. The article which is the subject of this protest, we think responds to this definition."

Despite its greater value, hollow building brick, therefore, may be imported on payment of a duty of ten per cent ad valorem, the rate applicable to ordinary bricks.

Landis Award Workers in Chicago Reach 16,000

Recent attempts on the part of international building trade heads to "settle" the building situation in Chicago with the Landis award committee so that the members of the thirteen outlaw unions might obtain employment have not been successful. More than 16,000 men are now working in the outlaw trades for Landis Award contractors. Since the first of the year $80,000,000 worth of building permits have been taken out in Chicago for work by these contractors. Building activity especially in apartment houses has slowed up materially. For the first two weeks in July compared with the second two weeks period in June the number of permits dropped from 590 to 458 with values nearly two-thirds less. According to *Chicago Commerce*, the journal of the Chicago Association of Commerce which has staunchly backed the Landis award and the committee, all building contracts awarded during the week of July 15 were taken by Landis award contractors. F. W. Armstrong, general manager of the citizens' committee, states that much of the speculative building is over as rents are dropping and returns are less than anticipated. This fact will give some relief to the Landis award contractors on larger buildings who have been handicapped by a shortage of mechanics in the pro-Landis closed-shop trades.

Coal Cars Short in West Virginia

Freight loadings for the week ending July 8, totalled 718,319 cars, according to the American Railway Association. This is a reduction of 158,577 as compared with the week ending July 1, but an increase of 77,784 over the corresponding week in 1921.

Scarcity of cars for grain loading is beginning to make itself felt in the Middle West, while an actual shortage of coal cars is reported in West Virginia fields, where only about 75 per cent of the normal supply of surplus cars are now available for coal.

1913 Prices Will Never Be Reached in Many Lines

W. S. Bartholomew Believes Buyers at Present Would Be Satisfied With a 150 Level

W. S. Bartholomew, vice-president of the Westinghouse Air Brake Co., gives *Engineering News-Record* his views of the business situation with particular regard to prices. "As far as our own experience is concerned," he writes, "we are able to make prices on but one basis, namely, from proper relation to cost of production. This basis is not always acceptable to the buyer for the reason that a purchaser adopts ways and means for figuring out what prices ought to be according to trends and averages which often times do not square with the actual cost at the time. This brings very unfortunate complications.

"In recent months, a great effort has been made by everybody, and it has been highly commendable, to encourage resumption of purchasing, especially by the transportation companies both electric and steam. In a great many cases the manufacturer's contribution in the matter of lower prices has been without regard to cost of production or cost of material on hand, and used in filling orders which came from this united effort. We are, therefore, apt, under such circumstances, to strike a mark in the readjustment of price levels which is not justified by the facts as far as the selling prices being in proper relation to costs is concerned.

"It is our opinion that actual price levels of 1913 will never again be reached in many industries. There are various reasons for this which are too complicated to explain in a letter.

"It is also our opinion that buyers generally would be well satisfied at present if a level were reached which was approximately 50 per cent above 1913 prices.

"Further, we believe that the exact point of the price level does not cause as much concern to the buyer as does the question of the price being the lowest price obtainable at the time or in the reasonably near future; that is to say, the matter of first consideration to a buyer is not what the price is but whether it is the lowest price obtainable for his immediate needs in connection with transaction in hand. This leads to the conclusion, therefore, that stability of prices is more important than any price-level relationship with other price levels.

"The main consideration in securing stability of prices is, of course, continuity of production which can be secured only through general resumption of buying. This point has not as yet been reached and, therefore, there may be some further recession in prices in order to induce such resumption of buying to secure the continuity of production which will bring stability."

Next week - Index numbers, full list of prices, labor rates.

Production Briefs

Coal output dropped to present weekly rate of 5,000,000 to 6,000,000 tons below normal.

Connellsville Coke increased 10,000 tons during week ending July 20.

Crude Oil increased 24,000 bbl. daily in past two weeks.

Alabama pig-iron totaled 189,101 tons during June as against 93,000 tons in June, 1921; an increase of nearly 100 per cent.

Zinc supply down to only 29,576 tons, or less than one month's requirements. Shipments during first six months exceeded production by 37,032 tons.

Automobile production, including both passenger vehicles and trucks, exceeded 288,000 cars during June; an increase of 12 per cent over May, 1922.

New York Central R.R. placing orders for new equipment to cost over $36,000,000; Baltimore and Ohio, ordering 500 fifty-ton gondolas. Improvements and new equipment on other roads will exceed $150,000,000 for 1922.

Mexican Petroleum advanced 25c.; Eastern, South Western and Pacific crude oils down 50c. per bbl. during past week.

Gasoline down 1c. in New York and 2c. per gal. in Middle West, during week.

The price question—has many interesting components:

Will "future" prices be lower or higher than present?

Next summer—how much lower? How much higher? How about five years from now?

Will prices ever return to the 1913 level? If not, ought pre-war schedules be forgotten and a "new normal" be considered?

Professor Irving Fisher *thinks "the new normal is a delusion and a snare."—See Business Side of Construction, June 15, p. 1018.*

I. F. McDonnell *believes future trend will lie between 1914 trend and the declines following other wars.—July 13, p. 86.*

D. L. Bissell *holds that future wholesale prices will agree with per capita money circulation.—July 20, p. 126.*

W. S. Bartholomew *and* E. E. George *are speaking today.*

Engineering News-Record *believes that the price trend over the next few years will largely determine the degree of prosperity which* all industry *will enjoy or may not enjoy. For this reason it has invited an expression of opinion by the authorities mentioned and by other eminent authorities who have not yet spoken in these pages.*

Study of these opinions should be helpful in planning expansion.

Fifty Big Contracts Since March Total $81,960,860

Of These, Building Construction Leads—Industrial Works Next—Excavating and Dredging Third

From time to time *Engineering News-Records* is requested to publish a list of large contracts recently let or actually under way. Such a list, of twenty-six important jobs awarded in February and March, was published in the Searchlight Advertising section of the April 20 issue.

The accompanying table shows fifty big projects placed under contract since March and representing a total value of $81,960,860, 75 per cent or $61,921,900 of which was for building construction alone. Industrial expansion stood second with $9,900,000 or 12 per cent, and excavating and dredging follows with $1,142,145 or 1 per cent of the total for these fifty contracts.

Only three sewers, one railway and a single big bridge job are included in large projects let during the last three months.

The biggest job listed in these classifications is a twenty-one story bank and office building, in Cleveland, O., valued at $10,000,000. This project, together with two others in the Middle West representing a combined value of $11,304,828, or 14 per cent of the total value of the fifty contracts, is being constructed by New York contractors.

ESSENTIAL DATA ON LARGE CONTRACTS AWARDED SINCE MARCH

Place	Work	Size	Price	Successful Contractors
Cal., Berkeley	Hotel		$1,000,000	Lindgren & Co., Monadnock Bldg., San Francisco, Cal.
Cal., Live Oak	Ditching	380,000 cu. yd.	140,000	Ajax Dredging Co., 249 1st St., San Francisco, Cal.
Cal., Oakland	Office and bank	16 stories	1,000,000	P. J. Walker Co., Monadnock Bldg., San Francisco, Cal.
Cal., San Francisco	Store and lofts	8 stories	500,000	Foundation Co., Holbrook Bldg., San Francisco, Cal.
Conn., Hartford	Factory	4 story, 80x400 ft.	500,000	R. G. Bent Co., 183 Ann St., Hartford, Conn.
Conn., New Haven	Office	12 story, 64x90 ft.	750,000	C. W. Murdock, Inc., 505 Grand Ave., New Haven, Conn.
Conn., Thompsonville	Mill		1,000,000	L. E. Locke & Sons Co., South Union St., Lawrence, Conn.
D. C., Washington	Hotel	8 stories	1,500,000	Weed & Stanton, 918 F. St., Washington, D. C.
Ill., Chicago	Printing plant	6 story, 170x177 ft.	700,000	R. F. Wilson Co., 1851 Elston Ave., Chicago, Ill.
Ill., Chicago	Hotel	10 story, 137x150 ft.	1,500,000	B. W. Construction Co., 10th and South La Salle St., Chicago, Ill
Ill., Chicago	Theatre		1,500,000	Van Etten Bros., 11055 South Michigan Ave., Chicago, Ill.
Ill., Chicago	Hotel	19 story, 120x210 ft.	3,000,000	McLennon Construction Co., 400 North Michigan Ave., Chicago, Ill.
Ind., Ft. Wayne	Office		1,000,000	Hageman-Harris, 95 Madison Ave., New York, N. Y.
Ind., Indianapolis	Office	17 story, 100x112x130 ft.	1,225,000	Bedford Stone & Construction Co., Fletcher Savings & Trust Bldg., Indianapolis, Ind.
Ia., Boone	Excavation		215,945	McHose Sand & Tile Co., Boone, Ia.
Ia., Des Moines	Office	12 story.	1,000,000	A Benson Contracting Co., 422 Valley National Bank Bldg., Des Moines, Ia
Kan., Spring Hill	Railway	13 mi.	45,000	Walsh Construction Co., 114½ West 3rd St., Davenport, Ia.
Me., Springvale	Mill and storehouse	5 story, 240x280 ft.	700,000	W. M. Bailey Co., 12 Salem St., Boston, Mass.
Mass., Boston	Hotel	10 story	5,000,000	Boyle-Robertson Construction Co., 601 Evans Bldg., Washington, D. C
Mass., Boston	Office	11 story.	6,000,000	W. A. & H. A. Root, 6 Beacon St., Boston, Mass.
Mich., Detroit	Sewer		304,328	Booth & Flinn, Ltd., 17 Battery Place, New York, N. Y.
Mich., Detroit	Plant	6 story, 102x979 ft.	2,000,000	W. E. Wood & Co., 1805 Ford Bldg., Detroit, Mich.
Mich., Detroit	Office	10 story, 66x140 ft.	750,000	E. Winters Co., 752 Book Bldg., Detroit, Mich.
Minn., Redwood Falls	Ditching		119,000	New Ulm Drainage & Construction Co., New Ulm, Minn.
N. J., Jersey City	Sewer		2,124,525	Holbrook, Cabot & Rollins, 52 Vanderbilt Ave., New York, N. Y.
N. Y., Bear Mountain	Bridge	1,700 ft long, 50 ft wide	5,000,000	Terry & Tench, Grand Central Terminal, New York, N. Y.
N. Y., Brooklyn	Apartment	12 story	1,500,000	By day labor, M. Courland, 47 West 34th St., New York, Engr.
N. Y., Buffalo	Plant		2,000,000	Du Pont Engineering Co., Du Pont Bldg., Wilmington, Del.
N. Y., Cohoes	Excavation and dredging		600,000	By day labor, Sanderson & Porter, 52 William St., New York, Engrs.
N. Y., Long Island City	Apartments		1,250,000	Stone & Webster, 120 Broadway, New York, N. Y.
N. Y., Long Island City	Sewers		311,855	H. J. Mullin Construction Co., Inc., Jamaica Ave., Jamaica, N. Y.
N. Y., New York City	Apartment	15 story, 100x100 ft.	900,000	By day labor, R. Candela, 200 West 72nd St., New York, Engr.
N. Y., New York City	Hotel	15 story, 204x220 ft.	2,500,000	F. T. Ley, 19 West 44th St., New York, N. Y.
N. Y., New York City	Loft	12 story	750,000	Rheinstein & Hass, 21 West 40th St., New York, N. Y.
N. Y., New York City	Apartment	14 story	1,000,000	By day labor, G. F. Pelham, 200 West 72nd St., New York, Engr.
N. Y., New York City	College		1,000,000	Nugent Construction Co., Inc., 21 East 40th St., New York, N. Y.
N. Y., New York City	Hotel	17 stories	1,500,000	Longacre Engineering & Construction Co., Inc., 562 5th Ave., New York, N.Y
N. Y., New York City	Library		1,900,000	Hegeman-Harris, 95 Madison Ave., New York, N. Y.
N. Y., New York City	Bank and office	23 story, 90x115 ft.	2,250,000	G. A. Fuller, 949 Broadway, New York, N. Y.
N. Y., New York City	Office	20 stories	2,000,000	T. C. Desmond & Co., Inc., 26 Beaver St., New York, N. Y.
N. Y., New York City	Courthouse		4,139,000	G. A. Fuller, 949 Broadway, New York, N. Y.
O., Cincinnati	Clubhouse	11 story, 88x200 ft.	907,900	J. & F. Harig, 1240 Queen City Ave., Cincinnati, O.
O., Cleveland	Bank and office	21 story, 147x258 ft.	10,000,000	Thompson-Starrett Co., 49 Wall St., New York, N. Y.
O., Cleveland	Waterworks	20,000 ft., 6 in., steel main	510,607	P. J. Connelly, Kent, O.
Pa., Philadelphia	Office	16 story, 69x163 ft.	2,500,000	P. H. Kelly Co., 173 Sansom St., Philadelphia, Pa.
Pa., Pine Grove	Generating plant	25,000 kw.	3,000,000	J. G. White Engineering Corp., 43 Exchange Place, New York, N. Y.
S. C., Charleston	Hotel	12 stories	1,000,000	J. W. Cowper, Oliver Bldg., Pittsburgh, Pa.
Tex., San Antonio	Temple		1,000,000	By day labor, R. H. Cameron, 116 Central Trust Bldg., San Antonio, Tex., Engineer
Va., Norfolk	Dredging	140,000 cu. yd.	67,200	F. E. Jones Dredging Co., National Bank of Commerce Bldg., Norfolk, Va.
Wash., Seattle	Office	6 story, 120x173 ft.	500,000	Grant, Smith & Co., Seattle, Wash.
Total			$81,960,860	

The heaviest lettings are in the Middle Atlantic States and include 43 per cent of the building construction, two of the three sewer awards, and the only large bridge job.

Three out of seven industrial projects are in New England, two in the Middle Atlantic States and two in the Middle West.

Excavation and dredging appears to be fairly well distributed with one contract in the Western, one in the Middle Atlantic, one in the Southern states and two west of the Mississippi. The single large railway project is in Kansas.

Chicago's Building Record Broken

Building records for Chicago since 1893 have been beaten by those of the first six months of 1922, according to a statement by the citizens' committee to enforce the Landis Award. The previous high record was in 1912, when the value of all structures erected amounted to about \$110,000,000. But the total value of building permits from Jan. 1 to July 1, 1922, was \$111,502,310, this six months period beating all previous yearly totals. Of this building development, the contractors backing the citizens' committee are said to be getting the greatest percentage, an analysis of contracts let between May 10 and July 7 showing the committee contractors to have 82 per cent of all work costing \$25,000 or over. The figures were: Landis Award contractors \$25,328,000; non-Landis contractors \$5,485,000. Monthly records of Chicago building permits during 1922 show the steady growth of the Landis boom as follows:

Month	No. Permits	Value
January	457	\$7,991,550
February	634	13,493,800
March	1,327	19,333,900
April	1,315	17,076,560
May	1,273	27,029,650
June	1,419	26,576,850

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of July 6; the next, on August 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	+\$2.83	\$3.65	\$4.00	\$2.68	+\$2.95	\$3.60	\$3.10	\$3.75	\$3.75
Structural rivets, 100 lb.	3.60	4.35	5.50	3.10	3.53	4.45	4.25	3.75	6.50
Reinforcing bars, ¾ in. up, 100 lb.	+2.73	3.50	3.50	2.58	+2.85	3.67½	2.55	3.60	2.90
Steel pipe, black, 2½ to 6 in. lap, discount	[illegible]1%	61.15%	45%	59½%	61.9-5%	46%	49.1%	53%	30.00
Cast-iron pipe, 6 in. and over, ton	50.80	−48.00	51.50	46.60	50.50	57.00	51.00	−52.50	50.00
Concreting Material:									
Cement without bags, bbl.	2.40@2.50	2.50	2.25	2.05	2.29	2.90	2.71	2.90	2.78
Gravel, ¾ in., cu.yd.	1.75	1.85	2.25	1.80	1.50	1.75	2.25	1.10	1.50
Sand, cu.yd.	1.00	1.15	2.25	1.80	1.00	0.75	1.50	1.10	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+51.00@52.00	39.00	−38.00	−47.00	40.00	51.00	31.00	+23.50	47.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.14½	1.80	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	11.00	11.15	11.00	+17@18	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0758	.115	.0707	.086	.08	....	.11	.09
Hollow partition tile 4x12x12, per block	.1112	.0758	.115	.0657	....	.08	.108	.11	.08
Linseed oil, raw, 5 bbl. lots, gal.	.93	.98	1.07	1.01	1.03	1.16	1.04	.86	1.04
Common Labor:									
Common labor, union, hour	.60	.35	....	.80	....	.50@.55	.56¼	.50@.60	......
Common labor, non-union, hour	.44@.60	+.30	.25	.72½	.35@.50	.35@.50	.47½@.50	....	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is [illegible] per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c. per hr.

Chicago quotes hydrated lime in [illegible]-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed store quoted at pit. We quote on brown lime per 180-lb. net, white is \$1.70 for Kelly Island and \$1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5¾ x [illegible]. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at pit.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.13 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., \$30; 6-in., \$110.

Changes Since Last Week

Although a recent slackening of steel buying has been noticeable, slower freight movements and falling off in production have stimulated sudden demand for shipments on orders already placed. Steel shapes quoted at \$1.70@\$1.80, Pittsburgh, on new business. Some sales, however, still go through at \$1.60 on special tonnages, but a maximum of \$1.85 has been reached on shapes and bars and \$1.90 per 100 lb. on plates, for immediate deliveries. Slight stiffening of mill prices reflected in advance of 15c. on shapes and bars in New York warehouses and 9c. per 100 lb. in Minneapolis.

Birmingham pig-iron market temporarily softer; quotations for third-quarter deliveries slightly lower. Atlanta reports reduction of \$1 and Seattle [illegible] per gross ton on cast-iron pipe.

Advance of \$2@\$3 quoted on long-leaf yellow pine, base sizes, in New York; Douglas fir up \$1 per M. ft. b.m. in Seattle. Dallas, however, in the face of increasing demand, quotes reduction of \$1, and Chicago \$2 per M. ft. on yellow pine structural timbers.

Linseed oil prices unchanged over week end, but general tendency of market is downward.

Wage rate of 30c. quoted on unskilled common labor in Atlanta as compared with 20c. per hr., formerly. Birmingham still retains the lowest wage schedule for unskilled building laborers, 15c.@20c. No other large city beside Birmingham maintains a rate lower than 30c. per hour.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

Volume 89 NEW YORK, AUGUST 3, 1922 Number 5

Brooklyn Bridge Again

DURING the past week the Brooklyn Bridge once more became subject to wide press notice because of official cognizance of a recent slipping in the cables and a subsequent, though not necessarily consequent, official suggestion for another East River bridge. The structural facts in the case are noted in the news pages of this issue. Nothing has happened that makes necessary any revision of the editorial in our issue of July 13, p. 47, which stated that the bridge is in no immediate danger.

Rain Curtails Road Construction

CURTAILED production of paved road because of excessive rain in many eastern states is arousing concern. With mileages of new pavement under contract which equal or exceed those of any previous year some large roadbuilding states expect to see a smaller mileage completed than during 1920 or 1921 unless weather conditions quickly improve and continue good well into the fall months. In Pennsylvania the highway department reports that of 82 working days up to July 22, there has been rain in 34 days. While doubtless on many of these days there were showers only, it is equally probably that on other days the rain was heavy enough to put the subgrade in a condition impracticable to work for one or more days following. Altogether it is not extravagant to conclude that in Pennsylvania one-half of the roadbuilding season up to July 22 has been lost on account of rain and mud delays. Other states will show different records as their weather conditions have been different, but none will fail to show a considerable lost road-construction time because of wet weather. To assign any specific economic loss because of these delays is mere speculation without more complete records than are at hand but no one will dispute that it is large. The question naturally follows: Why should we endure this loss? Is it beyond construction engineering skill to devise methods of carrying on road construction which will not be upset by every summer shower? This is a problem which engineers and contractors have to solve if they are to justify their right to leadership in the construction industry.

Representative Opinion

A MEASURE of the responsibility imposed upon the Federated American Engineering Societies may be gained from the published report of the recent meeting of its Committee on Procedure, noted in the news pages of this issue. That committee, composed of several of the country's leading engineers, among other things petitioned the President to go slow in any action regarding the German dye patents controlled by the Chemical Foundation which the President has ordered returned to the Alien Property Custodian. This action has been seized upon by the public press as indicative of an attitude of the engineers of the country against the Department of Justice and in favor of the Chemical Foundation in the highly controversial issue of the dye patents. This view is fostered particularly because the reports of the resolution were accompanied by a statement of Dean Cooley that the federation "speaks concerning national problems . . . on behalf of some 55,000 engineers." The fact is that while some few engineers, among whom are doubtless some of the Committee on Procedure, are qualified to pass judgment on the case, probably not 10 per cent of the profession know anything about it, or could be persuaded to give an opinion if asked. Just how far is a committee of a council of representatives authorized to pledge the many who elect the representatives?

Nibbling at the Water Power Act

TO THOSE who have watched the long fight to enact a federal water-power law which would aid the development of navigable and federal streams the disregard by the Ford offer for Muscle Shoals of the provisions of the law finally enacted was the most serious fault of that much advertised offer. It seemed to be the camel's nose under the tent, the forerunner of many attempts to make exceptions to the general rule. This is proving to be the fact. From Washington come authentic reports that every effort is being made to remove the proposed St. Lawrence project, if ever approved, from the provisions of the act; the Swing-Johnson bill for the development of the Colorado places that water power under the jurisdiction of the Secretary of the Interior. These are the three biggest water-power prospects in the country. Evidently the water-power act is expected to apply only to the little fellows too weak to fight or to control legislation. Such an outcome would make a joke of the act.

Demos and Garbage Disposal

ONE of the arguments in favor of garbage disposal by incineration rather than by reduction or by hog feeding is that incineration makes possible the material shortening of garbage haul because several incinerators can be provided in well planned garbage collection districts, whereas with either of the other two mentioned garbage disposal methods the disposal plant must be located at the outskirts of the city or even beyond the city limits. Theoretically this is correct but as a matter of practice, in American cities at least, it is a mistaken notion. Within a year Philadelphia changed a garbage disposal project from several incinerators to a single one and then, through the action of city counsel after local objection, hastily abandoned the site chosen for the one plant—where the project seems to have rested for months. Recently the administrative officials of Toledo, Ohio, decided upon garbage disposal

by incineration in accordance with this same theory of shortened haul by the provision of several incinerators. The site chosen for the first of these incinerators caused such opposition that it was speedily abandoned. Experience with garbage incineration at Toronto seems to have played a part in deciding on the adoption of incineration for Toledo; but when Toronto, very recently, proposed to build another incinerator the strong opposition to the site, as voiced at a public meeting, led one of the city officials to declare, according to the Toronto *Globe* of July 19: "The will of the people must be respected. We are living in an age of democracy, and when the people say they don't want a thing, it should not be forced upon them." It appears that Demos has not been sufficiently considered in urging the superiority of garbage incineration over reduction or hog feeding.

Hooch Refuse Disposal

ENGINEERS—as engineers—might reasonably have expected to have little interest in the Eighteenth Amendment. As members of the human race, they are subject to all that race's well-known frailities and desires, but to them as a profession the alcoholic content of a beverage would seem to be a matter of the slightest consequence. But prohibition, it seems, has a universal reaction, for we read that the sewer inspector of North Tarrytown, N. Y., has been compelled to beseech by public proclamation the good citizens of his town to refrain from throwing the refuse from their private—and illicit—stills into the sewers. Grain, mash, prune pits, and like discards have clogged and choked the pipes to the necessity for repair, and realizing the absurdity of requesting a law governing or even restricting the performance of an illegal act, the inspector falls back on good-natured appeal. Sooner or later the home brewer and distiller must have his own disposal plant, or at least some nomenclature committee may have to decide whether hooch refuse is sewage or garbage.

A National Conspiracy

PRESIDENT HARDING has put his finger on the crux of the coal strike when he intimates that peace would have been here long since had not the United Mine Workers been hostile to district or state agreements between operators and miners. He significantly suggests that every state legislature and Congress itself would have put an end instantly to the arrangement if the coal producers as a national body had attempted to determine the policy of every member and permit no sales of coal except on terms dictated by the national officials. The United Mine Workers, however, assumed national dictation and have prevented district groups from settling with the operators. In the anthracite region, for example, only the question of wages was at issue. That would probably have been compromised long since had it not been for the pressure of the union. The President says he will submit the whole matter to Congress after the House reassembles. We believe that he should. To us it seems conspiracy as iniquitous as would be a national price fixing scheme by the operators. It will be interesting to learn whether the people, as represented by their members in Congress, take the same view as the President. If the facts are before them we have no fear of the verdict. How it may be translated into legislation is another—and a very difficult—matter.

Rail Priorities and Road Work

IT IS still too early to predict the general effect on state-highway-construction programs of such emergency orders, growing out of the coal and the railway strikes, as the Interstate Commerce Commission may issue to cover priorities on rail shipments. In those states where road-building materials are obtained largely from local sources or where the lower types of construction, such as earth or sand-clay, are prevalent, the situation will not be serious. Elsewhere, however, a more critical condition threatens, as is indicated by the comment of state highway officials in this week's news pages. The reports from Texas, California, New York, Pennsylvania, Maryland and Kansas, for example, forecast a marked slowing down of road-building activities if priority orders are rigidly enforced. Few contractors have sufficient stocks of stone, cement or bituminous materials on hand to tide them over any considerable period of discontinued railway service. The coal shortage also is making itself felt at the cement mills, and unless the situation improves the Portland Cement Association believes, according to a statement issued last week, that a number of mills must soon shut down. All of this occurs just when the road-building season is at its height. Coupled with the unusually great number of rainy days this season a crippling of rail transport serivce for highway materials at this time would effectively reduce the estimate of over $700,000,000 as the probable volume of this year's highway work outside of cities.

Twenty Years of Reclamation

ON the twentieth anniversary of the reclamation act, June 17 last, the secretary of the interior sent out a heartening message of interest to engineers as well as to the people on the various projects and in the Reclamation Service. Reclamation by irrigation, the secretary said, is worth while for the nation as a whole. There is no longer question as to the ability of federal engineers to plan and construct efficiently the monumental works required. Compact and contented communities have been established. The success of the adventure is measured by the extent to which the reclaimed lands are utilized in the making of self-supporting American homes and not by the accomplishments of engineers in constructing great hydraulic works.

Twenty years after the act was signed there are still problems; possibly President Roosevelt's dreams have not all materialized, but the optimistic reports from every one of the projects by bona fide water users as given in the June *Reclamation Record*, followed by the imposing array of statistics in tables and diagram form can lead to but one conclusion; the investment was sound. Of the total $135,000,000 fund $106,000,000 came from the sale of public land. The $20,000,000 advanced by the treasury department is being repaid at the rate of $1,000,000 a year. Collections totaling $41,000,000 do not increase the investment but constitute a working capital. Since 1921 a certain portion of royalties on oil and potassium leases on public lands totaling $7,600,000, has been credited to the fund.

Against this debit side of the ledger are the following facts: Crops in 1922 will be produced on 1,200,000 acres by government water and will be valued at $53,000,000. The aggregate value of the crops since

the beginning including 1921 is approximately $475,000,000 as compared with the net construction cost of $129,000,000. Gradually the investment is being returned in increasing amounts.

Many times have politicians in the East said that the cost never would be returned so it must be gratifying to reclamation officials to read the boasts of several projects to the effect that not a settler ever has defaulted. Secretary Fall says he believes the majority of irrigation settlers will meet their obligations when due. From the economic as well as social viewpoint the engineer may look on this work, primarily of his conception, as a decidedly helpful factor in the upbuilding of the nation. His works are useful and used.

The Crisis in Coal

AS THIS is written (Monday morning) there is promise of an early settlement of the railway shopmen's strike. But peace in the coal industry seems as far removed as every. Some settlement of the latter controversy must come soon; we are in the crisis stage. The public is beginning to appreciate the situation, and public ire is sure to mount rapidly in the next few weeks. Stoppage of industry is imminent; cold houses are foreshadowed for next winter.

The beginning of the coal strike was witnessed by the public with remarkable complacency. The winter was over, and the daily press heralded widely the Geological Survey's report of the large amount of bituminous coal (67,000,000 tons) on hand. But the stocks have dwindled to the panic point; on July 1 only 20,000,000 tons were left. The amount is much smaller now. The production of the non-union fields was expected to save the situation. It did rise to a maximum of 5,600,000 tons per week—against a consumption of 8,000,000 tons. But the railway shopmen's strike—apparently with special pressure put on the non-union mine area—cut the production week before last to 3,600,000 tons, on account of the failure to move the cars actually loaded. With the coal-moving priority in effect on the railroads, the production last week jumped to over 4,000,000 tons and will probably go back to the maximum. Had it stayed at the minimum the plight of industry would at once have been serious. The railroads and other public utilities burn 3,250,000 tons per week. The margin for industry would have been extremely small.

But even with the non-union mines at maximum capacity the prospect is serious. The railroads and utilities need not worry. They will get coal under the priorities. Industry must continue to draw on its stocks, which, even when augmented by the margin of non-union production above the needs of the utilities, will not last over four weeks at the maximum. Some districts have larger stocks than others; New England, for example, probably can run its industries for two months or more. In other districts supplies are below the four-weeks average. The priorities will help much, but there is no blinking the fact that the situation for industry is serious. The reports of shutdowns on account of coal shortage are already coming in.

In anthracite conditions are even worse than in bituminous coal. When the strike is finally called off the bituminous mines with their great over-capacity will be able quickly to build up stocks. But the anthracite industry has no over-capacity. It works 12 months in the year to supply fuel for the 7 months of use. The stocks are negligible. Four-months production has already been lost. Coal control even for bituminous coal will probably continue until well on into the winter; anthracite control will be absolutely necessary in order to secure equitable distribution and freedom from suffering.

From this brief review the critical juncture which the strike has reached is apparent. The public is beginning to sense the situation—which foreshadows settlement. Until now it has been complacent. It felt certain that it would not be pinched. Now it foresees loss of employment—through industrial stoppage—and an uncomfortable winter. Soon it will begin its rumblings; then will the disputants realize that they must come to terms. Lewis, the miners' leader, senses the rising storm. Last week he predicted peace within a month. Certainly under the pressure of the government, backed by a growing public demand for settlement the production of coal somehow cannot long be deferred.

Water Purification Sweeps On

ONE by one the cities on the Mississippi and Missouri and the Great Lakes not already provided with complete water purification works are taking rapid steps to that desirable end. Omaha, through the Metropolitan Utilities District, has begun construction of a 50,000,000-gal. filter plant, as noted elsewhere in this issue. Kansas City voters approved an $11,000,000 bond issue April 4, which will provide filtration and other improvements. Buffalo and Detroit are at work on water filters. Milwaukee, due to political and professional strife, is deadlocked on carrying out filter plans advised by experts after careful investigation. Chicago is the only large city taking water from the Great Lakes or from the Mississippi and Missouri—to which the Ohio River may be added—which has made no move for water filtration. It is only a question of time before it will do so. The reasons for its inaction were discussed in these columns, April 28, 1921, p. 707. One of these reasons is that excessive water waste should first be cut out. Another is that the heavy fall in typhoid at Chicago to a very low figure has begot confidence in the safety of the water supply.

It has been the increasingly urgent demand for clear, sparkling, colorless, odorless, tasteless, and soft water in place of supplies lacking one or more of these qualities that has been a large and sometimes the major factor in the adoption of complete purification works by many of the cities just passed in review. In fact, it was mud rather than typhoid that led Omaha and other Missouri and Mississippi River cities to adopt sedimentation many years ago and later to add coagulation. And it has been mud or color rather than typhoid that has spurred hundreds of cities to build mechanical filtration plants.

The time has now come when all the available agencies of water treatment—coagulation, sedimentation, filtration, and chlorination—or as many of them as are needed to ensure a water supply ideal in character—should be adopted by every city dependent on a surface supply. The most expensive of these combinations adds comparatively little to the cost of water and leaves water supplies still by far the cheapest public utility in the field, considering its many functions and their vital character as regards life and property.

Driving a Concrete-Block Sewer Tunnel by Shield: Some Troubles and Their Remedies

A Record of Experience in Water-Bearing Sand at Flushing — Traveling Platform for Supporting Leading Ring — New Equipment Sets Blocks Accurately to Place in First Operation

By John F. O'Rourke

O'Rourke Engineering Construction Co., New York City

An 87-in. shield-driven interlocking-concrete-block tunnel at Flushing, L. I., built last year for the city of New York, is the first tunnel of that description constructed under the supervision of the writer. This tunnel, 1,922 ft. long, passed through sand, clay and hardpan at depths varying from 25 to 60 ft. below street and 15 to 50 ft. below groundwater, and was driven without use of compressed air, though much pumping was required. In this experience the concrete-block type of tunnel proved highly successful both in execution and in the finished product, but some faults were discovered in the apparatus and procedure used, whose elimination is important if the most advantageous application of concrete blocks is to be realized. The troubles encountered and how to eliminate them on similar work hereafter, with suggestions for improving tunneling generally, form the subject of this article.

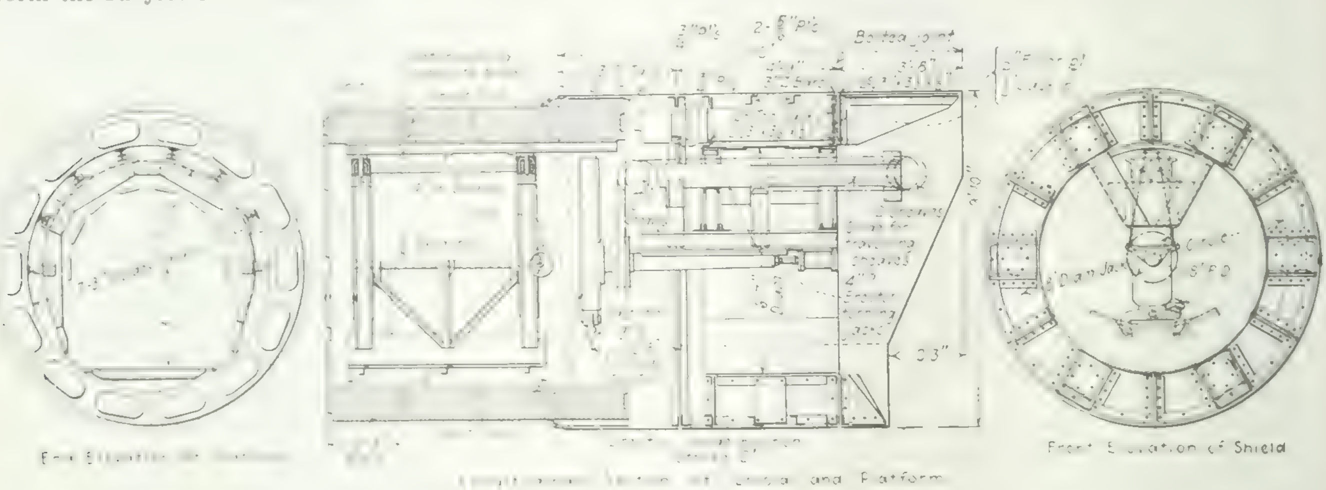


FIG. 1—SHIELD AND PLATFORM OF FLUSHING SEWER TUNNEL DESIGNED FOR CONCRETE-BLOCK SETTING

The distinguishing feature of the equipment used at Flushing was a platform carrying movable H-bars (Fig. 3), forming traveling support for the leading ring of blocks. This platform, as well as the shield and erector, was designed with the best knowledge then possessed by the writer of the problems and difficulties involved. The shield itself was built similar to those used heretofore in cast-iron lined tunnels, and there were no troubles encountered with it. The erector, which was fitted with a rigid tongs-shaped grip, proved inadequate, however.

While it held the block with strength and firmness, the erector commonly failed to hold it exactly in line with the arc of the tunnel or in the plane of the ring, so that it was usually necessary to land the block on the movable H-bars and adjust it into position with crowbars, before it could be shoved into place with the shield jacks. In connection with this operation, also, the H-bar arrangement was defective, in that the outward motion of the bars towards the tunnel shell was restricted to the play afforded by the Z-bar guides in which they were held, which play was usually insufficient to allow them to come into contact with the rings. For this reason it was generally necessary to put packing on top of the H-bars in order to hold the block in position. Thus considerable time was lost in setting the blocks, and as the bars were seldom in contact with the interior surface of the tunnel they could not be clamped against the rings while shoving the shield.

In spite of these handicaps the tunnel was driven an average of 11½ ft. a day from the commencement of erection until its completion. On many days erection was suspended for grouting, the tunnel being too small to drive and grout at one time; there were also delays from pockets of groundwater in the roof and from hardpan and boulders. When everything was favorable the usual progress was three rings in each 8-hr. shift, or 20 ft. 3 in. of completed tunnel in 24 hr.

The drawing Fig. 1 herewith shows the details of the shield, erector, platform and H-bars. The erector, operated by two turning jacks, had a range in either direction of 375° and a longitudinal motion forward and back of 5 in. for inserting the projections of the lining blocks in the recesses. The grip used may be seen in Fig. 4.

Setting Blocks Accurately—It is of great importance in concrete-block tunnels that the block be set by the erector without recourse to crowbars or other means of getting it into position, and also that the rings in the neighborhood of the shield jacks should be firmly clamped while the shield is being shoved. How this can be done is shown in Fig. 2, together with the other changes from previous practice. Modification of the erector grip and H-bar holders, based on the Flushing experience, enables the blocks to be set in their exact position by the erector without otherwise being touched, and to be clamped by the bars for five rings from the face. Moreover, the erector is carried on the H-bar platform instead of on the shield, leaving the

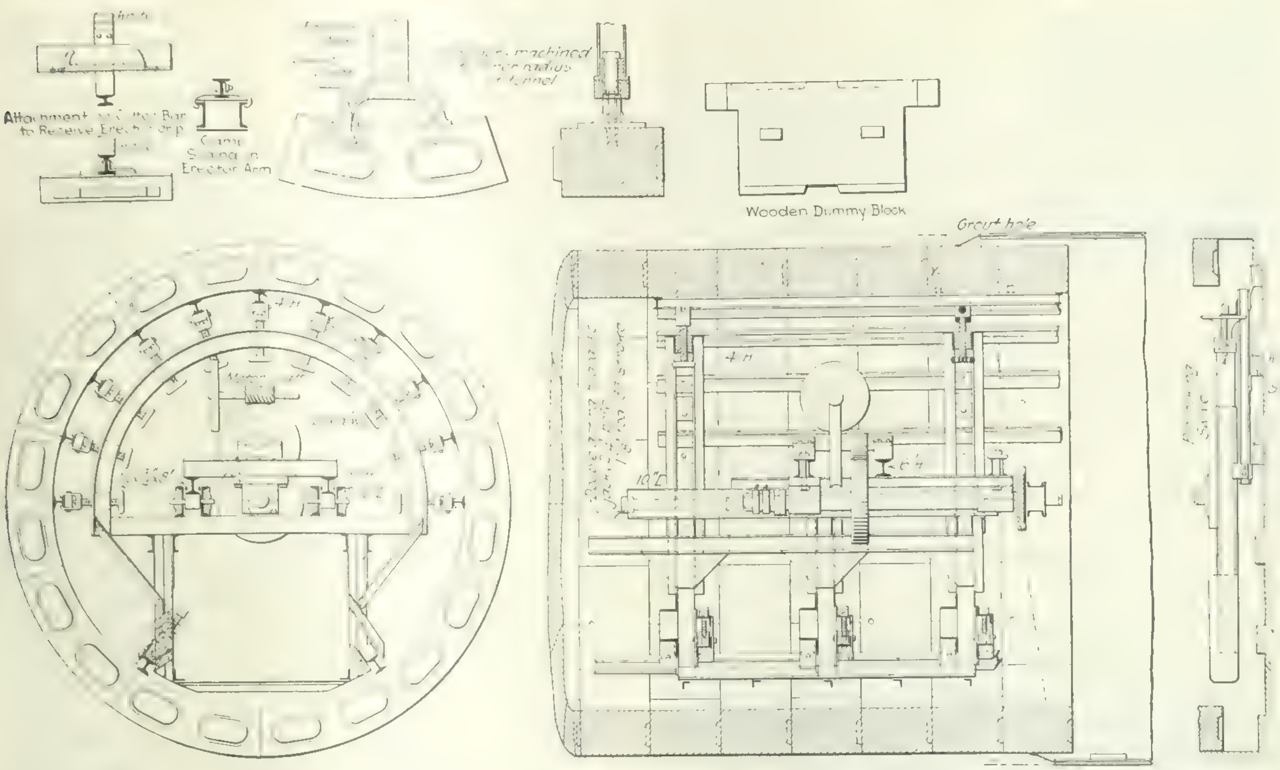


FIG. 2. NEW TRAVELING PLATFORM AND OTHER IMPROVED DETAILS FOR CONCRETE-BLOCK TUNNELING

latter free from obstruction and its only function the holding of the ground. The platform is carried on wheels resting on rails which are pulled forward before the platform is moved by aid of jack screws that lift each side of the platform alternately off the rails. Moving the platform forward is done by the erector on the platform, which has a longitudinal motion greater than the width of a ring.

The grip is attached to the erector arm with a swivel joint, capable of being both tightened and locked, and is fitted with two shoulders, the faces of which are machined to the inner radius of the tunnel. One of the jaws that enter the grip holes is rigid, the other swinging on a pin and being locked in position by a cam. Whenever the inner surface of the block is not in perfect contact with the shoulders of the grip the erector arm can be swung to an upright position and the cam loosened sufficiently to permit the block to slide down the jaws to a perfect contact with the shoulders, when the cam is again locked with the concrete block held exactly to fit into the arc of the ring. The swivel joint allows the block to adjust itself in the vertical plane of the ring when it is moved backward, bringing the projections of the block against the back of the recesses of the previous ring. This is assisted by half the top of the H-bar, supporting the adjoining block, affording a surface upon which the block may rest while it is being shoved into place. This H-bar also should be used to support spacers to maintain the correct size of the longitudinal joint and support the arch before the joint is grouted. The width of the circumferential joints is fixed by the excess length of the projections over the depth of the recesses.

As already stated the movable H-bars at Flushing

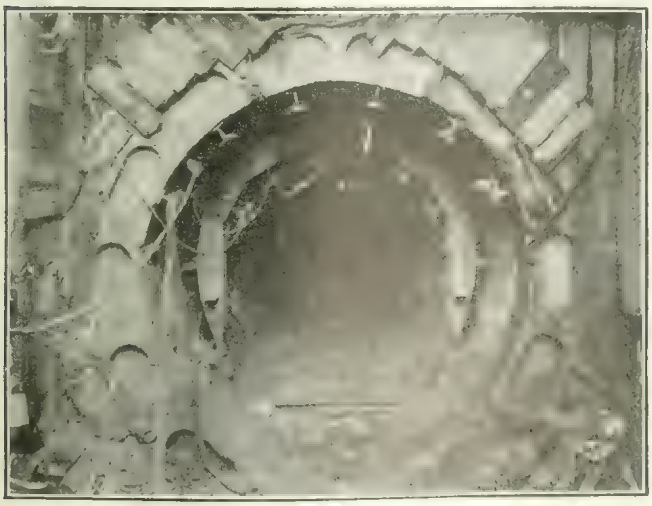


FIG. 3. TRAVELING PLATFORM. FRONT VIEW AFTER REMOVAL OF SHIELD AT TERMINAL SHAFT

FIG. 4. FLUSHING SHIELD STARTING OUT FROM SHAFT. ERECTOR MOUNTED ON REAR OF SHIELD

had not sufficient outward play to be always in contact with the interior surface of the rings. In the new design this difficulty is overcome by inserting the H-bars in castings attached to the ends of the jack screws and bearing on rollers in the castings. The screws are of a length to give the H-bars sufficient play so that they can be clamped in contact with five or more rings, thus supporting them during a shove, preserving the cylindrical form of the tunnel and maintaining adjoining blocks flush with one another.

Block and Form Design—At the Flushing tunnel the key-block was made with parallel joints, so that the closure could be set in the same way the closure is set in a cast-iron-lined tunnel. This required four different kinds of blocks in each ring, and there was usually some difficulty in entering the key, which was generally done by setting the adjoining blocks a little high on the side toward the opening and then when the ring was closed lowering the three blocks into place together. In the new design the key is a standard block with radial joints that is set after the shield has been shoved and before the erector platform is moved to its position for erecting the next ring.

To accomplish this a wooden dummy block of the design shown is set to close the ring before the shield is shoved. This is removed after the shield has been shoved but before the platform is moved forward. The concrete key-block is swung up forward of the ring in the space for the next ring and moved backward into place by longitudinal motion of the erector. The ring being now closed and made self-supporting by packing or wedging the key block, the H-bars are unclamped, the platform is moved forward for the next ring, the H-bars are again clamped against the rings and the jack screws at the bottom of the platform clamped against the rails, and the new ring is erected with its dummy-block closure.

This key-block with radial joints gives a better ring than the old form of key and obviates the difficulty of using four different kinds of blocks in the same ring. It also greatly simplifies the molding of the blocks, which are now uniform and can be molded singly in separate forms. Block forms with cast-iron bottoms were used at Flushing, but the bottoms of the new forms can be made of hard wood, reinforced with three flat bars to take the bearings of the steel sides and to hold the fastenings of the side and end plates.

Tunneling Without Shield—An important feature of the new apparatus is that when tunneling in firm clay the shield may be omitted and the erector used to excavate the tunnel and erect each ring immediately after the space for it is excavated. This is done, as shown on the drawings, by attaching a bar to the erector that carries knives which cut sods from the face, similar to a well known tunnel machine. The erector grips hold the bar firmly through an attachment at the outer end, the inner end having a sliding connection with the erector arm permitting the bar and knives to move outward radially while the arm is being rotated. The drawing shows three knives 30 in. apart, cutting sods 6 in. wide and 3 in. thick. It follows that with a uniform radial movement outwards of 6 in. for each revolution of the arms the knives will describe a helix and five revolutions will cut a 3-in. thickness off the entire face. The sods would be taken by hand from the knives in about 2-ft. lengths and thrown into a muck car by two men, as the two inner knives would cut about the same amount of sods as the outer one is capable of cutting.

Assuming the tunnel rings to be 24 in. wide there would be 8 cuts per ring. At five revolutions of the erector arm per cut it would require 40 revolutions per ring. Thus it would require less than an hour, with proper facilities for removing the muck in that time, to drive sufficient heading for another ring. Allowing 30 min. for erection, which experience shows to be ample, driving and erection of each ring could be done on an average in 1½ hr. or 16 rings in 24 hr., equal to 32 ft. of finished tunnel. An average of half that amount would exceed any other known method of tunneling.

This method of using the erector to drive and erect tunnels in clay, where a shield is not used, is new but obviously simple and practical. It could be used to great advantage where brick or monolithic concrete is now employed, for the tunnel driving would be done safer, quicker, and without cost for supporting roof, and also because the concrete blocks cost less to mold and set in place than the monolithic concrete or the brick.

Where this method is followed the lining which fills the excavation gives practically the same support to the ground that is given by a shield and no subsequent settlement need be feared. If some timbering is necessary for the short length of roof left unsupported while the cut for the new ring is being made, that can easily be done with the help of the movable H-bars. The tunnel can also be driven in exact line and grade, as each ring as set can be placed in its true position.

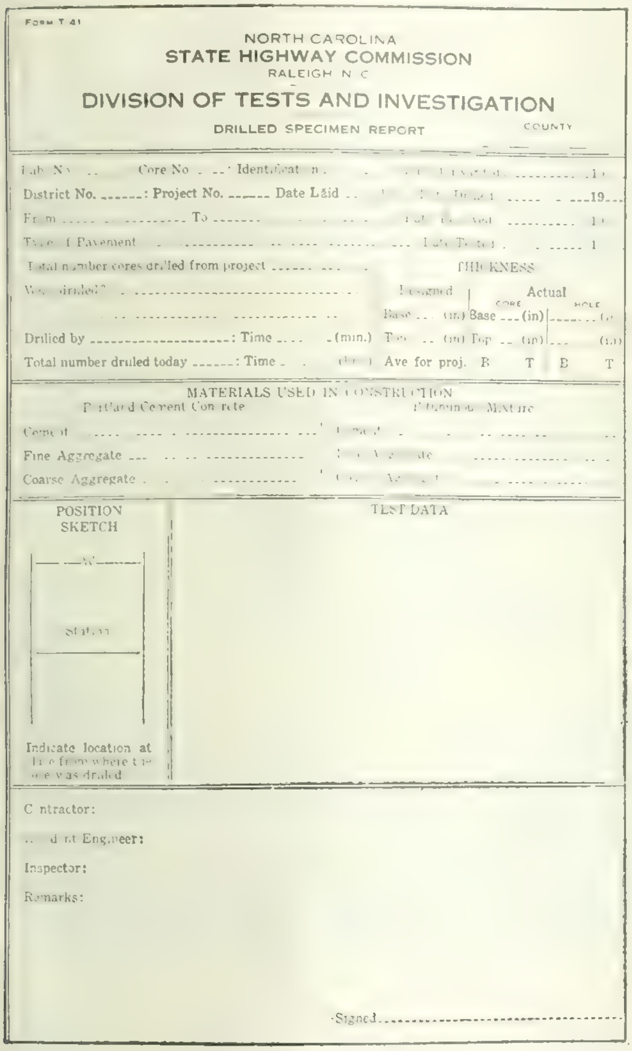
Filling the Clearance Void—It has been found impracticable to shove a shield exactly right for line and grade, so that a small space should be allowed for outside the lining within the tail of the shield to admit of adjusting the new ring on blocking in its exact position. It is also essential to fill the space around the lining that is left by the shield, so that the blocks may be held in place as set. This packing also sustains the ground from settling. Gravel packing was used for these purposes with great success at the Flushing tunnel and also in connection with recent East River tunnels.

Summary—Experience indicates that the new apparatus will fully avoid the difficulties that have heretofore been encountered in driving concrete-block tunnels, with or without shields. One of the advantages of cast-iron-lined tunnels is the freedom with which cast-iron plates may be handled in contrast with the concrete blocks, which, while very strong, are liable to suffer abrasion and spalling during erection. The new methods avoid this form of injury to the blocks, and a concrete-block tunnel built as described, packed with gravel and thoroughly grouted, may now be adopted with confidence instead of one with the costly cast-iron lining. It is true that many engineers object to concrete blocks because of former difficulties of erection and also for lack of sufficient precedents for their use. However, such objections as the foregoing are now things of the past.

Acceptance of Pavement Based on Core-Drill Tests

Drilled Specimen Final Test in North Carolina—Drill Truck Carries Hole-Plugging Outfit—Tests Form Permanent Record

CORE-DRILL tests of the completed slab must be satisfactory before final estimates are paid on paved road construction in North Carolina. Ordinarily in the past cores have been drilled primarily to determine the constitution and structure of pavements and



Form T 41

NORTH CAROLINA
STATE HIGHWAY COMMISSION
RALEIGH N C
DIVISION OF TESTS AND INVESTIGATION
DRILLED SPECIMEN REPORT

District No. ......: Project No. ...... Date Laid ...

Drilled by ....: Time .... (min.)

Total number drilled today ......: Time ... Ave for proj. B T B T

MATERIALS USED IN CONSTRUCTION

Fine Aggregate ...

Coarse Aggregate ...

POSITION SKETCH

TEST DATA

Indicate location at ...

Contractor:

Inspector:

Remarks:

Signed ....

FIG. 1. FORM FOR DRILLED SPECIMEN REPORT
Original sheet is $8\frac{1}{2}$ x 11 in. with a left-hand stub to be punched for binding the record into a filing cover.

not as a means of determining the acceptability of completed work. Their use for the newer purpose is an additional use to which they are being put with good effect in preventing careless construction and without any detriment to their value for research purposes. Records of the tests are preserved by means of the form shown in Fig. 1.

Samples are taken by means of the outfit illustrated by Fig. 2. This consists of a 3-ton motor truck, with a covered body on the tail of which is mounted a Calyx core drill with a $7\frac{1}{2}$-in. bit. The drill is belt-driven by a separate 8-hp., two-cylinder gasoline engine. Inside the truck there are also a 130-gal. water tank, a hand force-pump for filling the tank, bins for sand, stone and cement for molding repair plugs, plug molds, accessories and repair parts.

FIG. 3. CORE DRILL SPECIMEN

In operation, the truck is spotted at the place where the sample is wanted, and the drill, operating at 200 r.p.m., cuts a $6\frac{1}{4}$-in. core from an 8-in. pavement in from 20 to 30 minutes. About 3 lb. of shot are required for one boring, and, under average conditions, about 3 gal. of water. When drilled, the core is marked and shipped to the testing laboratory at Raleigh, where it is measured, tested for strength and analyzed for physical composition. The results are recorded on the form Fig. 1. Fig. 3 shows a core from a bituminous top on a concrete base.

The drill holes in the pavement are filled with plugs molded in the field from materials carried by the truck.

FIG. 2. CORE-DRILLING OUTFIT IN OPERATION

The plugs are molded slightly smaller than the drill hole and are sealed into place by a quick-setting cement grout. The drilling outfit is operated by the Division of Tests and Investigations of the North Carolina State Highway Commission.

Money Saved by Painting Bridges

The life of many steel highway bridges is materially shortened because of infrequent and improper painting, says the U. S. Bureau of Public Roads. Each year a considerable amount of money is expended for the replacement of rusted bridge members which could have been avoided if they had been kept painted; and more serious than the waste of money is the positive danger to the public which results from such carelessness due to the weakening of some hidden part which may cause the collapse of the whole bridge. Officials of the bureau urge that all steel bridges be inspected at least once each year and repainted at the first sign of rusting. Normally repainting is required at periods of from two to five years depending on the climate. A suitable paint should be used and if there is uncertainty as to the suitability of any paint, information should be requested from the state highway department. It is a mistake to repaint without properly cleaning the metal of all dirt, rust, loose paint and blisters. Usually the places hardest to reach are the ones that should receive the most attention.

What One State Highway Bridge Department Has To Do

Survey of Work Under Georgia State Highway Department Indicates Diversity of Problems to Be Solved

By Searcy B. Slack

Bridge Engineer, State Highway Department of Georgia, Atlanta, Ga.

UNDER the constitution of the state of Georgia the authority to construct roads and bridges is vested in the boards of county commissioners (or ordinary where there are no county commissioners), of the 160 counties. With 160 separate agencies and no definite plan it can be readily understood why comparatively little progress had been made in systematic bridge construction until the inception of the state highway department in 1917. A few of the counties had learned the value of engineering work on the more important structures but most of them were building either without skilled supervision or simply with the advice of the bridge companies.

As a result of these conditions when the highway department came into existence one of the most urgent needs of the state-road system was the immediate construction or reconstruction of a large number of bridges. Many sections of the state were served by ferries or low-water bridges and traffic was frequently interrupted by high water. The policy of the highway board has been to favor the counties desiring to cooperate in the construction of "permanent" bridges.

The legislature passed an act creating the highway commission in August, 1917, but the commission did not begin to function until late in the fall. Plans for several large bridges were prepared in 1918 but war conditions prevented any construction until the spring of 1919. Since then there have been completed 217 concrete bridges, with a total length of 31,619 ft.; 12 steel bridges, totaling 4,142 ft.; and 26 wooden bridges having a length of 6,323 ft. A total of 255 bridges having a combined length of 42,084 ft. were completed from March, 1919, to January, 1922. These bridges are all more than 20 ft. long. Figures are not available for drainage structures less than 20 ft. in length.

Practically all bridges constructed have a width of 18 ft. between curb faces, or a little more than 19 ft. between railings. A few bridges having widths of 16 ft. have been constructed in the mountainous sections of the state and a few of greater width where the locations were close to towns.

Bridges on State Roads—In August, 1921, the state legislature passed an act directing the state highway department to take over for maintenance on Jan. 1, 1922, the entire state-road system comprising about 5,600 miles. A census of the bridges to be taken over under this act has just been completed and shows 1,101 wooden bridges, with a combined length of 64,674 ft.; 254 steel bridges totaling 19,493 ft.; and 38 concrete bridges having a total length of 3,600 ft. None of the bridges constructed by the state highway department is included in this table. Practically all of these 1,393 bridges should be rebuilt in the near future to meet the requirements of modern motor loadings. Many of the steel bridges can be taken down and utilized on the county-road systems.

The total number of bridges on the present state-road system, both new and old, is 1,648 and the total length is 129,851 ft. No interstate bridges or bridges on the county-road systems are included above. The county systems comprise about 75,000 miles of road but no figures are available for structures on these roads. These figures show that during the last three years Georgia has constructed about one-third of the existing length of bridge structures on the state-road system. Seventy-five per cent of the new bridges are of reinforced concrete.

A study of the 5,600-mile state-road system shows that only about 14,000 lin.ft. of entirely new construction, in addition to the bridges already built by the state and counties, will be necessary. When all bridges on the state roads are completed the total length will be approximately 144,000 ft.

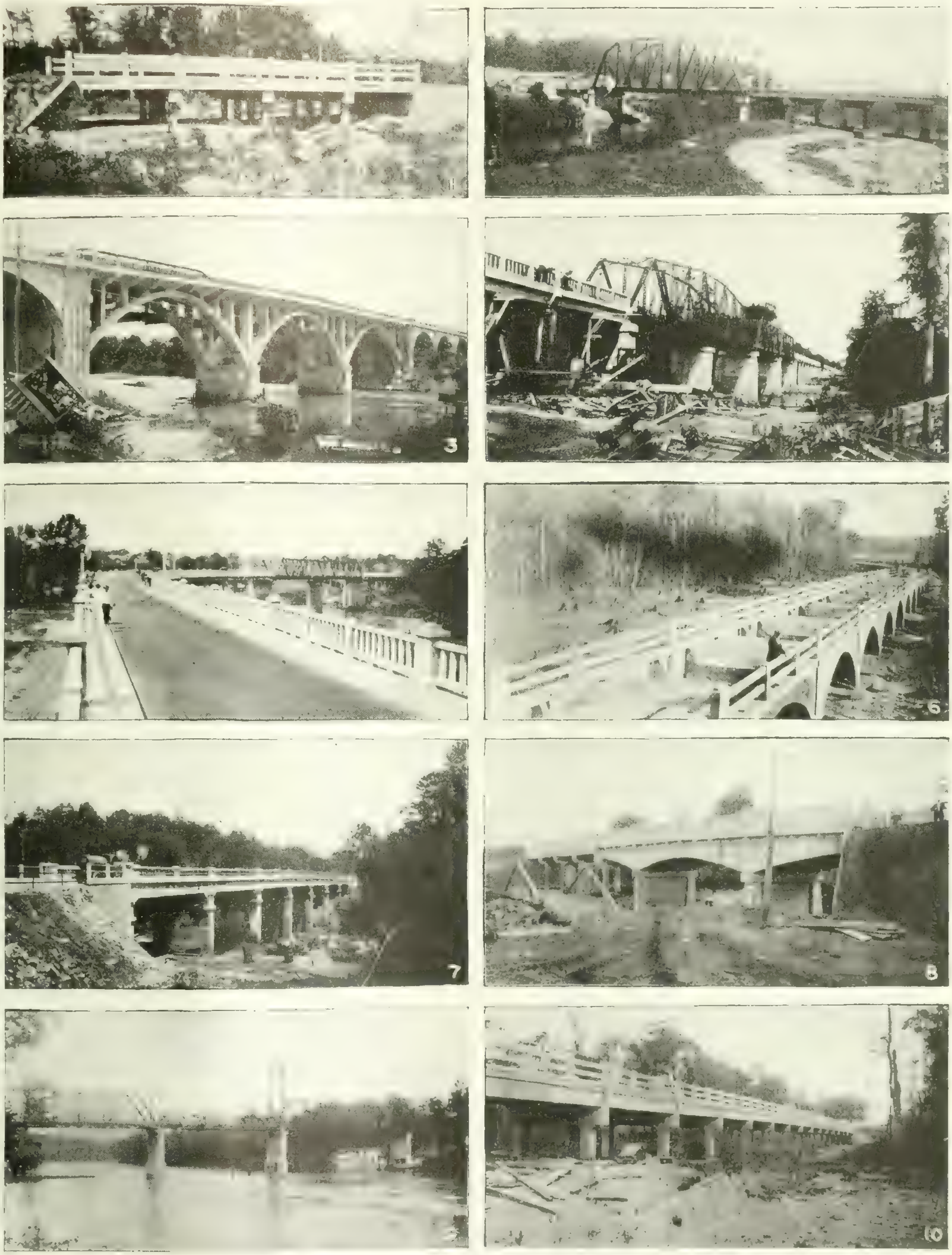
Very little progress has been made in the construction of interstate bridges. The Georgia-Alabama state line below West Point, Ga., is the low-water line on the west bank of the Chattahoochee River, all of the river and islands being in Georgia. Until very recently Alabama was prohibited by law from building beyond the state line, so joint bridge projects were impractical. The last session of the Alabama legislature corrected this trouble so that an equitable division of the cost can now be made.

Development during the next few years will probably justify the construction of three bridges between Georgia and Alabama, three between Georgia and Florida and six between Georgia and South Carolina. The total length of these interstate bridges will be about 25,000 ft.

Types of Bridges—Foundation conditions in Georgia vary so widely that no particular type is adaptable to all sections. The majority of the concrete bridges, however, consist of deck-girder spans supported by two-column bents or precast concrete-pile bents. On the two-column bents the footings are separate, each being about 6 ft. square. In wet work this makes a small cofferdam and reduces the size of the pumping equipment necessary. This type of bent has proved very economical and satisfactory.

Precast concrete-pile bents have been used principally in the southern part of the state where foundations are generally deeper. Precast piles are easily handled and under certain driving conditions are satisfactory but no scheme has yet been devised for predetermining the necessary lengths before driving. Frequently, using both jets and hammer in driving, piles in the same bent about 18 ft. apart show penetrations differing as much as 5 ft. This necessitates building up or cutting off the piles, and precast piles soon lose their economy if many cutoffs are necessary. This difficulty is not met, of course, where the soil is at all uniform, but uniform soil is comparatively rare in the stream valleys of this section.

Concrete abutments have been built for about 75 per cent of the new bridges and for the other 25 per cent end bents with fills extending between the legs, sheeting behind pile bents and various other schemes have been used. The abutments are nearly all of reinforced concrete and are built 26 ft. wide from shoulder to shoulder. A few of the earlier abutments were only 22 ft. 6 in. between shoulders but the difficulty of maintaining a roadway to a narrow abutment was soon apparent.



TYPICAL HIGHWAY BRIDGES BUILT UNDER THE DIRECTION OF THE GEORGIA STATE HIGHWAY DEPARTMENT

1—Typical precast concrete-pile bent bridge.
2—Toccoa River truss bridge, 1[illegible]-ft. span.
3—River spans of Flint River bridge, Albany, Ga.
4—Crossing of Oconee River at Mt. Vernon, Ga.
5—Approach to swing bridge over Ocmulgee River.
6—Twelve 30-ft. arches over gum swamp.
7—Seven 54-ft. deck girders over Oconee River.
8—Cantilever of 50-ft. span over Alcovy River.
9—Vertical-lift span over Flint River.
10—Concrete trestle on two-column bents.

Abutments up to 18 ft. high are of the cantilever design: for heights of 18 ft. and more the counterfort design is used.

Precast concrete railings of several different types have been used and are satisfactory provided proper attention is given to the expansion joints. When vertical spindles are used it has been found best to have the bottom rail above and separate from the curb or rail beam. If this is not done the top rail and bottom rail will have different rates of expansion and the spindles near the expansion joints will generally be cracked. If half-spindles are used next to posts they should either be cast with the post or separated from the post by a small open space. If expansion material is used to separate the half-spindle and post the half-spindle will nearly always crack.

A brief description of a few of the more noteworthy projects may be of interest.

Project 81—The bridge over the Flint River at Albany, Ga., has a length of 773 ft., and consists of 8 filled-spandrel approach arches with spans of 53 ft. and 3 open-spandrel ribbed arches with spans of 93 ft. over the river. It has a 32-ft. roadway and two 6-ft. sidewalks. Steel centering was used for the 93-ft. arches, two three-hinged steel arches being used for each rib. Six steel arches were used to center the upstream line of ribs from abutment pier to abutment pier. After the ribs had set, the centering was loosened and shifted downstream for the down-stream line of ribs. After these ribs had set, the centering was again loosened and shifted between the ribs and used to shore up the floorbeams and deck slabs. Wood truss centering was used very effectively for the 53-ft. approach arches. The bridge was opened to traffic July 4, 1921.

Project 195—In the crossing over the Altamaha River at Darien, Ga., there are six bridges consisting of 3,900 lin.ft. of wood trestle, one 45-ft. steel-girder span and two 245-ft. steel swing-spans, making a total length of 4,430 ft. The stream crossing was originally built in 1911 by the Georgia Coast and Piedmont R.R. which was sold and dismantled in 1919. Interested citizens and Glynn and McIntosh Counties bought the bridges and fills and turned them over to the state highway department to be reconstructed for use as a highway. The old railroad fills were widened and surfaced with shell. The old railroad trestle, consisting of pile bents, was in such bad condition that complete reconstruction was necessary. This was done by cutting off the piling about 2 ft. above low tide and building framed bents on the piles. There is a 5-ft. tide in the streams. By cutting the piles off just above low tide the piles and pile cap, although they are exposed daily, are constantly wet and there is little chance for decay. The posts between the pile caps and the bent caps will decay in time but these can be replaced easily without interrupting traffic. The original plans for the trestle contemplated the use of creosoted materials for all parts except the flooring but when the contract was let, in September, 1920, it was found that creosoted timber would cost twice as much as first-grade heart cypress and under these conditions the cypress is the more economical. The bridges have an 18-ft. roadway except through the steel swing-spans which were built for a single track and have a clearance of only 15 feet.

An interesting feature of this stream crossing is the small discharge area required for the 14,600-sq. mile drainage area of the Altamaha River. The area below high water is approximately 35,000 sq.ft. Several crossings of this river farther inland have more than double this area below high water. For a considerable distance above the bridge site there are wide marshes and swamps and these serve as reservoirs and effectively regulate the discharge. Extreme high water is about 1 ft. above high tide, but during time of freshet there is almost no tidal variation, the discharge being maintained constantly toward the sea. Work began in December, 1920, and the bridge was opened to traffic in June, 1921.

Project No. 8—The bridge over the Oconee River between Montgomery and Wheeler Counties is 2,378 ft. long and consists of 54 concrete deck-girder spans 35 ft. long, supported by two-column bents; three 100-ft. through riveted trusses with concrete floors and one 180-ft. steel swing-span. It has an 18-ft. roadway and is paved with wood block. This is the longest concrete and steel structure in Georgia.

Practically all of the new bridge work in Georgia has been done by co-operation between the counties, state highway department and the U. S. Bureau of Public Roads under the direction of W. R. Neel, state highway engineer and the author as bridge engineer.

Colors for Traffic Signals

Standardization of colors for traffic signals, in the interest of public safety, was recommended by the signal section of the American Railway Association at a recent conference attended by the Illuminating Enginering Society and International Traffic Officers Association and held under the auspices of the American Engineering Standards Committee. The recommendations are as follows: (1) Red for stop everywhere unless qualified by a more favorable indication. That is, at highway crossings with railroads if train is approaching, in fixed signals and in the hands of traffic officers, at street intersections, at the ends of streets and possibly to indicate street excavations; (2) yellow for tail lights of automobiles, possibly street excavations, for calling policemen and for any purpose where caution is required; also possibly at busy street intersections to indicate that the traffic lights will be changed from red to green or green to red; (3) green for fire-escapes, for "proceed" at street intersections and for other purposes to indicate the way is clear.

In presenting these recommendations A. H. Rudd, chief signal engineer of the Pennsylvania R. R. system stated that the railroads are particularly interested in eliminating the use of the red light for various purposes. They have used yellow for caution and green for safety for several years. The public generally understands that red means danger, but this color has been so misused as to weaken its significance. For instance, the use of a red light for a fire exit in a theater is absolutely wrong. This signal means that the exit should be used in a hurry in case of emergency, and the light should indicate "proceed" instead of "stop" or "danger." It is stated that many crossing gates are broken owing to automobile drivers mistaking the red light on the gate for the tail light of an automobile and turning to the left to pass it. This was the primary reason for suggesting that tail lights on automobiles be changed to yellow.

Drain Tile Tests Show Concrete Affected by Alkali

Third Progress Report Carries Observations on Test Tile Placed in 1913 in Alkali Soils Through 1920

OBSERVATIONS on the behavior of concrete drain tile and concrete blocks in alkali soil are reported upon in the third progress report of a group of engineers under the general direction of the United States Bureau of Standards in Technologic Paper No. 214 of the Bureau just issued. This paper is entitled "Durability of Cement Drain Tile and Concrete in Alkali Soils: Third Progress Report (1919-1920)" is by G. M. Williams, who was at that time associate engineer of the Bureau of Standards, and was written in co-operation with consulting engineers and representatives of government departments as well as a representative of the Engineering Institute of Canada, the Portland Cement Association and the American Concrete Pipe Association. The tile under study were placed in 1913 in eight alkali bearing districts in the West. According to the conclusions of the latest report the best quality of concrete will disintegrate when exposed to severe alkali attacks and installations of concrete in soils containing more than 0.1 per cent of salts of the sulphate type should be preceded by an examination of surrounding conditions.

Drain tile of 16 varieties were installed in working drains in western states. Five additional types have since been provided to replace tile removed for tests. At the same time a large number of concrete blocks were molded and placed in alkali waters. Variations in brand of cement and proportions of concrete as well as types of manufacture were made. Early inspections showed that both the tile and the blocks were seriously affected by the alkali attacks. The 1919 field investigation showed that in general the condition of the tile was quite similar to that found in 1916 and that average strength results as well as appearance of the tile with respect to salts in the walls had not been greatly changed by three additional years' exposure.

A summary of the results of the inspection and tests is given in the report. It is stated that durability of concrete drain tile for any given concentration appears to vary with the richness of the mix and consistency. Hand-tamped tile are less resistant to action than machine-made tile made of the same mortars. Tile made with sufficient mixing water to result in such a consistency that they must be retained in the molds for several hours have proved more durable than richer mix tile of the machine-made type of such a dry consistency that the jacket may be stripped immediately. As a class it may be said that wet mix tile have been much less affected by alkali action than dry mix tile.

Inspection of drain tile and concrete structures in other localities where the alkali salts are of the chloride or carbonate types seem to justify the conclusion that these waters are not so severe as waters of the sulphate type which are found in all of the drains in the alkali districts. In waters of the sulphate type severity of action appears to vary with the concentration of soluble salts. For the concrete blocks somewhat the same observations are made and the additional one that with the same aggregates lean mixtures are more seriously and rapidly affected than rich mixtures. Durability appears to be dependent upon impermeability, which is mainly dependent upon richness of mix and gradation of aggregates.

Conclusions—The following conclusions end the paper:

1. Results to date indicate that materials of good quality and proper workmanship are of great importance in the production of concrete which is to be exposed to alkali soils and waters.
2. Action noted on surfaces of concrete blocks of best quality after one year exposure in sulphate waters has in most cases been progressive, depending upon conditions of exposure.
3. Extent and rapidity of disintegration in sulphate waters depends upon concentration of salts in waters to which the concrete is exposed.
4. In blocks containing reinforcing rods disintegration appears to be aided and accelerated in some cases by corrosion of embedded steel and consequent cracking of the concrete, as has been observed in some reinforced-concrete structures exposed to sea water.
5. Structures placed in alkaline soils or exposed to alkaline seepage waters should be given all possible protection by drainage.
6. Seepage waters and alkaline soil conditions may be encountered which will disintegrate concrete of the best quality, and proper consideration should be given to soil and water conditions and protection by drainage and other means when it is proposed to expose concrete structures to conditions similar to those in which these test blocks have been placed.
7. Alkali salts are not uniformly distributed throughout the soil or large bodies of seepage waters, and it will be difficult to determine in advance the concentrations to which a structure may later be exposed. A systematic scheme for sampling soils will furnish information as to the quantities and types of salts available for solution, while analyses of seepage waters will indicate the concentrations present at the time of sampling. Disintegration is brought about only by those salts which are in solution as indicated by analyses of water samples, while the soil analyses merely represent reserve supplies which may bring about changes in the existing solutions with changing conditions of rainfall, flooding, etc. The problem of drawing conclusions as to the most severe conditions which may occur becomes more difficult when the source of supply of the salt is through underground seepage from some distant point.
8. For the same concentration of soluble salts, and for the same aggregates, resistance of mass concrete to alkali action appears to vary with cement content or richness of mix, within the limits employed in these tests.

Carrying Out the Chicago City Plan

Street widenings are an important part of the city improvement work now being undertaken at Chicago by the Board of Local Improvements in accordance with the "Chicago Plan," according to the latest annual report of the Chicago Plan Commission. Three important streets on the west side which are to be widened and opened up to form continuous north and south thoroughfares for the 26-mile length of the city are Ashland Ave., Robey St. and Western Ave. Several streets in the business district just west of the river are to be widened to facilitate the development of a warehouse and commercial district. Much of this work is in the preliminary legal stages but physical progress has been made in widening some streets adjacent to the congested loop district and in extending Ogden Ave. as a diagonal thoroughfare northeast from Union Park on the west wide to Lincoln Park on the lake front.

Eliminating a Tunnel Without Interrupting Traffic

Bessemer & Lake Erie R.R. Improves Critical Point by Deep Open Cut—Bridge Built Over First Lift of Cut—No Work Trains on Main Tracks

CONTINUAL TROUBLES with the maintenance of a tunnel in unstable ground have led the Bessemer & Lake Erie R. R. to eliminate this tunnel by converting it into an open cut. Difficulties were encountered due to the necessity of executing the work without interrupting the heavy traffic on the railway and on a highway crossing the line of the tunnel.

Tunnel Conditions—The Culmerville tunnel about 20 miles south of Butler, Pa., was 394 ft. long, all on tangent, and had a width of 26 ft. at the springing line. It was built in 1897 and originally carried a double-track line, but it gave very limited clearance for present equipment and after its reinforcement by a timber lining for the arch in 1921 the tracks were gantletted for single-track operation. This tunnel with its roof bracing and gantletted tracks is shown in Fig. 1.

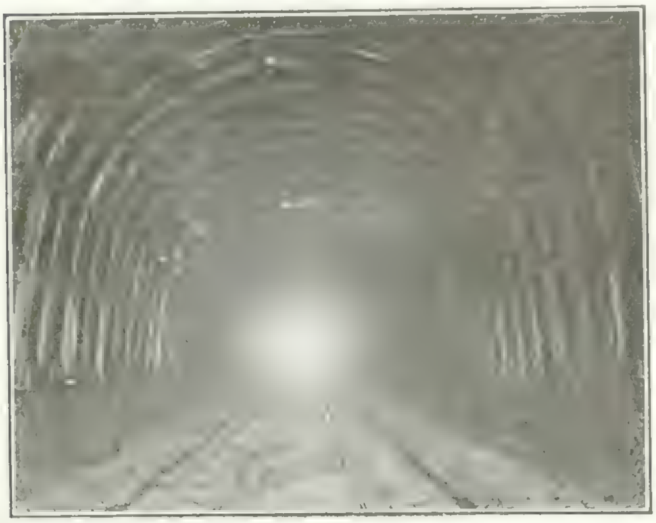


FIG. 1. TUNNEL ARCH BRACED TO PREVENT FAILURE
Double track gantletted for single-track operation.

In the original design a horseshoe section was adopted, with side-walls of cut stone and a semicircular six-ring brick arch. Cut stone was used also for the portals. Since the lower portion was in sound shale rock no invert was necessary. But overlying the rock was a mixture of clay, loam and soft shale which was liable to slip when wet. Being located in a saddle in the hills the tunnel has always been wet with seepage water.

In this bad ground considerable trouble was encountered when building the tunnel and it was found necessary to place a timber lining to hold the excavation while the permanent lining was being built. Trouble was experienced also after the tunnel was in service, and in 1909 a settlement of the arch necessitated the placing of heavy timber bracing. In 1909 also a timber-lined drainage tunnel 5 x 5 ft. was driven parallel with the railway tunnel on the west side and level with the crown of the latter. This relieved the situation somewhat in respect to water and was followed by renewal of part of the brick lining.

After this relining and the repointing of the brick the material behind the arch was grouted by means of 3-in. pipes about 25 to 50 ft. apart, put through the brick arch at the crown. Cement grout was forced through the pipes by a grouting gun, this being continued at each pipe until no more grout could be taken up. About 2,000 barrels of cement and 75,000 brick were used in the above repairs, which proved effective for some time.

In the winter of 1920-1921 bricks again began to spall out and the tunnel showed signs of slight distortion. As a precautionary measure a heavy timber lining was put inside of the brick arch and the tracks were gantletted so as to give only a single running track through the tunnel (Fig. 1). Studies were then made for either permanently relining and enlarging the tunnel or making an open cut. The latter plan was adopted and a contract for the work was awarded on Sept 3, 1921. Fig. 2 is a profile of the tunnel and cut. Fig. 3 is a cross section at the highway which has to be carried over the cut.

At the time of original construction it is probable that the tunnel was cheaper than an open cut and that the conditions above the tunnel involving extensive highway changes and litigation with property owners were factors in deciding on the tunnel. From Fig. 2 it will be seen that five improved highways converge into one highway crossing over this tunnel. The traffic is very heavy and on July 4, 1921, this joint section of highway carried 3,887 automobiles, 18 horse vehicles and 87 pedestrians. No detour was possible during construction. Further, the highway had to cross the cut by a bridge practically in its original position near the middle of the tunnel.

Bridge over Tunnel Cut—Among the first considerations therefore was the provision for highway traffic while building the bridge. A temporary road was graded across the south end of the tunnel, as shown, and this road was used from the beginning of work in September, 1921, until traffic was turned over the new bridge on April 1, 1922. No change was made in the location of the main track and the work had to be carried out so as not to interfere with railway traffic. As the tunnel is on the main line, with very heavy traffic and with no possible detour in case of blockade of tracks, the contractor was not allowed to use the tracks or to interfere with them in any way.

The first step was to make the excavation in the cut down to rock from the north portal to the temporary road over the south end of the tunnel. This work was so far completed in December that the abutments for the bridge could be built and these were completed about the end of January. The steel was erected during February and very little additional excavation was done in the cut while the bridge was being built. Fig. 4 shows the work on April 1, 1922, as resumed after the completion of the bridge. The steam shovel is at the right of the tunnel roof and some of the ribs of the old exterior timbering can be seen under and beyond the head of the boom. The original main line cut and top of north portal are in the background.

A reinforced-concrete floor is to be laid on the bridge but winter weather prevented this work being done immediately after completion of the steelwork. Only the

floor forms and the reinforcing bars were placed at that time, a temporary floor of 7 x 9-in. bridge ties being then laid so that the bridge could be opened to traffic, thus releasing the temporary road and allowing the work of excavation in the cut to be continued. It was required that the bridge should be opened for traffic before the temporary road was removed and as there was no way of making a detour for the road it was necessary to get the highway bridge in service as early as possible. For this reason the temporary floor was placed. It is so laid that one half can be taken up and the concrete floor put in while the other half is in use. After the half floor of concrete is sufficiently cured traffic will be turned over it and the other half built. The concrete floor construction is shown in Fig. 3.

The concrete abutments are of the gravity type and of a general U-shape, curved wings being used to provide easy approaches. The bridge is of sufficient length to span four tracks, thus providing for the widening of the cut for additional tracks when necessary (Fig. 3). Concrete was placed during the winter but owing to the open season it was sufficient to provide the ordinary precautions of heating all the materials and keeping a

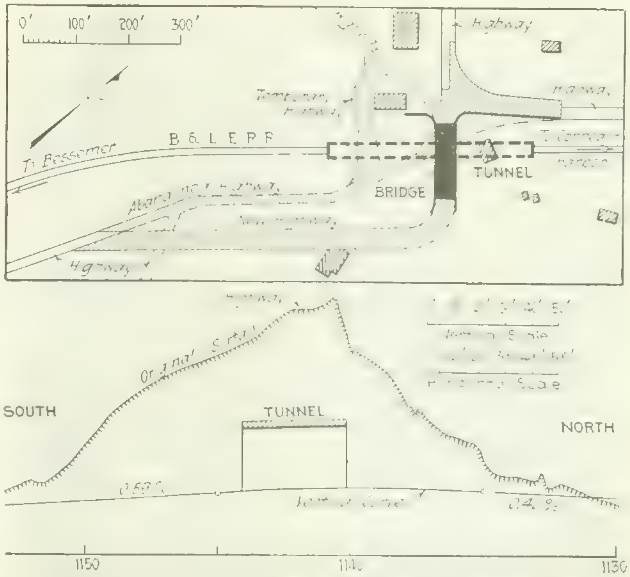


FIG. 2. PLAN AND PROFILE OF CULMERVILLE TUNNEL IMPROVEMENT

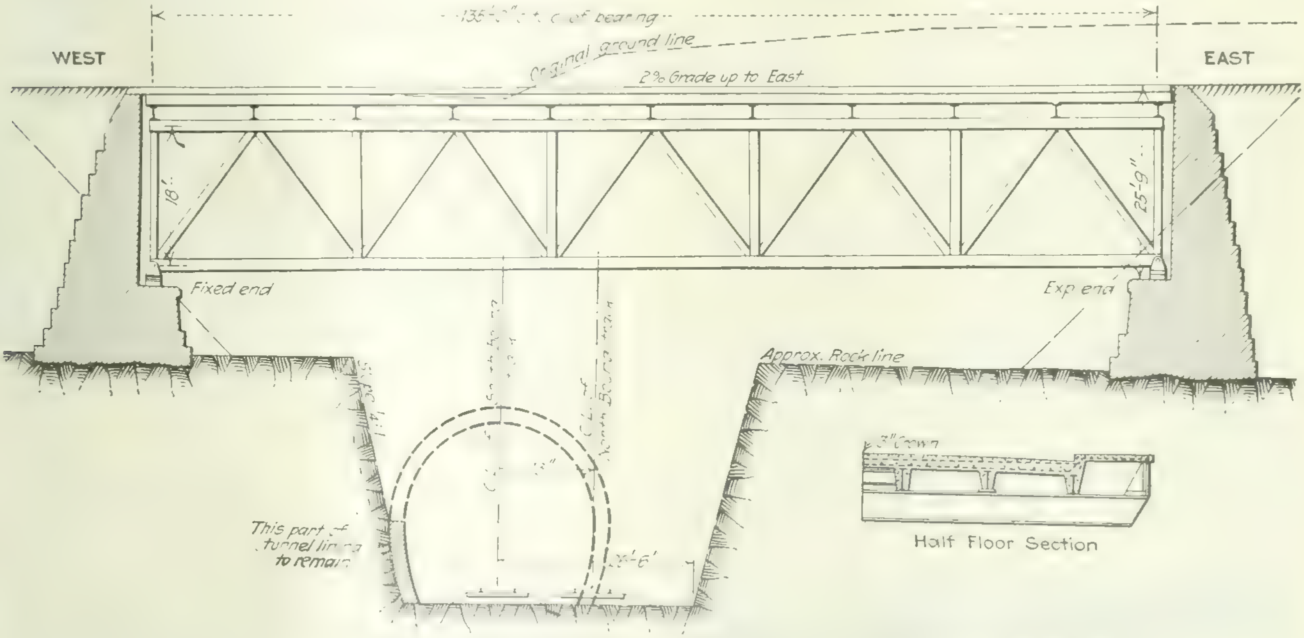


FIG. 3. CROSS-SECTION OF OLD TUNNEL AND NEW CUT, WITH BRIDGE OVER CUT

canvas cover over the concrete, with fires around abutments and lines of steam pipe under the covering. The foundations are in the shale rock found in the lower part of the excavation, the berm between rock slope and earth slope being about at the top of the foundation course.

Heavy construction was required for this bridge in order to provide for future electric cars in addition to the 16-ton trucks now specified for highway traffic loading. Floor work was done during March and traffic was turned over the bridge on April 1.

Opening the Tunnel—During March good progress was made south of the tunnel with traction shovels and motor trucks in excavating material above the rock line on the east slope of the cut where widening was required. Beginning in April the work in the cut over the tunnel was pushed to the limit of the plant that could be handled economically in the limited area. Also beginning at the north portal of the tunnel where the top excavation had been completed several months previous, the work of stripping the brick arch of the tunnel was in progress. This work below the rock line was done by hand, the material being loaded in skips and handled to narrow-gage dump cars on a track in the cut by stiff-leg derricks erected on the rock berm.

Stripping of the arch was of particular interest in revealing the results obtained by the grouting done in 1910. Except in a few places just over the crown, the entire tunnel excavation behind the lining was found to be a solid mass of concrete, in which was imbedded the original timbering and the stone packing between the timber bents. In Fig. 6 the upper view shows the crown of the old timbering, with the haunches embedded in a mass of grout. In some cases the ribs were completely encased and in all cases the sides were well grouted.

After the removal of the original rock and shale to expose this concrete casing a row of holes was drilled

FIG. 4. BRIDGE ERECTED BEFORE OPENING TUNNEL
Ribs of old timbering under head of steam-shovel boom.

around the arch through the concrete but not extending into the brickwork, the grouted concrete being then broken up by very light shooting. The material could then be removed by pick and shovel, leaving the brick arch exposed, as shown in the lower view of Fig. 6. At the left of this view are the haunches of some of the old ribs partly embedded in grout

The brick arch was then drilled and a section of about 3 ft. all around the arch was shot by light charges in order to loosen up the brick so that they could be handled with pick and shovel by men working on top of the arch. All except the inner ring of brick was removed in this manner. This last ring was knocked down onto the track, where the material was at once thrown off to the sides to be picked up later a opportunity between trains afforded. The interior timber lining was removed either later or at the same time as the brick was torn down. It is to be noted that the timber ribs inside the tunnel served as a support, so that a considerable length of one ring of brick has been left standing during an entire day when a section of the brick arch was being taken down.

Removal of the brick arch was done on Sundays when the railway traffic was light, but the work could have been carried on at any time. Fig. 5 shows part of the arch removed, exposing the temporary timber lining inside the tunnel. The several kinds of lining are plainly shown, including the inside timber ribs, the brick arch, the outside timber rings and the grouting. Portal bracing is shown in the view at the left.

Disposal of Spoil—In taking out the top lift of the excavation the contractor used traction shovels and motor trucks and utilized the highways for carrying the material to various dumping places. Sand and coarse aggregate for the bridge abutments were also brought to the work by motor trucks and delivered at the mixer by the dealers. This material was only supplied as required, since it was not desirable to accumulate a large amount on the ground for work done during winter weather.

The main dumping ground for excavated material was about half a mile north of the tunnel and was reached by a narrow-gage construction track laid on the company's right of way. All the material excavated after getting down to the rock level was hauled to this dump. It was first intended to take practically all of the excavated material to this dump, but owing to the use of motor trucks the contractor was able to arrange with various property owners to fill in low ground along the highways and thus dispose of a large portion of the top lift, as noted above. Owing to the poor quality of the material above the tunnel and on account of its running and sliding qualities when wet none of it was permitted to be dumped into the railroad embankments. All of this material, therefore, was either wasted or used in filling low ground.

This elimination of a troublesome tunnel was planned and carried out under the direction of H. T. Porter, chief engineer, Bessemer & Lake Erie R. R., and W. S. McFetridge, principal assistant engineer, with R. Ridge

FIG. 5. REMOVING BRICK ARCH OF TUNNEL (PORTAL BRACING OF TEMPORARY TIMBERING AT LEFT)

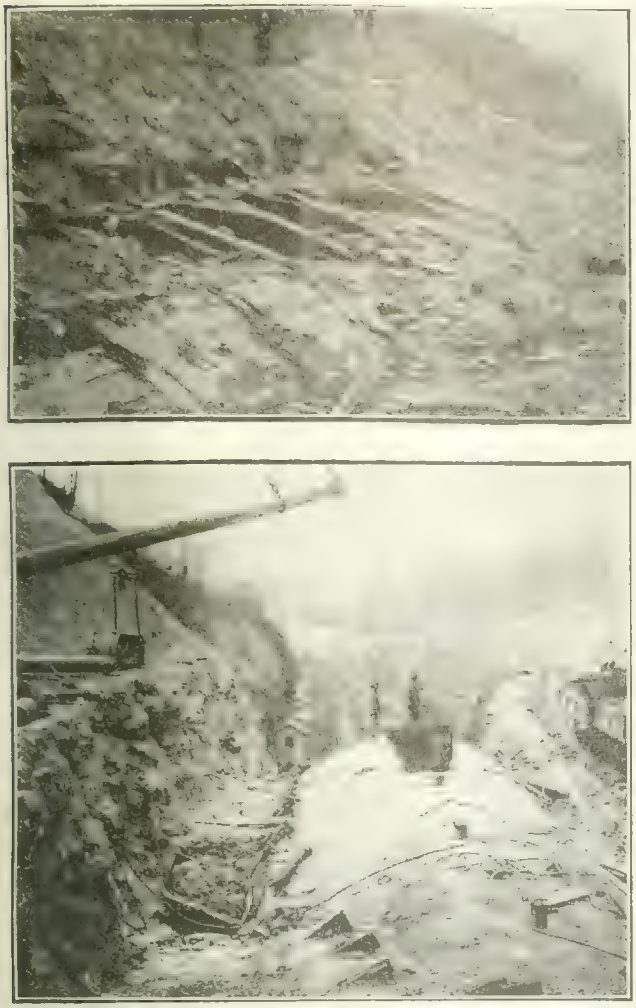


FIG. 6. EXCAVATING CUT OVER TUNNEL
Above; old exterior timbering embedded in grouting of later date. Below; old arch exposed; timbers and grouting at left.

as field engineer in charge. The general contractor is the Arthur McMullen Co., New York, with Thomas McGuire as superintendent in charge of the work. The steel highway bridge was built and erected by the American Bridge Co. This work includes the following principal quantities: 100,000 cu.yd. of excavation in the railway cut, 12,000 cu.yd. for highway changes and 2,000 cu.yd. for foundations; 142 tons of structural steel and 1,700 cu.yd. of concrete.

New Sounding Device Successful

Extensive trials of a new sounding apparatus developed at the Naval Engineering Experiment Station showed the device to be entirely successful. In this apparatus the depth of water is measured by measuring the length of time required for sound waves to travel from the ship to the ocean bottom and back. The apparatus was recently installed on the ship "Stewart." In a trip from Newport to Gibraltar, running over a course where the depths were known, the new apparatus gave results checking exactly with those obtained by sounding lead. With the old method, stopping to take soundings meant a delay of at least one hour, while the new method permits obtaining accurate depth measurements without stopping the ship. Dr. H. C. Hayes, of the technical staff of the station, who is in great part responsible for the new equipment, made the trip.

Illinois Drainage Works Involve River Control

Improve Agricultural District by Straightening Embarrass River and Building Levees and Long Diversion Ditch

By E. F. Mail
Civil Engineer, Robinson, Ill.

STRAIGHTENING a tortuous river channel and inclosing a district of some 5,000 acres by levees as a protection against river and upland flood waters are the main features of the work on the Captain Pond drainage and levee district on the Embarrass River, in Illinois. This project, shown in Fig. 1 and now underway, is characteristic of much of the work required for protecting and reclaiming rich overflow lands in the central states.

The Embarrass River, having its source near Champaign, Ill., flows in a general southerly direction, and empties into the Wabash River below Vincennes, Ind. The drainage area of 2,426 square miles has an extreme length of 110 miles, but the crooked river channel is almost twice this length. Considerable drainage and reclamation work has been done on the upper part of the river, but practically nothing on the part below Greenup. This section has more than 100,000 acres of bottom lands subject to rapid and frequent overflow. In the past ten years thousands of acres have been abandoned for farming purposes and are now grown over with brush and scrub. Below Greenup is a rather poor agricultural country, excellent for grasses and stock raising but unprofitable for corn and small grains. All the lowlands of the river are rich sedimentary deposits. The soil is exceptionally fertile and if properly reclaimed would fill the need of the adjacent country. Corn has been known to make more than 100 bushels per acre and alfalfa crops (where protected from overflow) have been extremely heavy.

Owing to the crookedness of the river (Fig. 1) effective reclamation will require a combination of levee construction and channel straightening. As the valley averages only about two miles in width this will entail a high cost per acre of land reclaimed, which is the principal cause for lack of progress in a territory where good land is needed so much. The Captain Pond drainage and levee district has its northern limits at the village of Ste. Marie (south of Greenup) and extends south for about six miles. Its land is of the richest along the river. From the north end the Embarrass River flows south and southeast to the bluffs on the east side, where it is joined by the large tributary known as North Fork. It follows the east bluff for 1¾ miles and then flows through the center of the valley to the southwest corner of the district, where it turns abruptly to the east for about a mile and then passes out of the district.

The ideal improvement would be to construct an entirely new channel along the western edge of the valley, but this was out of the question because of the necessity of caring for the North Fork. After thorough investigation of the physical features and consideration of the financial resources a plan of reclamation was adopted which includes three river cutoffs, a levee and an intercepting ditch.

River cutoff No. 1, 1,000 ft. in length across a narrow neck of land (see Fig. 1), will shorten the present course

more than ¾ mile. Cutoff No. 2, 2,000 ft., will shorten it ½ mile. Cutoff No. 3, extending south three miles, will do away with about ten miles of the most crooked and drift laden part of the river. In addition it will throw all of the land to be reclaimed on one side of the channel. This cutoff channel will be straight except for three silght curves of long radius. The average fall in new and old channels throughout the district will be 1.71 ft. per mile.

A river levee is to begin at the bluff at the northwest limits of the district and thence follow the south and west sides of the river as straightened, crossing the present channel three times. From the southeast corner it will return along the north bank, crossing the

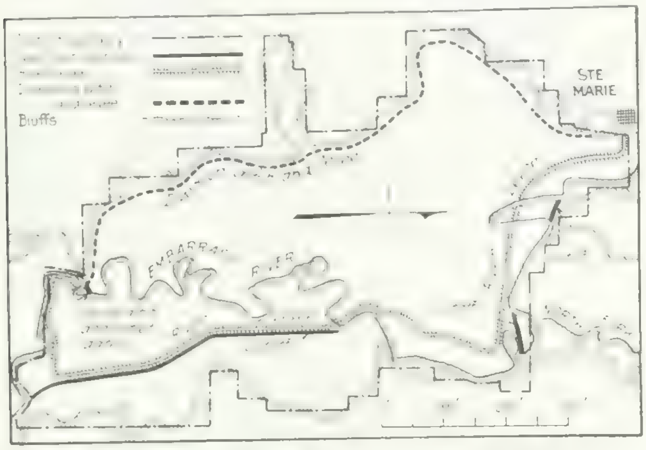


FIG. 1. CAPTAIN POND DRAINAGE DISTRICT AND LEVEE ON THE EMBARRASS RIVER, ILLINOIS

channel and joining the diversion levee. This river levee, Fig. 2, will be nine miles in length, with an average height of 11 ft. (5 ft. above known high water marks). At river channel crossings it will be constructed to a special section commensurate with its added height, as shown. Along the main cutoff the levee will average 13 ft. in height, or 29 ft. above the bottom of the new channel. It will be built of the earth excavated from that channel. Not less than 20 ft. clear berm will be left and at convex curves this will be increased to 75 ft. It is expected that the new channel will wash and widen, and that in time this section of the levee will have to be rebuilt. But half of the material excavated from the new channel will build a levee of almost twice the required section and it is believed that intelligent maintenance will preserve its utility for several years. Finally, a diversion ditch and levee along the western edge of the valley for a distance of six miles will divert all water from 21 square miles of high prairies, which water now flows over the valley and is a source of almost as much damage as the river overflows.

River cutoffs Nos. 1 and 3, which must carry the entire channel flow, have been designed for a 60-ft. bottom with side slopes 1 to 1. The average cut will be more than 16 ft. and the fall 2.65 ft. per mile. Using 0.25 for n in Kutter's formula, the bank-full flow is found to ze 8,125 sec.-ft. From gagings at the village of Ste. Marie it has been found that the carrying capacity of the present channel is 3.3 sec.-ft. per square mile of drainage area, or 6,200 sec.-ft., giving a difference of practically 2,000 sec.-ft. carrying capacity in favor of the new channel.

The river levee location is such that above and below the mouth of North Fork the width of the floodway will not be less than 1,300 ft. and 1,400 ft. respectively. These widths may be somewhat extreme for so small a stream, but it was highly desirable to avoid the error so commonly found in levee location, that of forcing the flood waters through too narrow a floodway. It was felt that a large factor of safety was more to be desired than the saving of a few hundred additional acres to the detriment of the district as a whole. Too many drainage districts have failed because of the attempted saving of every available acre regardless of the general effect on the entire project.

Sluices—A sluiceway ditch 415 ft. long from the old channel at the south end of the district will carry the rainfall run-off into the river. At the levee this ditch will have a reinforced-concrete sluice with two openings or culverts 4 ft. square, fitted with vertically sliding gates which may be closed to exclude flood water when the river is at high stages.

Internal drainage works are not included in the present plans and the proximity of a large part of the land to the old river channel precludes the necessity for many ditches. No water will reach the protected area except that which will fall as rain, and no pumping plant has been provided. Ordinarily the Embarrass River reaches the flood stage in a very short time, remains there usually three to four days (seldom more than one week) and as quickly returns to the low water flow. The old river channel will provide considerable storage during the times that the sluice gates must be kept closed, so that a pumping plant would seldom, if ever, be needed.

The mean annual rainfall on the Embarrass River drainage area during a period of twelve years was 39 in., with a maximum of 47.06 and a minimum of 30.84 in., according to a report by Jacob A. Harman on the reclamation of overflow lands in the Embarrass River valley (Bulletin No. 25 of the Illinois State Geological Survey). The greatest flood occurred in May, 1908, the maximum rainfall in one day being 4.15 in. at Robinson, Ill., on May 6, but the rainfall for that year was only 36.92 in. Run-off data for this drainage area are very limited, but gagings at Ste. Marie, Ill., in 1909-1911 showed that the capacity of the river channel when bank-full was approximately 3.3 sec.-ft. per square mile of drainage area.

Investigations in the adjacent Kaskaskia valley, which has similar characteristics and the same bank-full capacity (as reported in the bulletin noted above), showed that with water entering the valley from the entire drainage area at the rate of 25 sec.-ft. per square mile, the run-off averaged only 10 sec.-ft. per square mile, due to the storage effect of the overflowed lands. A modification of the Murphy formula, with constants adapted to conditions on the Kaskaskia, was used to give the approximate rate at which the flood waters must be carried through the valley when this "overflow" storage is eliminated by the construction of levees and channel corrections along the entire river. This formula for the Kaskaskia is given below, in which $Q =$ the run-off in cubic feet per second from 1 square mile and $M =$ the area in square miles. This same formula applied to the Embarrass River above the Captain Pond drainage district (1,865 square miles) gave 29.5 sec.-ft. per square mile or a total of 55,000 sec.-ft.

$$Q = \frac{30,000}{M + 200} + 15$$

For determining the velocity of flow, the method

recommended by the Harman report was followed, the floodway being divided into two parts: (1) The channel proper, including the area of the floodway immediately above and between the lines of the slopes projected to the flood plane; (2) the entire area of the floodway minus the above prism. In the Chezy formula, the value of R, hydraulic mean radius, was determined as follows: (1) For the channel prism, by dividing the area of the bank-full stage by the wetted perimeter and adding to the quotient the depth from the bank-full stage to the flood stage; (2) for the floodway outside of the channel prism, by dividing the area by the bottom plus the side slopes. In the Kutter formula a coefficient of roughness, $n = 0.025$ is recommended by the Harman reports. For the Embarrass River this was thought to give results entirely too high for that part outside the channel proper, and for that portion a value of $n = 0.035$ was used.

Assuming an extreme flood of 9 ft. above the bank-full stage (4 ft. below top of levee), the area for the channel prism is 2,044 sq.ft. and for the remainder of the floodway 11,700 sq.ft., using an average fall of 1.71 ft. per mile for new and old channels. By the Chezy formula as above outlined the average velocities are

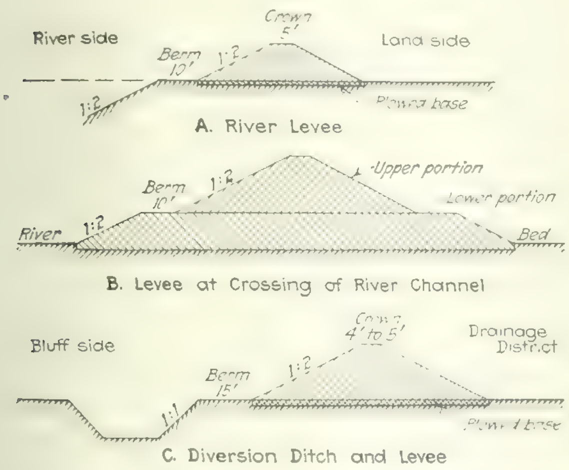


FIG. 2. SECTIONS OF LEVEES AND DIVERSION DITCH

8.06 and 3.44 sec.-ft. respectively, which give flood flows of 16,500 and 40,150 sec.-ft. respectively, or a total of 56,650 sec.-ft. As noted before, the expected maximum future flood flow is 55,000 sec.-ft. It will be many years before the flood storage in the valley above will be eliminated by the construction of new levees and channels, and even then it is doubtful if such an extreme flood will occur. Tributary streams will be improved and the maximum run-off from the lower parts of the drainage area will have reached the Embarrass and passed downstream before the crest from the upper reaches of the watershed has arrived.

Large amounts of material in suspension, carried by the river in time of flood, are deposited along the banks, with the result that the ground surface is highest along the banks and there is a considerable downward slope towards the bluffs. When the river exceeds the bank-full stage, therefore, the water spreads over the entire valley. At certain points the overflow has been so frequent and violent as to cause "washes" or "runs" through the banks and adjacent lands, sometimes denuding large areas of all productive soil. Since some of these washes are 4 to 5 ft. deep the overflow of the valley begins before the river reaches its normal bank-full stage. In the first half of 1920, the river thus spread over the valley no less than six times, although the rainfall of that season was only normal. Enormous loss resulted through the delays in preparing crops.

About 1,440,000 cu.yd. of earth will have to be moved. The total estimated cost, including clearing, bridges, right of way, incidentals and reinforced concrete sluice is $291,000, or an average of $63 per acre of land protected. This is a record figure for drainage in southern Illinois, but will permit the development of almost 5,000 acres of highly productive land. The landowners in the Captain Pond district are virtually the pioneers of the lower reaches of the Embarrass, and on the success of this district depends the future reclamation of 100,000 acres.

A contract has been let at 12c. per cubic yard and the bonds have been sold at a small discount. Some saving will be made below the estimates for bridges and sluiceway. Altogether the work now planned will be done at a saving of $40,000 to $50,000 below the estimate. The drainage commissioners and engineers plan to use part of this for a system of internal drainage and to hold the remainder for the construction of a pumping plant if it should be found necessary. E. F. Mail, Robinson, Ill., is engineer in charge of design and construction; N. D. Reed, Robinson, Ill., is consulting engineer. The W. E. Callahan Construction Co., Dallas, Tex., has the contract for earthwork and has installed two walking-type drag-line excavators with 60- and 70-ft. booms and 1½- and 2-yd. buckets.

Evil Fate Still Pursues Concrete Ships

The concrete ships built by the United States Government during the war continue to get in trouble, not through any fault of their own. As has been reported, several of the large ships have sunk, notably the "Polias" and the "Cape Fear." Several others have been in accidents, notably two of the ships built at Mobile, which ran into the breakwater at Tampico, Mexico. During the month of June additional accidents occurred. The War Department had six small concrete boats tied up in the Cape Fear River to an old dock. A storm came up, the boats pulled the dock down, and were driven downstream and bumped over sandbars. It is a good testimonial to their construction that though they were subjected to very rough treatment, none of the boats was seriously damaged. One of the hulls developed a slight crack in the concrete above the water line, but repairs in each case can be made including the damage done to the fenders for less than $800.

One other small boat, the "General Wilkins," a 125-ft. army transport built after the war from designs made during the war ran ashore on a submerged boulder on the Long Island coast. Two holes were made in the hull, one penetrating to the forward end of the engine room and one to the cargo space, and the boat went down in 9 min. There was no damage to the concrete other than at the points where the boulder struck, but oil tanks were penetrated and the oil caught fire, burning the entire wooden superstructure of the boat. These War Department boats were built to carry small numbers of troops to island coasts near the mainland.

# Indicates Lines of Attack on Industrial Waste

Hoover Discusses Problems of Quantity Production, Twelve-Hour Day, Intermittent Employment, and the Business Cycle

Extract from address before the National Conference of Social Work, Providence, R. I., June 27, 1922.

ONE of the problems in which there is much discussion is that of the hours of labor. In any discussion of this subject, we must embrace three points of view—the engineer's, the economist's, and the social student's. Both the engineer and the economist must insist on the maximum productivity. For the maximum production is the only foundation on which we can obtain more general higher standards of living. The argument is simple enough, for the more cheaply commodities can be produced, the larger are the number of people who can participate in them.

The Problems of Quantity Production—The engineer however, does not advocate unlimited hours; he does not obtain the maximum production when fatigue and deterioration in product begin to supervene. His view of human fatigue and of human deterioration leads directly to the restriction of hours to that number that will permit of best performance and efficiency in the tasks in the long view. The engineer takes more than the immediate view of a day's work, for there are some tasks of repetitive character which tend to intellectual and moral deterioration in the long run. It is one of the first problems in front of the engineer to find such a diversion and stimulation to intellectual interests either directly in the task itself or indirectly in some association with it that will prevent not only fatigue but deterioration itself. While this problem is of high importance, I am not one of those that thinks that the fabric of the nation is about to collapse because we have developed mechanical tools for mass production, for the very minor malign results that have accompanied these inventions can be overcome. The length of hours of labor in the vision of the engineer will vary with every task. There are many tasks in which four hours is too long for continuous action. There are other tasks such as that of the caretaker of an empty house where twenty-four hours, six days in a week, would not be absurd from a physical point of view.

The social student must approach the question from another and equally vital point of view, and that is family life, citizenship, and opportunity for recreation and intellectual improvement. These limitations are mandatory, and whatever the right hours may be as between these vital social limitations and the limitations imposed by the view of productivity, it is a certainty that the twelve-hour day or seven-day week cannot be entertained by any well-thinking social student. We have set up as a matter of public sentiment eight hours as an approximate standard, yet no empirical number can be right. The engineer is the proponent of scientific study into the hours in which maximum productivity can be obtained and maintained. We need these studies by the engineer and social student in every industry, for hours too short are an injury to the rest of us in that they impose lower standards of living upon us; and hours too long are injurious to the individual, thereby the race.

The Twelve-Hour Day—The President recently called a meeting of the leading steel manufacturers of the country and made an appeal to them in the name of social progress that they should take steps to abolish the twelve-hour day which now remains in respect to about fifteen or twenty per cent of the employees in that industry. For competitive reasons this abolishment needs be brought about coincidently in the whole industry and the President's action gains this opportunity for united action. This request was based solely upon social grounds and indeed the social necessity is sufficient justification for this or any other step. Many employers are in favor of it and I trust that this great step will be quickly brought about. I do not believe it is possible to develop proper citizenship or proper family life, whether men work twelve hours by necessity or by preference. And I think you will agree with me that 90 per cent of the public opinion of the entire country is solidly behind the President in his expression that we have now reached a stage of social conceptions wherein this anachronism should be abandoned.

Intermittent Employment—The industrial losses through unemployment and intermittent employment constitute a problem that is not to be solved by any formula. It must be attacked in detail. There are phases of our seasonal employment that no doubt could be mitigated by more co-operation in industry. There is one feature now being given consideration in many directions that I believe is of interest and promises ultimate results, and that is the accurate study by civic bodies of the character of the particular industries in any particular center in the endeavor to discover opportunity for integrating industries to intermesh with each other in reduction of seasonal idleness. Every city in the United States would be well advised in the interest of its own development to consider its industries with view to a determination of what industries might be introduced that would take up the slack in seasonal employment of their already existing establishments.

The Business Cycle — One of the tremendous wastes through unemployment is due to the fluctuation of the business cycle. We are constantly reminded by some of the economists and business men that this is inevitable; that there is an ebb and flow in the demand for commodities and services that cannot from the nature of things be regulated. I have great doubts whether there is a real foundation for this view. Thirty years ago our business community considered that a cyclical financial panic was inevitable. We know now that we have cured it through a Federal Reserve Banking system. We know also that many of our industries are themselves finding methods for insuring more continuous operation of their plants during these ebbs and flows of demand. At the present moment a committee of important business men and economists, with the co-operation of the Department of Commerce, are engaged in a systematic study of this problem. An analysis of the business cycle quickly brings one to the separation of our production of consumable goods from the construction of our plant and equipment, that is, our houses, our public utilities, our public improvements, our public works. The ebb and flow of demand for consumable goods probably in the main may be uncontrollable. There is more hope that we could direct certain branches of our construction and equipment, such as public works, the greater utilities, in such a fashion that we could provide the finances and then delay construction until periods of depression, and thereby shift our labor from consumable goods to plant and equipment in these periods. It would clip the top from booms and the depression from slumps.

It has been calculated that if we could secure a delay of such equipment to the amount of one-tenth during the period of normal business in the great utilities and construction works under the control of the Government that it would almost plane out the depression in employment. I am confident that there is a solution somewhere, and its working out will be one of the greatest blessings yet given to our economic system—both to the employer and the employee. And there is nothing that would contribute so much to the contentment and the advancement of our people as assurance of a reasonable economic security.

To Assess Water Main Costs at Hartford

The cost of water main extensions at Hartford, Conn., is to be assessed against abutting property owners in accordance with an ordinance recently adopted by the city council. The assessment is to be based directly upon the frontage with a deduction of 75 ft. for corner lots. The amount assessed shall be in no case in excess of the average cost to the Board of laying 6-in. pipe during the preceding calendar year.

Making Load Tests of a Tile Wall and Measuring Floor Deflections

By Edward Godfrey
Structural Engineer, Pittsburgh, Pa.

IN A RECENT investigation of a building where concentrated loads were placed on tile walls it became necessary to ascertain whether or not the provision for distributing the load into the wall was adequate. The case was one where interior tile walls were used as bearing walls carrying concentrations computed to be 22,600 lb. The walls were 13 in. thick and 12 ft. high. The method of distributing the concentrated load was by building brick blocks or saddles about 2 ft. long, as thick as the wall and about 28 in. high. A concentration of 22,600 lb. meant a load of about 380 lb. per sq.in. of net tile area.

It was considered that if there was a factor of safety of four, the construction would be accounted safe. Hence it was decided to apply a load twice as great as the computed concentrated load, on an area of wall half as large as the base of the brick saddles.

A specially designed rigging, used to hang the load from the wall, proved so satisfactory a means of testing that a description may be of interest to engineers in general. The accompanying sketch, Fig. 1, illustrates the manner in which the load was applied, and the view, Fig. 2, shows the test during loading and at completion. The purpose of the 4 x ½-in. steel plate was to prevent the steel beams, if they should rock, from bearing on the corner of the 12-in. steel plate, thus creating a high intensity of pressure at the edge. The bricks which constituted the loading were laid in close rows on edge on the loading platform, symmetrically on each side of the wall (the number of bricks in the layers being counted). One hundred bricks were weighed to ascertain the average weight.

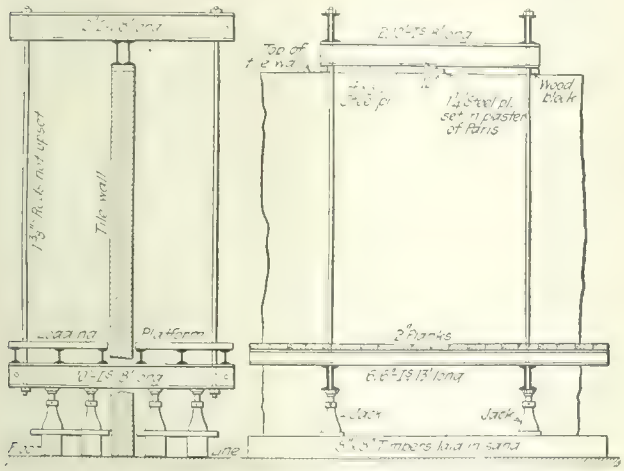


FIG. 1 HANGER RIGGING FOR WALL TEST

The eight screw jacks under the platform supported the load while it was being placed, but when these jacks were released the entire load was supported by the 12-in. steel plate on top of the wall. The channels passing through the wall had ample clearance, and the 10-in. I-beams along the top of the wall were free at the ends, though as a safeguard wooden blocks were placed under them so that in case the wall should crush the beams could fall only ½ in. or tilt to this amount. To prevent the upper beams from falling if the wall failed, scaffolding was built to catch them.

When a considerable portion of the load was placed, and a count showed a balance, the jacks were released, causing the load to be transferred to the top of the wall. This was repeated a number of times so as to catch the capacity load, and when the total load amounted to 47,174 lb. it was considered that the wall had been fairly tested. This load was allowed to hang on the wall for several minutes, the jacks being all released for that time.

The tile wall tested indicated by inspection that the mortar joints were good, hence no apprehension was felt as to the result of the test.

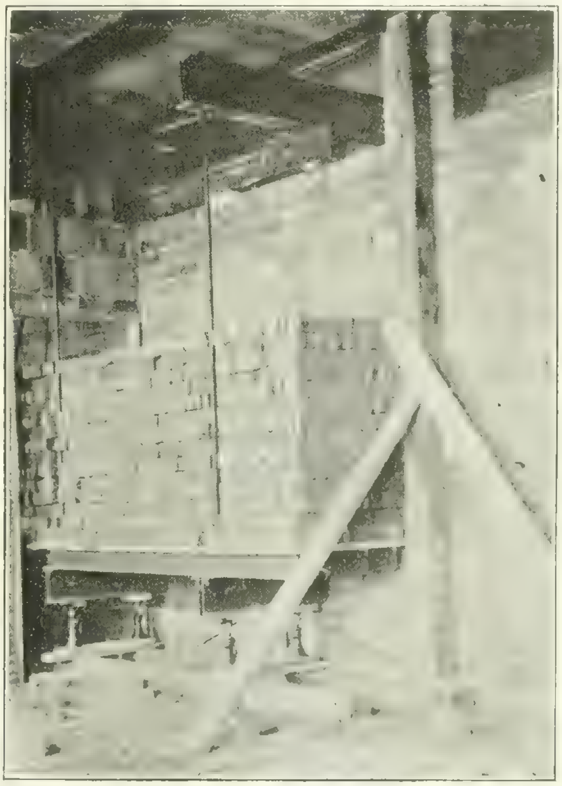


FIG. 2. LOAD ON WALL SAFEGUARDED BY JACKS

Floor Deflection Gage—In connection with the same investigation floor tests were made. In these tests I hit upon a method of measuring deflections which gave very satisfactory results and required no special apparatus.

The deflection at the middle of a floor space tested was measured by means of an Ames dial. This dial was fastened by means of a screw on an upright 4 x 4-in. timber, as shown in Fig. 3. The movable column of the dial was set in contact with the ceiling under the floor where the test load was being placed. The upright timber was braced against motion all ways, and a ladder was placed where access could be had to the dial when it was desired to take readings.

There was only one Ames dial on hand, and on one occasion it was desired to measure the deflection over a wide door opening as well as that in the middle of the floor. I asked the contractor's foreman to get a stick to measure the ceiling height, so that we could rig up a scheme to measure this deflection approximately. He

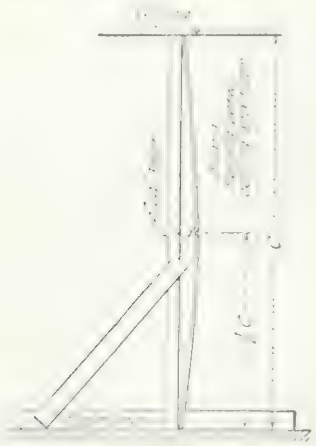


FIG. 3. FLOOR DEFLECTION MEASURED BY BENT STRIP

brought a stick that was just a little longer than the ceiling height. I told him that was just what I wanted, and that we would just cut that stick so that it would have a little bow, and any deflection in the ceiling would increase that bow. This increase could be readily measured from the floor, and by a simple calculation the vertical deflection could be found. We, of course, had the door opening, in this case, across which a stick was nailed to measure the middle ordinate of the curve; but in the middle of a floor an upright 4 x 4-in. timber can be set up and braced, and beside this the bowed stick can be placed.

To make the calculation for the deflection the following formula is made use of: Where L = length of arc, C = length of chord, and D = middle ordinate of arc,

$$\text{Difference between } C \text{ and } L = \frac{8d^2}{3C} \text{ or } \frac{8d^2}{3L} \text{ very nearly.}$$

In this case C is the ceiling height and L is the length of the stick. The actual value of the difference between C and L is of no consequence, but the difference between the initial and final difference is the deflection. If d and d' are the initial and final readings of the middle ordinate of the curve, in inches, the deflection D in the ceiling is,

$$D = \frac{8}{3C}(d'^2 - d^2).$$

It will be readily seen that the smaller the value of d the more accurate will be the reading of the deflection. If, for example, the ceiling height is 12 ft. and the initial offset of the curve (d) is 1 in. an increase in the offset of $\frac{1}{8}$ in. means .005 in. deflection.

The edge of the upright 4 x 4 should be straight and the board that is sprung between floor and ceiling should be uniform in section and quality. The bowed stick should not be heavy enough to carry any appreciable floor load. A piece of 4 x $\frac{3}{8}$ in. was used in this test.

Development of Drainage in U. S.

According to recent figures of the Bureau of The Census, there were on January 1, 1920, 65,495,038 acres of land in the United States in organized drainage enterprises, either operating or under construction. These figures emphasize the extent to which agricultural drainage has become a community problem in this country. Practically all the states in which there is sufficient wet land to justify it have now enacted laws providing under certain conditions for the organization of lands into drainage districts. These laws provide for a permanent organization which is endowed with power to condemn property needed, to borrow money and issue bonds, to assess and collect drainage taxes, to construct whatever improvements are necessary to accomplish the drainage of the district, and in short to perform any and all acts required for the successful carrying out of the project.

The California Pipe Method of Water Measurement

By Blake R. Vanleer
Assistant Professor of Mechanical Engineering, University of California, Berkeley, Cal.

THERE is need for a method of measuring water which the man on the job can use with the ordinary tools at his disposal. The method described below offers a solution to this problem for the irrigation farmer, the man operating dredge pumps and many others where the discharge of the water is not submerged or under pressure.

The necessary apparatus consists of: a tee (same size as the discharge pipe); nipples; a spirit level; a 2-ft. carpenter's rule.

Principles—The "California pipe method of water measurement" is based upon the principle that if water is delivered to a short pipe nipple with a zero or at least a very small velocity head, then for the same size pipe and the same quantity, the depth of water in the pipe will always be the same.

Apparatus similar to that shown in Fig. 1 was set up in the Hydraulic Laboratory of the University of

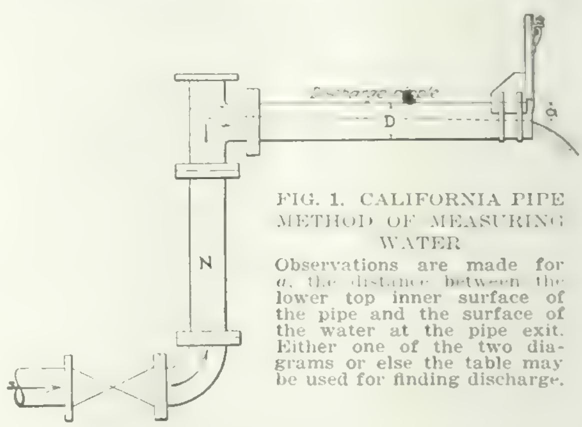


FIG. 1. CALIFORNIA PIPE METHOD OF MEASURING WATER

Observations are made for a, the distance between the lower top inner surface of the pipe and the surface of the water at the pipe exit. Either one of the two diagrams or else the table may be used for finding discharge.

California and the following general formula was derived, $Q = K\,(D - a)^{1.88}$. (See "Report on the Measurement of Water Discharged from a Short Horizontal Pipe," a thesis by Ejnar Smith and Clarence A. Pollard, submitted in partial satisfaction of the requirements for the degree of B. S. in Mechanical Engineering at the University of California, May, 1921.) In this formula

Q = The quantity in second-feet.
K = A constant depending upon the diameter of the pipe, in this general case, $K = (0.0116 + 0.00787D)$.
D = The diameter of the pipe in inches.
a = The distance in inches from the upper inside surface of the pipe to the surface of the flowing water measured in the plane of the discharge end of the pipe.

The formula has been checked by experimentation with pipe up to 6 in. in diameter and has been found to be quite accurate. The error was at all times less than 5 per cent.

Operation—The apparatus is set up as shown in Fig. 1. The length of the discharge nipple should be at least six times the diameter of the pipe. The exact length is immaterial so long as the nipple is not so short as to make the measurement of the distance, a, very difficult and hence inaccurate. The nipple, N, may have

CALCULATED VALVES FOR CALIFORNIA PIPE METHOD OF WATER MEASUREMENT

	D Pipe Diameter, In.	a Dist. from Upper Edge, In.	$D-A$ In.	K 0.0116+ 0.00787d	Q Quantity, Sec.-Ft.
Nominal	3	2.75	0.318	0.0352	0.014
Actual	3.068	2.50	0.568		
		2.25	0.818		0.026
		2.00	1.068		0.040
		1.75	1.318		0.055
		1.50	1.568		0.076
		1.25	1.818		0.099
		1.00	2.068		0.128
		0.75	2.318		0.158
		0.50	2.568		0.193
		0.25	2.818		0.231
Nominal	4	3.75	0.276	0.0432	
Actual	4.026	3.50	0.526		0.0124
		3.25	0.776		0.0253
		3.00	1.026		0.0436
		2.75	1.276		0.0651
		2.50	1.526		0.093
		2.25	1.776		0.123
		2.00	2.026		0.156
		1.75	2.276		0.194
		1.50	2.526		0.238
		1.25	2.776		0.285
		1.00	3.026		0.333
		0.75	3.276		0.388
		0.50	3.526		0.441
		0.25	3.776		0.498
Nominal	6	5.75	0.25	0.0588	
Actual	6.065	5.50	0.50		0.0161
		5.25	0.75		0.0342
		5.00	1.00		0.0588
		4.75	1.25		0.090
		4.50	1.50		126
		4.25	1.75		168
		4.00	2.00		0.208
		3.75	2.25		0.270
		3.50	2.50		0.330
		3.25	2.75		0.392
		3.00	3.00		0.463
		2.75	3.25		0.540
		2.50	3.50		0.620
		2.25	3.75		0.701
		2.00	4.00		0.793
		1.75	4.25		0.879
		1.50	4.50		0.987
		1.25	4.75		1.082
		1.00	5.00		1.183
		0.75	5.25		1.283
		0.50	5.50		1.388
		0.25	5.75		1.494
Nominal	8	7.75	0.321	00.0751	
Actual	8.071	7.50	0.571		0.0252
		7.25	0.821		0.0505
		7.00	1.071		0.083
		6.75	1.321		0.124
		6.50	1.571		0.173
		6.25	1.821		0.225
		6.00	2.071		0.290
		5.75	2.321		0.361
		5.50	2.571		0.434
		5.25	2.821		0.522
		5.00	3.071		0.610
		4.75	3.321		0.715
		4.50	3.571		0.810
		4.25	3.821		0.930
		4.00	4.071		1.03
		3.75	4.321		1.16
		3.50	4.571		1.27
		3.25	4.821		1.42
		3.00	5.071		1.55
		2.75	5.321		1.71
		2.50	5.571		1.85
		2.25	5.821		2.02
		2.00	6.071		2.17
		1.75	6.321		2.37
		1.50	6.571		2.52
		1.25	6.821		2.72
		1.00	7.071		2.90
		0.75	7.321		3.08
		0.50	7.571		3.30
		0.25	7.821		3.50
Nominal	10	9.75	0.27	0.0904	[illegible]
Actual	10.02	9.50	0.52		0.0264
		9.25	0.77		0.0553
		9.00	1.02		0.094
		8.75	1.27		0.140
		8.50	1.52		0.162
		8.25	1.77		0.216
		8.00	2.02	0.0904	0.339
		7.75	2.27		0.420
		7.50	2.52		0.512
		7.25	2.77		0.609
		7.00	3.02		0.722
		6.75	3.27		0.88
		6.50	3.52		0.96
		6.25	3.77		1.08
		6.00	4.02		1.22
		5.75	4.27		1.37
		5.50	4.52		1.54
		5.25	4.77		1.69
		5.00	5.02		1.87
		4.75	5.27		2.04
		4.50	5.52	0.0904	2.25
		4.25	5.77		2.43
		4.00	6.02		2.64
		3.75	6.27		2.88
		3.50	6.52		3.10
		3.25	6.77		3.32
		3.00	7.02		3.58
		2.75	7.27		3.79
		2.50	7.52		4.08
		2.25	7.77		4.32
		2.00	8.02		4.59
		1.75	8.27		4.87
		1.50	8.52		5.17
		1.25	8.77		5.41
		1.00	9.02		5.74
		0.75	9.27		6.04
		0.50	9.52		6.35
		0.25	9.77		6.68

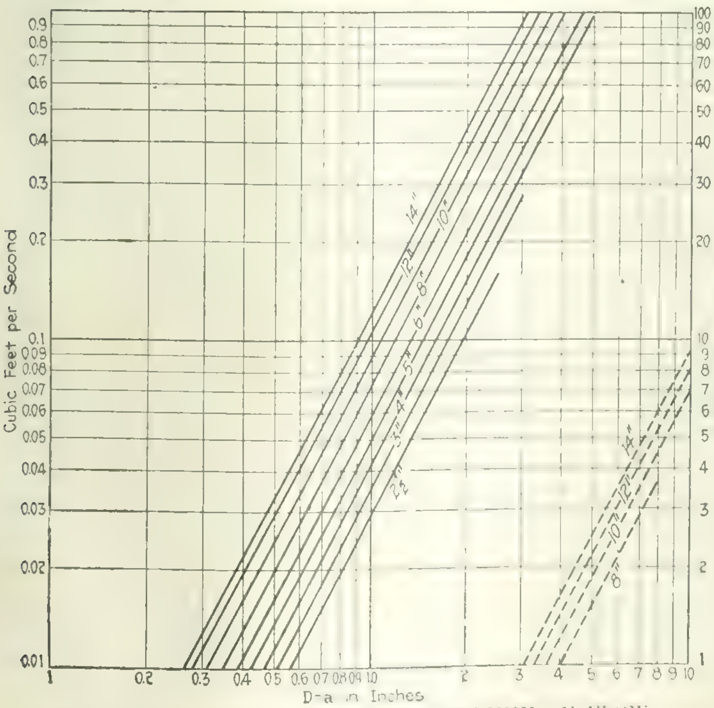


FIG. 2. LOGARITHMIC DIAGRAM FOR VOLUME OF FLOW

Based on $Q = K\,(D - a)^{[illegible]}$. The left-hand scale with the solid lines and right-hand with dotted.

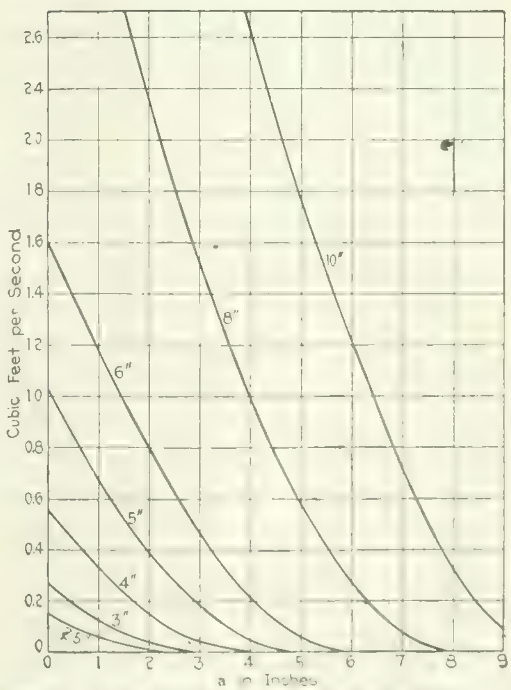


FIG. 3. DIAGRAM FOR VOLUME OF FLOW

Quantities for values of a instead of $D - a$ plotted on ordinary cross-section paper.

any convenient length. Its purpose is to allow the water to approach the discharge nipple with a very small velocity of approach and as little turbulent flow as possible. The tee is used not only to turn the direction of the water but also to allow free access of air into the discharge nipple. The discharge nipple must be level and horizontal and under no circumstances must it be permitted to run full of water, as the formula does not hold for this condition for obvious reasons.

After the water flowing through the apparatus has become steady the distance, a, may be measured with any ordinary rule. Substitution may then be made in the general formula and the quantity in second-feet will be given. The distance a should be measured as accurately as possible, but on most work the nearest $\frac{1}{32}$-in. will be sufficiently accurate.

This apparently has not simplified the problem very much because substitution in the formula $Q = K\ (D - a)^{1.88}$ involves not only a knowledge of the formula but also the ability to use logarithms, which necessitates either a slide rule or a table of logarithms. This will not help the man on the job. So, for his benefit Fig. 2 has been prepared. This shows D-a plotted as abscissae on logarithmic paper against Q, quantity in second-feet as ordinates. The method of use of these curves is obvious.

For those, however, who are not accustomed to the use of logarithmic paper Fig. 3 has been prepared. These curves give the relation between the distance a and the quantity Q, in second-feet. For those who do not like to use charts the accompanying table has been prepared.

Zoning Ordinance Adopted by St. Paul, Minn.

By George H. Herold
City Plan Engineer, St. Paul, Minn.

The zoning ordinance adopted by the city council of St. Paul, Minn., July 7, provides for six use districts and four height districts, with area requirements made to conform with the use districts and all shown on one zoning map. The ordinance was prepared by the City Planning Board, with E. H. Bennett and W. E. Parsons, Chicago, as consultants and the writer as city planning engineer.

There are three residence districts—A, B, and C—a commercial, a light industry and a heavy industry district. The material difference between A and B residence districts is that the area required per family is greater in the A than in the B district. Apartment houses are not permitted in either A or B residence districts, but are permitted in the C district. There are special provisions in the ordinance relating to (1) the grouping of institutional buildings in order to preserve the residential character in the A and B residence districts; (2) the construction of public garages, which are not permitted in the A, B and C districts; (3) the establishment of setback lines in the residential districts and (4) the requiring of stores to take the same setback as the residence where they are permitted at certain corners in the residential areas.

There are four height districts: 40, 75, 100, and 150 ft. The original ordinance called for a height limit of 120 ft. in the downtown business district but this was amended to 150 ft. by the council. There are provisions for increasing the height in each district for each foot the building is set back, as follows: In the 40-ft. district, 1 ft.; 75-ft. district, 2½ ft.; 100-ft. district, 3⅓ ft.; 150-ft. district, 4 ft.

The zoning ordinance was authorized by the State Legislature, Chap. 217, Session Laws of 1921. It provides for zoning under the police power. A Board of Zoning is established, consisting of five members of the City Planning Board and the city architect. Provisions are made for amending the ordinance upon petition of 50 per cent of the owners of the frontage after review by the Board of Zoning and approval by a two-thirds majority of the City Council.

The field work on the zoning ordinance began in May, 1921, and the ordinance was presented to the City Council on April 26. A complete field survey was made to determine the use of every piece of property in the city, and these uses were noted by symbols on a new map of the city prepared by the City Planning Board on the scale of 500 ft. to 1 in. Setbacks, height of building, etc., were also determined by the survey. Upon this was built up the zoning map.

No public hearings were held on the ordinance before its introduction in the council, but considerable publicity work was done by presenting the general principles of zoning to all clubs and civic organizations and through the newspapers, and in some cases exhibiting the tentative zone plan. All newspapers of the city backed the zoning ordinance and the City Planning Board.

The ordinance required four readings before the Council, and on these dates, which were published, a few objectors appeared. It was the viewpoint of the City Planning Board and of the Council that public hearings would develop individual opposition only, and that as a zoning ordinance was for the good of the greater number and being done under the police power that individual objectors should not influence the plan. Ample provision, however, was made in the ordinance to permit those who felt aggrieved to present evidence and petitions to have the ordinance amended after its passage.

At the third reading (May 23), the St. Paul Real Estate Board asked for six months' time to study the ordinance, but only 30 days were granted. On June 30, the Real Estate Board recommended that all car lines be zoned for business and suggested some small changes in boundary lines and an increase in the area in which apartments might be built and business be admitted. After considerable argument over throwing residential areas along car lines into a business district, this recommendation was incorporated in the ordinance the day it was submitted.

St. Paul has a population of 240,000 and an area of 55.4 sq. miles. It has no tenement districts. The most congested area, one-quarter square mile in the old residential district to the west of the state capitol building, has a population of only 40,000 per square mile. The existing area for each purpose and the corresponding area as zoned is shown in the following table:

	Present Areas Square Miles	Zoned Areas Square Miles
Residential	17.10	31.05
[illegible]	[illegible]	1.78
Industrial and railroad land	3.80	12.10
Miscellaneous, parks, cemeteries, rivers, lakes, etc.	6.42	6.62
Vacant	27.08	Unassigned 3.85
	55.40	55.40

Mixer Performance on Illinois Road Work in 1921

Few Mixers Work Over One Hundred Days—Central Proportioning Plants Predominate—Double Shifts Prove Efficient

ONLY five contractors laid pavement on more than 100 days in building concrete road in Illinois in 1921. The maximum number of days on which any mixer worked was 127. A total of 102 mixers were operated and every day was counted on which the mixer worked any considerable portion of the time. Of the 102 mixers, 20 were operated with central proportioning plants and industrial railway delivery; 34 were operated with central proportioning and truck delivery; 28 were operated with material strung along the subgrade; 8 were operated from large storage piles at intervals along the road, and 12 were central mixing plants, with wet-batch delivery by trucks. Altogether 111 contractors had paving contracts during the year.

ROAD WORK AT NIGHT IN ILLINOIS

An output comparison of the five general types of plant gives the figures in Table I.

TABLE I.

Type of Plant	Number Outfits	Days Worked	Total Footage	Av. Ft. Per Day
Industrial Ry., central proportioning	42	1,478	623,403	421.8
Truck, central proportioning	51	1,731	581,345	335.9
Truck, central mixing	18	623	237,059	380.5
Truck, large storage piles	10	350	128,306	366.6
Stock piles along subgrade	20	521	128,662	246.9

Comparison only in a very broad way is safe. As might be expected the wheelbarrow gangs charging from stock piles strung along the subgrade show the smallest output. The output of the industrial railway plants averages higher than that obtained by any of the methods employing truck haulage. The significant part is that the average daily output per outfit for all methods was 361 ft. per day worked, of 7-8-7-in. pavement 18 ft. wide.

A record of the outputs of 68 contractors based on the sizes of mixers used is given in Table II. Obviously some of the records in this table are abnormal because of the short runs or an output for some reason very much smaller than there is a right to expect under ordinary conditions. The number of these abnormal records, however, is not large enough seriously to affect the comparative daily averages which are set forth in Table II.

TABLE II

Size of Batch	Total Days	Total Footage	Feet per Day
Two-bag	176	28,757	163
Three-bag	265	69,224	261
Four-bag	3,559	1,233,766	347
Six-bag	256	95,450	372
Eight-bag	428	191,198	446

In examining all the figures in and derived from Table III the fact must be kept in mind that the mixers include those at central mixing plants and others at portable plants as well as mobile paving mixers. Some large daily and weekly yardages were recorded. On June 16, W. F. Smith, working a single shift laid 1,434 ft., or 2,549 sq.yd. and in the week Aug. 15-20, Jansen & Schaefer, working double shift laid 5,985 ft. or 10,650 sq.yd.

Double shifts were worked by a number of contractors and about 0.8 times the footage of the day shift was secured. As fewer men were employed on the

TABLE III—AVERAGE DAILY OUTPUT OF DIFFERENT SIZE MIXERS FOR 1921

Contractor	Days	Feet Completed	Average Feet Per Day
Two-Bag Batch			
Cole & Fauber	34	9,237	271
Miller & Comstock	32	3,178	100
A. C. Loomis	2	265	132
F. T. Williams	56	10,336	184
E. C. Trowbridge	14	1,063	75
Day Labor	38	4,679	123
Three-Bag Batch			
Albert Fahrig	34	6,936	204
R. H. Rhoades	25	6,960	278
Str. Cotton Co.	79	18,212	230
Chicago Heights Coal Co.	21	7,779	370
J. J. Dunnegan	29	9,800	337
Keokuk Q. & Const. Co.	4	323	80
Stocker Gravel Co.	54	15,137	280
Powell & Gauen	19	4,067	214
Four-Bag Batch			
R. F. Conway	345	147,135	411
Jansen & Schaefer	149	82,032	550
Cameron, Joyce & Co.	173	52,241	303
Arnold & Co.	60	20,117	334
J. W. Etchison	100	37,251	373
Jos. Kesl & Sons	38	15,067	396
Miller & Comstock	20	8,501	425
Fred C. Nelson	50	33,257	554
Federal Paving Co.	181	56,545	312
W. A. Jaicks	181	57,589	318
Vermilion Co. Board	140	50,576	361
C. W. Clark	57	15,658	274
Barnes & Verhey	53	18,228	343
R. P. Devine	15	8,248	549
C. L. Porter	23	7,427	322
Hans. Jensen	22	3,723	169
Ill. Hydraulic Co	45	6,158	136
B. F. Walters	34	6,100	179
St. Clair County	76	15,665	206
J. A. Shockley	19	7,603	400
Eclipse Const. Co	61	16,579	271
W. A. Black	17	5,100	300
S. A. Cunningham	27	3,226	119
Henry Horst	15	4,921	328
Jas. Black Mas.	252	106,314	421
H. H. Hall Const. Co.	131	46,801	357
C. E. Carson	63	21,280	337
C. J. Moritz	82	36,652	446
A. J. Parrish	168	87,638	521
Force Account	125	41,278	330
J. J. Dunnegan	108	49,642	459
W. D. Lonergan	31	133,325	429
Warner Const. Co	30	6,843	228
Trompeter & Sons	75	18,903	252
Rockford Const. Co.	26	7,627	293
Milburn Bros.	91	36,959	406
Farmer & Laing	11	1,742	158
H. Pfizenmayer	20	4,400	220
Hug. Lumber & Const. Co.	119	51,152	429
Shanks & Gannon	16	5,898	368
C. E. Giertz & Sons	49	17,137	349
Van. D. & Baumberger	6	1,119	186
Hedges Const. Co.	30	8,698	289
N. B. Ridge	32	8,534	266
John Darrow	24	5,280	220
M. Hayes & Sons	63	28,700	455
Macon Co. Board	58	27,496	470
Paschen Bros.	30	11,401	380
Six-Bag Batch			
Jas. Black	78	35,775	458
McCall Const. Co.	88	26,817	304
Force Account	90	32,858	365
Eight-Bag Batch			
W. F. Smith	76	38,816	510
I. O. Heyworth	184	80,709	438
Powers & Thompson	168	71,673	426

night shift it was figured as nearly 100 per cent efficient compared with the day shift. On some operations Delco lighting outfits were used and on others carbide lights. A night photograph taken by F. L. Dunavan and reproduced here shows a carbide-light operation by R. F. Conway Co., Chicago. This contractor used a No. 21 mixer charged with proportioned batches delivered in light trucks. The fine grading and the form setting for the night work was done during the day shift, as satisfactory work could not easily be secured by artificial light. Carbide flood lights were used, placed about 20 ft. apart and carried ahead as the work progressed.

On this operation the surface secured at night is stated to be just as perfect as that secured on the day shift. In fact variations in surface were emphasized by the artificial light and were more easily discerned and corrected. The greatest difficulty was with stone pockets as the water filled these and gave the appearance of a perfect surface. Less care, however, was required at night to keep the surface from drying too rapidly.

New Studies of Stress Distribution in Irregular Members

By George Paaswell
Construction Engineer, New York City

SOME illuminating data on the complex stress distributions occurring in irregular-shaped members are contained in a report of a committee of the British Association presented at the annual meeting of the association last September and just published. Engineers already have available a vast fund of information on the elementary stress distributions in structural units of simple form, but little that is effective has been done on the more complex distributions of stresses in odd-shaped members. However, research has received a powerful impetus through the introduction of the methods of photo-elasticity: study of the polarization of light transmitted through a stressed transparent member. Celluloid behaves very much like steel under stress, and is transparent, making an ideal material for the test. Some of the work reported by the committee deals with tests of this kind. Prof. Coker, chairman of the committee, has been working in this field for some years, and earlier results of his investigations were published in the *General Electric Review*, Vol. XXIII, p. 870.

Engineers have long recognized that cracks, notches, holes, and the like in a member produce local weakness exceeding the reduction of section. Of the nine papers included in the committee report, three treat of the observed effect of notches and holes.

Effect of Notches and Holes—At a discontinuity, say a notch or a re-entrant angle in a simple tension member, stress concentrates at an alarming rate. If the material is ductile, as soft steel, the concentrations are ironed out by the time failure is reached, so that rupture generally takes place at the weakest section of the member in accordance with ordinary calculation. But in brittle material the stress concentrations persist until failure occurs at the discontinuity. In a short specimen the complex stress distribution extends throughout the entire member and it may happen that no cross-section of a tension member exhibits pure tension. Under these conditions it appears to be possible that great irregularity of stress distribution may exist in a composite structural section, due to the method of assembling the elements or due to variations in the modulus of elasticity. Notch effects are particularly marked with relation to impact, when the stress concentration depends upon the sharpness of the fillet in the notch; stresses as high as six times the mean have been noticed when the fillet radius was very small. It follows that low working values must be used in designing parts with such notches subjected to impact in service.

Bearing on the justifiability of comparing celluloid and steel, one of the papers deals with the theory of stresses in a flat member (in a plane). If one or more holes exist in such a plate, the stress formulas contain the elastic constants, while in a plate without holes the elastic constants disappear from the formulas. However, it is now shown by the committee report that the elastic constants play only a minor part in the formulas applicable to plates with holes, so that for practical purposes the constants may be neglected. Thus, the difference of elastic constants in different materials does not affect the results, and a study of stresses in a celluloid model is therefore applicable to materials other than steel.

Effect of Surface Flaws—In the fourth paper it is pointed out that while theory indicates high stress concentrations due to minute surface imperfections (such as small scratches) actual tests do not show them. Apparently the surface imperfection must bear a comparable ratio to the overall dimension of the member; minute flaws do not produce structural weakness, while large flaws produce the weakness that theory indicates. It is observed by the committee that minute surface flaws may lack apparent effect because the material already has unobserved flaws which reduce the ideal strength. Experiments were made on a glass model that normally gave a tensile strength of 25,000 lb. per square inch, and it was found that by treating the material so as to remove all possible flaws a strength as high as 900,000 lb. per square inch could be developed. Taking a "perfect" specimen so produced, and giving it a light finger tap, thereby producing a flaw so small as to be unobservable even under 250 magnification, the effective strength was reduced to one-eighth that of the "perfect" specimen.

Distribution of Stress in a Flanged Pipe—One of the papers deals with stresses in a flanged pipe, and by applications of differential equations a practical solution of this difficult problem is effected. It may be of interest to follow the solution. If the mean loading on a small piece of pipe is taken as w, then the flexure formula gives

$$EI \frac{d^4z}{dx^4} \quad w$$

where z is the deflection or radial displacement. The mean load w is the resultant of the internal pressure on the pipe and the component of the circumferential stress q. If E is the modulus of elasticity, m Poisson's ratio, f the longitudinal stress in the shell, and R the radius of the pipe, then

$$q \quad Ez \; R + f \; m$$

which after simple reduction gives the differential

equation

$$\frac{d^4z}{dx^4} + 4nz = b$$

where n and b are constants of the pipe. The effect of the flange is then taken into account, and the resulting expression for displacement is shown to agree very closely with test results. It should be possible to apply the theory as outlined to the study of flanged penstocks, tunnel sections, and the like.

Repeated Bending and Torsion—Experiments on the effect of cyclic or repeated simultaneous bending and torsion are reported. It is interesting to note that when a run of bending cycles was made alone, and then cyclic torsion was added, the maximum strains *decreased;* vice versa, when the torsion cycles were run first and the bending was then added, the deformation also dropped. While the experimenters offer no explanation, it would seem that hysteresis, or lagging behind of the deformation, might account for most of this resulting drop.

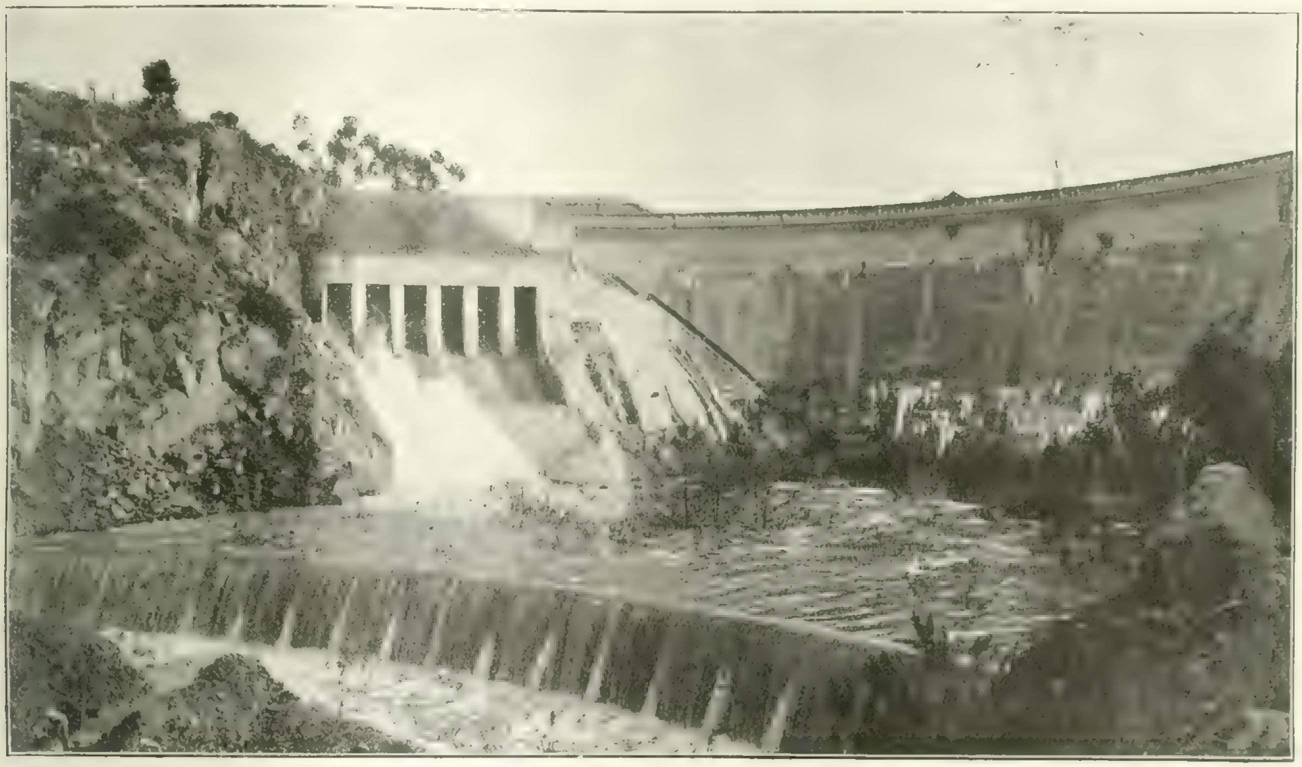
Papers on high-speed discs (turbine discs), stability of rotating shafts with end twist and thrust, and stresses in eccentrically bored pipe, are also included in the report. These investigations contain painstaking mathematical analysis, which, it is gratifying to note, results in workable formulas.

Admittedly, the design of details is the weak element of present-day practice in stress analysis. Such analysis as the present report contains offers hope that the design of details may be improved. Evidently a promising liaison exists between scientific investigators and the engineering profession in Great Britain; one hopes that such co-operation may be encouraged in this country.

Sweetwater Dam Siphon Spillways Function for First Time

One Pair of Tubes Operates Independently, Though Two Adjoining Pairs Are Only 0.1 and 0.2 Ft. Higher, Respectively

SIX SIPHON spillway tubes built in the Sweetwater Dam near San Diego, Cal., at the time of its reconstruction and extension in 1916 had not been required to function up to the first of this year. On Jan. 4, 1922, neglect on the part of the keeper to remove sufficient stop planks from the side-lip spillway on the opposite end of the dam resulted in raising the reservoir level to El. 89.86, whereupon the lowest pair of siphon tubes began to function. This afforded an opportunity to observe the operation of the siphons and the sensitiveness of the automatic control is reported to be gratifying. The siphon spillways were described in *Engineering News-Record,* May 15, 1919, p. 948.



TWO SIPHON TUBES IN OPERATION ON SWEETWATER DAM

The pair discharging are operating at about one-tenth estimated capacity while the adjoining tubes, only 0.1 ft. and 0.2 ft. higher, respectively, remain inactive.

Each of the six tubes has a 6 x 12-ft. rectangular throat section and an estimated maximum discharge capacity of 2,500 to 3,000 sec.-ft. The tubes were built at three different levels for the dual purpose of (1) avoiding the shock incidental to all the tubes starting to function simultaneously and (2) gaining the advantage, if possible, of automatically regulating and limiting the discharge through the siphons in accordance with the rate of inflow into the reservoir. The two tubes nearest the north bank were built with throat levels about 0.3 ft. below reservoir El. 90. The middle pair about 0.2 ft. below and the third pair about 0.1 ft. below the same datum, thus giving a difference of 0.1 ft. in level between successive pairs of the tubes.

The water level in the reservoir early in January reached the level of the lip spillway on the opposite end of the dam from the siphon spillways, and an additional 2 ft. of storage was secured by stop planks placed between piers. When the reservoir level reached the El. 89.86 the lowest pair of siphon spillway tubes began to function. Observation from the upstream side showed that the functioning continued for about 5 to 6 sec. when the suction in both tubes broke. After taking air for about the same interval the siphons again functioned for a like period, this cycle continuing until the reservoir level had lowered to El. 89.62. The same two siphon tubes have functioned twice since Jan. 4, each time the discharge beginning when the reservoir level reached El. 89.86.

Estimates of the flow based on observation while the two tubes were functioning placed the total discharge at 500 to 600 sec.-ft. or about 10 per cent of the estimated total capacity of the two tubes. The discharge from the outlet of the tubes appeared to be about constant in quantity and the frequent make and break of the suction caused an admixture of air and water to the extent that the discharge was described as "an emulsion of air and water."

H. N. Savage, hydraulic engineer for the city of San Diego, under whose direction the reconstruction and extension of the Sweetwater Dam was designed and carried out, supplied the information on which the foregoing is based. In commenting on the operation of the siphons, Mr. Savage said: "Whenever the water in the reservoir attained sufficient height to start the siphonic operation of the tubes, the rate of operation was automatically limited to just the discharge required to prevent the water in the reservoir from attaining a higher level and continued until the level had reduced sufficiently to put the siphons out of commission. On account of the longitudinal cross-section of the siphon tubes and the entrained air it is not surprising that the discharge did not appear to vary materially from a constant quantity, notwithstanding the fact that the intake suction was obviously and prominently intermittent."

St. Gothard Railway Electrically Operated

The St. Gothard Ry. from Lucerne to Chiasso on the Swiss-Italian frontier is now completely electrified, both passenger and freight trains being handled by electric traction. This line is 140 miles long and was opened to traffic forty years ago, since which time steam locomotives have been used. Electrification was begun in 1913 and probably would have been finished by 1916 had it not been for the war. The 62-mile continuation of this line from Lucerne to Basle will be ready for electric traction in 1924 and another line from Lucerne via Zug to Zürich, a distance of 35½ miles, should be electrified by the beginning of next year. The 15,000-volt current generated by three power stations is transformed to 60,000 volts for transmission to substations, of which there are five between Lucerne and Chiasso. Apart from the saving in cost of operation, due to the electrification, the journey by express train between Lucerne and Chiasso has been reduced from five hours to four. It is estimated that the cost of the St. Gothard electrification will amount to about 1,000,000 francs per kilometer, or about what the line originally cost to build.

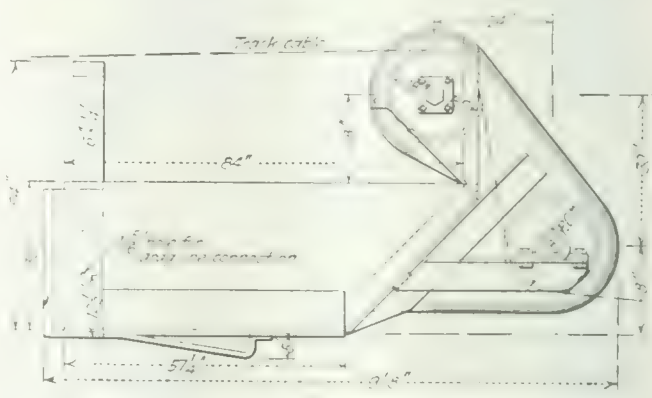
Dragline Excavator Handles Earth On Los Angeles Stadium

Bucket With Two Sheaves Operated on Gravity-Return Plan from 124-Ft. Tower That Moves Along Excavation

By Leroy A. Palmer
San Francisco, Cal.

In the construction of a stadium at Los Angeles, which is being built entirely of earthwork by the cut-and-fill process, all the material is being handled by a dragline excavator operated from a movable tower. The excavation is to have a maximum depth of 31 ft. and the embankment a height of 32 ft., the area of the playing field will be 750 x 344 ft. Slopes will be two to one. The material to be handled totals between 250,000 and 300,000 cu.yd. and is a medium-grained sand almost wholly free from clay and easily handled by the dragline without previous loosening.

The tower has a base area of 30 x 30 ft. and a height of 124 ft. made up of twelve bents. It is built entirely of wood, the four corner-posts consisting of 12 x 12-in. timbers with only simple cross-bracing in the plane of each pair of posts. The gross weight with machinery is estimated at 60 to 75 tons. It is arranged to be moved lengthwise of the stadium site on trains of 12-in. wooden rollers, 4 ft. long laid on a runway of 4 x 12-in. plank resting on the earth. Power for moving is supplied by a 30-hp. motor belted to a double drum hoist operating cables to deadmen at the ends of the track.



SIDE ELEVATION OF DRAGLINE BUCKET

The dragline bucket hangs and operates on a 1-in. track-cable and is drawn toward the tower by a 1¼-in. dragline. As the bucket will return by gravity to any part of the site, no return line is used. The use of double sheaves on the bucket greatly facilitates control from the tower. As shown in the sketch herewith the sheaves are housed at the sides to form guides for the track-cable. The forward sheave is so placed as to prevent the cable from rubbing on the bucket at any time. In loading, the track-cable is tightened slightly to point the nose downward and give the bucket a good bite into the earth as it is pulled forward by the drag cable. With the load well started the brake is released from the track-cable drum, allowing the latter to slack of its own weight as the bucket is drawn toward the tower. On arrival at the desired dumping point the drag-cable is slacked away and the track-cable is tightened. With the tightening of the latter the bucket is pulled clear of the ground and dumped. The brake is

BUCKET IN PROCESS OF LOADING
Tightening the track-cable, which is the only line shown, tilts the nose of the bucket downward, insuring capacity load.

then released from the drag-cable and the bucket runs back along the track-cable by gravity. On reaching the point where the next load is to be taken the track-cable is slacked away so the bucket drops to the ground, the double sheave with its side housing lining the bucket automatically with the track-cable.

The track-cable is operated over a sheave at the top of the tower, the dragline can be operated over either of two sheaves set at 30 and 65 ft. above the ground level, respectively. The control house is in the third bent whence the operator commands a view of the entire work. The power equipment, housed in the base of the tower, consists of a 30 x 60-in. drum carrying the dragline and an 18 x 30-in. drum carrying the track-cable. These drums are so mounted with respect to a 300-hp. motor that the latter can be clutched to either or to both as may be desired.

The far end of the track-line is attached to a dead-man cable stretched the full length of the pit on the opposite side from the tower. It is 750 ft. long with a diameter of 1½ in. At either end this cable is anchored to a 14 x 14-in. timber 20 ft. long, buried 8 ft. in the ground. The track-cable runs over the topmost sheave of the tower which is 460 ft. from the

BUCKET DUMPING AS TRACK-LINE IS RAISED
Track and draglines are the only two cables used on this bucket for which speed, economy and accurate control are claimed.

dead-man cable, to a grip which can be moved along the latter and clamped to it at any desired position. The dragline is carried from its drum to the bucket over one of the two lower sheaves, as may be necessary according to the location and height of the point of delivery. In operation the tower is shifted along the side of the excavation as necessary and the far end of the track-cable is moved along the dead man to correspond.

The bucket shown herewith in side elevation is 5 ft. wide and 2½ ft. deep with an average length of 5 ft. This gives a capacity of 2⅓ cu.yd. but in actual practice in this material it carries about 50 per cent more than normal capacity, making a load that weighs about 4½ tons. The dot and dash line in the drawing shows the reeve of the cable through the sheaves.

The regular crew of the excavator consists of six men; a lever man, mate, electrician and three laborers. All of these are employed about the tower, none being required in the pit.

The maximum length traversed by the bucket on this job is somewhat less than 460 ft., the distance between tower and dead-man line. The average round trip of the bucket can be made in one minute or less, but averaged over the day's work and for all lengths of haul the trips are found to average about 1⅔ min. each. With the size of bucket used on this job, this gives, in the 288 round trips of an 8-hour day, about 1,000 cu.yd.

The bucket was designed by George E. Fields who is in charge of excavation work on the stadium for the Community Development Association, which is being carried out by the United Dredging Co. of Los Angeles

London to Extend Underground Railways

The Engineer, London, announces the beginning of reconstruction and extension of the London underground railways. The work is divided into three parts: Reconstruction of the City and South London Ry., which was London's pioneer tube; connection between the City and South London Ry. and the Charing Cross, Euston and Hampstead Ry., extending from Euston to Mornington Crescent; and extension of the Hampstead Ry. from Golders Green to Edgware. The first is undertaken principally to enlarge the diameter of the tunnel to permit interchange of traffic with the Hampstead line. It is planned also to lengthen the platforms and rebuild many stations, installing escalators at some of them. During the time portions of the tube are shut down for reconstruction, temporary service will be provided by motor buses. This section to be reconstructed is about 7¼ miles long. The connecting line will be about 1.1 miles in length and will provide at Camden Town for connection with both the line to Golders Green and that to Highgate. For this junction a time table is proposed for a one-minute service in each direction, which will mean 120 trains per hour. The track and signal layout at this point is receiving special study to eliminate grade crossings. It is hoped that the enlargement of the City and South London tunnel and the construction of this connection will be completed in time to open Oct. 1, 1923. The extension from Golders Green to Hendon is 1.63 miles in length and includes two new stations, a viaduct 30 ft. high over the River Brent, retaining walls, and embankments. It is hoped that this work will be completed in fifteen months. From Hendon to Edgware is 3.05 miles. It is expected this line will be complete by 1924.

Protecting Tientsin, China, From Flood Damage

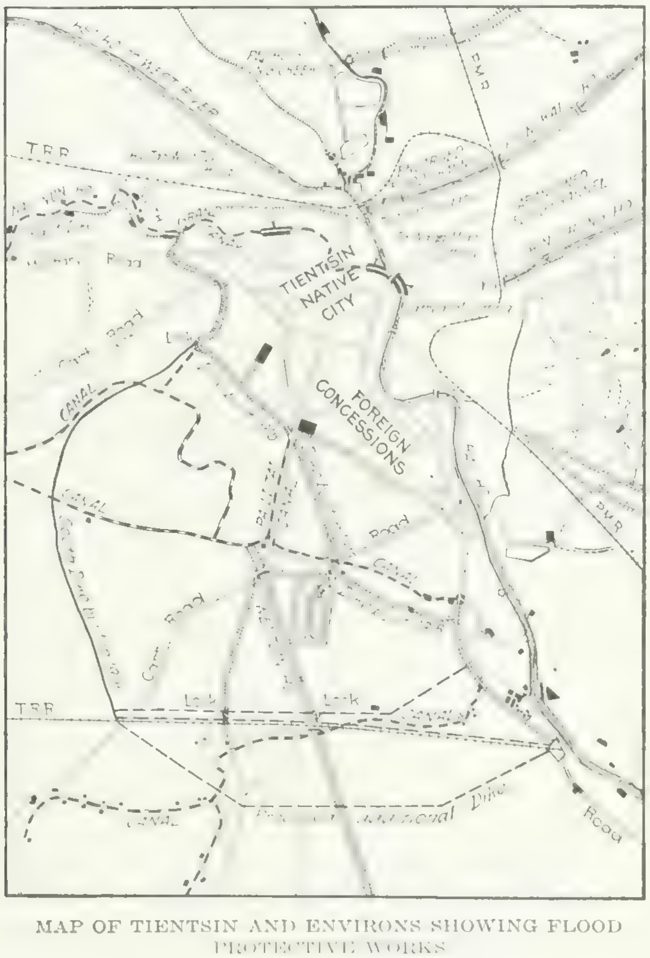
Dikes and Canals, With Regulating Works, Recently Built Indicate Way Modern Engineering Is Developing in China

By R. D. Goodrich

Engineer in Charge of Works, Commission for the Improvement of the River System of Chihli, Tientsin, China.

Since the great flood of 1917 in the Province of Chihli, North China, considerable work has been done for the protection of the port of Tientsin from a recurrence of such a disaster as was experienced at that time.

These protective measures have been carried out mainly under the direction of two organizations. The first is the police department of the district of which Tientsin is the seat of local government. The head of this department reports directly to the Civil Governor of the Province. The second organization is the Commission for the Improvement of the River System of Chihli, better known locally as the Chihli River Commission. This commission was formed soon after the 1917 flood, by agreement between the Chinese Government and the diplomatic corps of the foreign countries having representatives in China, for the purpose of planning and executing works for flood protection and river regulation in the province. The Chihli River Commission has co-operated with the civil authorities of the province in several of the works which have been carried out for the immediate protection of Tientsin and has also acted in conjunction with a third organization, the Hai Ho Conservancy. This last named organization is an older one, also formed by diplomatic agreement, but for the improvement and regulation of the Hai Ho, which is the name given to the river connecting Tientsin with the Gulf of Chihli and forming the outlet for the five rivers which unite at this city.



MAP OF TIENTSIN AND ENVIRONS SHOWING FLOOD PROTECTIVE WORKS

The principal flood relief and protection works which have been carried out by these organizations consist of (1) the construction of the South Dike, west and south of the foreign concessions, (2) straightening the Hai Ho and the Nan Yun Ho (South Grand Canal) by making the Cathedral Cutting on the former and two other cuts on the latter, (3) strengthening the main dike for nearly thirty miles along the east side of the Nan Yun Ho, (4) enlarging the Hsin Kai Ho Flood Channel, which was largely silted up through neglect and lack of proper controlling works, (5) replacing the old weir at the head of this flood channel with regulating gates having a lower sill elevation and much greater discharge capacity, (6) the construction of regulating gates at the head of the Ma-chang Canal which is a flood relief channel from the Nan Yun Ho at a point about 70 km. (43 miles) south of Tientsin, (7) the construction of a branch outlet from the Ma-chang Canal, with regulating gates at the head of the branch. The locations of all the improvements near Tientsin are shown on the sketch map.

That part of the south dike built in 1918 was constructed by the police commissioner on the site of the old "mud wall" (which was removed by order of the foreign powers after the Boxer trouble) to a point near the crossing of the Pa Li Tai Canal. For the greater part of the remaining distance, it follows the line of an old highway to the bank of an old loop of the Hai Ho, (Ho is Chinese for River, used mostly in the northern provinces). Most of the material for this dike was taken from privately owned land by police power in view of the emergency, and without waiting for condemnation proceedings or purchase negotiations. As a consequence the height and cross section of the dike is inadequate for permanent protection. This dike cost nearly $90,000 of which about $10,000 was for the removal and reinterment of bodies encountered in the borrow pits. The dike is built through land which has been used for graveyards for perhaps four or five hundred years. Very few of the graves were marked or claimed by anyone, but in one or two places ancestral burying grounds were owned by rich families of such influence as to require that the dike should be built around their properties.

On account of the conditions under which this dike was built an agreement was finally reached whereby a syndicate of interested property owners undertook to construct a suitable dike from a point near the beginning of the original dike to a railway embankment south of the city, while the Commission was to build three so called "locks" of the stop-log type at points where canals crossed the line of the dike and railway embankment. By this plan which was carried out in 1920, together with the purchase of some private lands to secure right-of-way for a part of the original dike, an adequate permanent dike has been built which protects all the foreign and native city concessions which lie south and west of the Hai Ho, from floods like that of 1917. The additional cost of these "locks," the right-of-way for the original dike, together with some repair

CATHEDRAL CUTTING ON THE HAI HO, SHOWING CONCRETE-BLOCK BANK PROTECTION

work and the closing of the old arm of the Grand Canal at the Hsi Tao Wan Tze Cut, has brought the total cost to the Commission for these works to $124,500. All costs are given in local currency or Mex. To obtain an approximate comparative figure in U. S. currency, divide by two. The rate of exchange has fluctuated very widely during the progress of this work. At the present writing this rate is from $205 to $210 Mex. for $100 gold. In addition to the foregoing, the South Dike Syndicate expended about $60,000 in right-of-way and earthwork for about nine kilometers of dike.

The channel improvements above the foreign concessions were designed by the engineers of the Hai Ho Conservancy, partly to increase the capacity of the river during flood and partly to improve tidal flow during ordinary stages. The work was carried out by a special syndicate co-operating with the police and public works department under authority of the Civil Governor. The Chihli River Commission contributed $70,000 for the two cuts made at the junction of the Nan Yun Ho and the Hai Ho. The syndicate was also partly compensated by being granted title to the abandoned portion of the Nan Yun Ho, which has been largely filled in and is very valuable property in the very heart of the Chinese City. The sale of spoil for filling adjacent low property was another source of revenue.

The Cathedral Cut was first attempted by Li Hung Chang when viceroy of the province, but the opposition of the property owners along the proposed cut was so strong that the plan was abandoned. The right-of-way

BUILDING DIKES FOR NEW OUTLET CHANNEL FOR THE MA-CHANG CANAL

was finally secured and the work done under the supervision of General Yang I Teh, Commissioner of Police and Public Works, doubtless with the aid of the "big stick." The Cathedral Cut involved about 60,000 fongs (257,000 cu.yd.) of excavation and the protection of the side slopes above ordinary low water with precast concrete blocks on a fill of mixed earth and lime (commonly used by Chinese builders for subfoundations) with a system of anchorage to concrete beams back of the slopes. The slope protection for this channel improvement proved to be very expensive so that hard burned brick was substituted for the concrete blocks for the bank protection of the adjacent cut forming the new mouth of the Nan Yun Ho. The extra anchorage was also omitted and the design greatly improved by these modifications. Unfortunately the details of the cost of these improvements are not available.

The Hsi Tao Wan Tze Cut was carried out entirely by the provincial authorities and details of the construction and results are not available. It undoubtedly increases the capacity of the Grand Canal during flood as there are no locks on this portion which is really a river

REGULATING WORKS FOR THE NEW OUTLET CHANNEL FROM THE MA-CHANG CANAL

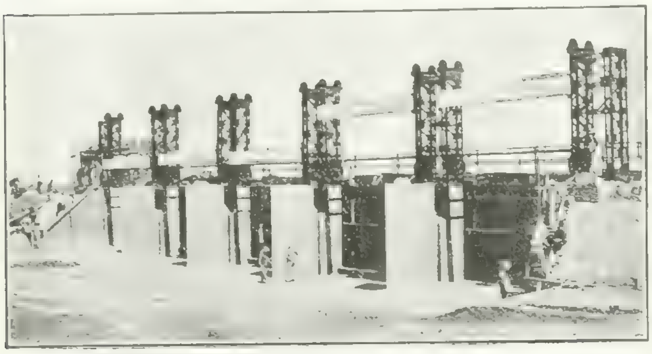
whose course was altered through northern Shantung and eastern Chihli so as to provide for the transportation of tribute rice to Peking.

The following general dimensions of these cuts, taken from reports of the Hai Ho Conservancy Commission, give some idea of the amount of work involved. The Cathedral Cut is 260 ft. wide at ordinary high water level and 145 ft. wide on the bottom with a maximum depth of 21 ft. at O.H.W. The length is about 800 ft. The Ta Wang Miao Cut is 100 ft. wide at O.H.W., 76 ft. wide on the bottom, 6 ft. deep and about 800 ft. long. The Hsi Tao Wan Tze Cut is of the same general section as the Ta Wang Miao and about 1,400 ft. in length.

The strengthening of the east dike of the Nan Yun Ho was one of the most important and valuable protective measures carried out and this was also initiated and carried out entirely by the provincial authorities. The immediate cause of the flood in Tientsin was the series of some sixteen breaches in a distance of about 20 km. (12 miles) from the city. While the former dike was lower and of smaller section than the present one, it could have been made effective but for the natives of the flooded villages on the west side of the canal. In spite of police patrols and the efforts of the villagers east of the canal to save their homes and property from the threatened inundations those on the west side cut the dikes on both sides of the canal to afford additional outlets so as to stop the continued rise of the water com-

ing across the great plain from the west. It is the probable results of the instinct for self preservation which make necessary the additional dikes immediately around the city of Tientsin.

The enlargement of the Hsin Kai Ho involved the removal of about 288,000 fong (1,230,000 cu.yd.) of material from the bed of the old channel about eight miles in length. Below this point additional dikes were built or old dikes raised amounting to nearly 312,300 fong (1,340,000 cu.yd.). The excavation was in two parts, the upper part provided a flood channel at least 100 ft. wide. The second part, or low-water channel, was 8 ft. deeper and 25 ft. wide on the bottom and was located on the center line of the wide channel. The enlarged channel has a capacity in flood of 7,000 sec.-ft. This will provide very material relief so long as unusually high floods do not occur at the same time in



REGULATING WORKS, HSIN KAI HO FLOOD CHANNEL

more than two of the four rivers which unite above this defluent channel. In order to make this channel more effective and provide adequate control, the central portion of the old stone weir was removed and in its place fourteen 10 x 10-ft. sluice gates were erected between 4 x 16-ft. masonry piers. The sills of the gates were placed 10 ft. below the crest of the old weir bringing the tops of the gates level with the old crest. About 30 ft. of the old weir was left at each end to avoid reconstruction of the abutments. The gates are operated in turn by two hand operated hoists carried on a timber trestle 14 ft. high, and can be held open by hooks and chains at the ends of the gates. This structure was designed and built for the Chihli River Commission and the re-excavation of the old channel supervised by the engineering department of the Hai Ho Conservancy.

The total cost of earthwork for improving the Hsin Kai Ho channel was about $160,000 while the reconstruction of the head works cost over $146,000. This work was all completed in 1919 before the flood season. Since this outlet channel is also used to a large extent for transportation purposes, a navigation lock suitable for river craft was built at the head works by the provincial authorities to ensure the usefulness of the canal at all stages of the river.

The native method of constructing sluice gates to control the stages of water in a canal by using stop-logs is quite satisfactory on account of the low first cost, if the openings are to be closed at infrequent intervals as once in a year or once in several years. When more or less continuous regulation is required as at the Hsin Kai Ho and Ma-chang Flood channels more modern types of regulation works are very necessary. At the head of the Ma-chang Canal the old stop-logs were replaced in 1918 by five 14 x 20-ft. gates similar in design, construction and operation to those above described for the Hsin Kai Ho Regulating Works. However, the deterioration of this channel had been so great, especially along the lower half of its course where the encroachments were greatest, that the capacity at the outlet was not more than half that of the upper section. Whenever extremely high water in the Nan Yun Ho made it necessary to divert an extra amount into the Ma-chang Canal, a breach was almost certain to occur near the middle of its length. To avoid this danger from uncontrolled flow over the land south of Tientsin and at the same time provide for greater discharge capacity for the Grand Canal which enters the Hai Ho in the heart of the city below the Hsin Kai Ho Outlet, the Chihli River Commission was charged with the improvement of this second flood relief channel. This has been done by the building of a branch outlet to the south from a point near the middle of the canal where the capacity begins to be materially reduced. This branch is controlled by regulating works consisting of five steel gates 2 m. high by 6 m. in width carried between brick piers 1.8 m. wide by 10 m. long with concrete foundation, floor and apron. The openings are spanned by a highway bridge of reinforced-concrete slab and beam construction with macadam roadway. The gates are counterpoised and provided with individual hoists and structural steel towers to permit of raising them to the level of the bridge. While these head gates and the branch channel have a capacity of only 100 cu.m. per sec. (3,500 sec.-ft.) this is about the capacity of the upper section of the Ma-chang Canal.

The earthwork for the new branch channel amounted to 1,145,500 cu.m. (nearly 1,500,000 cu.yd.) and cost $118,300 or 7.9 c. per cu.yd. The above does not include right-of-way or engineering and supervision. This work was all done by hand labor, being transported from the borrow pits to the dikes in baskets in the usual way in this country. The greater part of the work was done in the fall of 1920 largely by laborers recruited from the nearest famine districts. At one time there were about 4,000 coolies employed. The average rate of work was 1⅓ Chinese fong (5.7 cu.yd.) per man per day. The reason that ordinary earthwork is not done by teams or machinery in China is evident when one remembers that, with the present rates of exchange, the above work was done for less than 4c. per cy.yd. in U. S. currency. About 18 per cent of the excavation was wet and cost about 11½c. Mex. per cu.yd. which brings the cost of the dry excavation to 7c. Mex.

The total cost of the head works for this branch outlet when finally completed will be about $90,000. This work was designed and executed by the engineers of the Chihli River Commission and will serve to illustrate the modern type of permanent structure which the commission proposes to adopt for the more comprehensive plans for river regulation and flood prevention being prepared.

London to Build New Bridge Across Thames

Work is expected to begin shortly on the construction of a new bridge across the Thames at London, to be known as St. Paul's bridge. It will connect Southwark St. on the south side with Cannon St. opposite St. Paul's Cathedral on the north side. The river part will comprise five spans. A roadway width of 80 ft. is projected. Estimates put the cost at £1,650,000. The new crossing is an important relief to the increasingly heavy cross-river traffic.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Shingles and Conflagration Hazard

Sir—We have noticed the editorial in the June 22, issue of your publication, in which you take exception to my statement that the wooden shingle roofs were largely responsible for the spread of the Arverne conflagration. This was true not only at Arverne but at many other places. This assertion is based upon a considerable engineering experience covering conflagrations in a great many different cities, including Atlanta, Augusta, Jacksonville, Fort Worth, Houston, Paris, Hot Springs, Nashville, Salem, Bangor, and elsewhere. There has been no absence of the proof mentioned in your editorial, as far as fire-prevention engineers are concerned. Conflagrations are spread, not only by direct heat striking nearby structures, but also by flying brands, and these brands have, in some cases, ignited wooden shingle roofs as far as half a mile from the original fire, while intervening structures were still intact. In the Atlanta conflagration, embers borne by the wind started such fires in seven different portions of the city. Not long ago at Norfolk, Virginia, burning embers flying through the air started twelve separate roof fires simultaneously, several blocks from the original fire. Photographs taken at Arverne of the more expensive types of dwellings that were burned, show conclusively that the flames traveled from roof to roof.

ROOF TRANSMISSION OF FIRE AT ARVERNE AND EFFECT OF FIRE-RESISTIVE ROOF AT ATLANTA

A copy of one of these views is enclosed, together with one taken in Atlanta, in which a small structure with fire-resistive roof is shown standing unharmed in the midst of the devastated area. We believe that these prints will furnish the proof which you feel has been lacking. Further than this, we might mention the fact that during the five years ended with 1920 our Actuarial Bureau reported losses of $41,667,246 from "Sparks on Roofs" alone, the damage being in addition to that due to conflagrations, which are separately classified.

W. E. Mallalieu,
General Manager National Board
of Fire Underwriters.

New York, July 14.

[There is no difference of opinion about the fact that shingles will burn and the fact that the blast from a fire trends upward and therefore endangers a roof more than a wall. The Arverne picture speaks convincingly on the latter point, and might even suggest, did we not know better, that shingled side walls protect a wooden house from fire. The highest part of the house is the most vulnerable to fire damage, and it is quite logical to make it the first object of fire-prevention treatment. In other words, efforts to reduce the danger of outside fire attack should begin at the roof. But this, we believe, is as far as the argument has been carried successfully. It does not support two claims that have been constantly urged expressly or by implication in the anti-shingle campaign literature: first, the claim that the wooden shingle roof is a great fire menace and in particular is the prime conflagration breeder; second, the implication that the ordinary detached wood-frame-and-sheathing dwelling with wood shingle roof is dangerous. On the conflagration claim, figures giving conflagration losses together with causes would be in order; such statistics as have come to our attention make the shingle appear as a minor factor].—Editor.

Land Office and Geodetic Surveys

Public-land survey monuments in the Plains and Rocky Mountain regions are to be connected with triangulation stations, by co-operative field work to be undertaken by the General Land Office and the Coast and Geodetic Survey. Triangulation systems are to be carried from Pecos, Tex., to a point 50 mi. east of Colorado Springs, Colo., and from Pocatello, Ida., to the Canadian boundary, connecting with established triangulation stations. The cadastral engineer will identify the land-survey points and will co-operate with the geodetic engineer in making connection to the stations of the triangulation survey. The corners located will be reconstructed as permanent monuments according to the standard specifications approved by the Board of Surveys and Maps. The Coast and Geodetic Survey will determine the latitude and longitude of the points of reference. A degree of accuracy corresponding to that of secondary triangulation will be provided for. Preliminary results will be available shortly after the close of the present season.

NEWS OF THE WEEK

New York, August 3, 1922

Power Commission Sticks to Depreciation Ruling

In Answer To Petitions Decides That Amendment of Basic Act Is Only Way To Reform

The Federal Power Commission has decided that it has not the authority to alter its present depreciation regulation because that regulation is in accordance with the water-power act. It has informed the representatives of the electrical industry who have been petitioning for a more favorable depreciation regulation that their only relief is in legislation amending the act.

As a result of the dissatisfaction with the depreciation regulation, the commission ordered a careful study made of the act, of similar state statutes and of decisions of state courts and commissions which had a bearing on the matter in question. Both the National Electric Light Association and the National Association of Railway and Utilities Commissioners submitted briefs which were considered in connection with the whole subject matter by the chief counsel of the commission and by the law officers of the Departments of War, Interior and Agriculture.

Analysis of Decision

These law officers agree that in view of the use of the word "depreciation" in the federal statutes, and as defined in decisions of federal courts and of federal and state commissions, the primary purpose of accounting for depreciation under the Federal Water-power Act is that reserves may be established and maintained sufficient for offsetting the reduction in service value, due to accruing depreciation from whatever cause and for maintaining the original investment, unimpaired and adequate for renewing and replacing, so far as respects their original costs, units of equipment or structures when their useful lives expire. The chief counsel of the commission holds, and the law officers of the three departments agree with him, that the act, as now worded, requires an accounting for depreciation substantially as set forth in the existing regulations. It also is held that the definition of "depreciation" as proposed by the representatives of the National Electric Light Association and the amendment of the regulation proposed by them with respect to accounting for depreciation are not in conformity with the act.

O. C. Merrill, the executive secretary of the commission, told the commissioners that he is not convinced that the provisions of the act with respect to depreciation are in conformity with the wisest public policy, or that they are in the best interests of the rate payers, in the long run. He expressed the belief that the questions should be approached primarily from that standpoint. He suggested to the commission that, if upon further consideration, it should appear unwise to require the fully accrued depreciation to be taken up on the licensee's accounts, steps should be taken to secure an amendment of the act.

Mr. Merrill suggested and the commission approved that it should be optional with licensees whether they account for depreciation on the straight-line or on the sinking fund basis until the act be amended. A further suggestion by Mr. Merrill, also was approved by the commission that he be authorized to confer with the Water-power Development Committee of the National Electric Light Association, and others interested, with the view of presenting to the commission proposals for such a degree of flexibility in the annual charges of accruing depreciation as will give due consideration to the maintenance, both of the financial credit and of the capital assets of the licensee.

Omaha To Have Rapid Filters of 50-M.G.D. Capacity

The Metropolitan Utilities District of Omaha has begun construction of a 50-m.g.d. filter plant. The design will follow closely that of the Chain of Rocks plant at St. Louis with the exception of the collecting system, which will be a combination of concrete conduits and perforated pipes. The plant is so designed that it can readily be extended to a 100-m.g.d. capacity. Fortunately for the city, says F. P. Larmon, chief engineer, it will be able to utilize its present sedimentation basins for coagulation and for storage of the filtered water. All work will be done within the organization.

Propose Kern Water District

By the proposed organization of the Kern River water-storage district in California, embracing 260,000 acres to be irrigated by river water and pumping plant, a 300,000 acre-ft. capacity reservoir would be created in Hot Springs Valley. It is estimated that the district would cost from $15,000,000 to $25,000,000.

At the hearing held in Bakersfield, Cal., recently, before W. F. McClure, state engineer, which was conducted in behalf of the protestants to the proposed district, there occurred conflicting testimony as to the water level maintained in the McFarland district. In order to establish the facts in the case the hearing was adjourned until the state engineering department shall make an investigation of this and other features.

Public procedure will be resumed in Bakersfield Aug. 29. When the case is reopened, however, it will be in the nature of a new proceeding, as the state law provides that water-district hearings cannot be continued in excess of two weeks after the time of opening the hearing.

Buckling of Airship Keel Blamed for "Roma" Disaster

Summaries of reports of experts on the destruction of the semi-rigid dirigible "Roma," of the War Department on Feb. 21 have just been made public by Secretary of War Weeks. A report was made by the Chief of Air Service with the aid of a number of outside experts, and upon submission of this report to the air attaché of the Italian Embassy a separate report was made by him on the part of the Italian designers and builders. The reports diverge in their conclusions.

On Feb. 21 the "Roma" dived to the ground at Norfolk, Va., while flying at 50 to 60 mi. per hr. about 600 ft. above ground, and took fire and burned. Of those on board only 11 persons survived, while 34 were killed. Partly because of this fact the conditions and causes of the accident could not be determined with certainty. The Air Service concludes it to be most probable, however, that a slight flattening of the top of the nose and partial failure of the nose cap resulted in a downward pressure on the nose tending to produce a dive; that the stabilizer planes at the tail, tending to correct this action, brought a heavy strain upon the keel; that the keel yielded slightly near the rear end, and thereby placed the stabilizer surfaces into a position where they no longer acted effectively; and that the absence of provision in the pilot house for stopping the engines instantly was responsible for the forward pair of motors (there were six Liberty motors in all) continuing to run at normal speed until the vessel hit the ground.

Disagreeing with the theory of yielding of the keel, the Italian explanation points out that the stabilizer reaction due to pressure on the flattened nose could not be great enough to overstress the keel, and that the greatest stresses in the keel occur at the mid-section rather than near the rear end. It finds as most probable cause a failure of the elevator-rudder controls, due to breaking of the rudder cords provided to hold this rudder in horizontal position, followed by breaking of either the steering cable of this rudder or some other part of the control mechanism under the sudden strain. When uncontrolled, the elevator rudder had a tendency to drop at the rear to an equilibrium position about 8 deg. from horizontal, and through such change of angle the airship was caused to dive.

Mears to Retain Commission

To meet a decision of the Comptroller General that his service as a member and chairman of the Alaskan Engineering Commission, a civil function, deprives him of his army commission, the House has passed a resolution authorizing the appointment of Frederick Mears as an officer of the army and making him eligible to continue the engineering commission office.

Action by F. A. E. S. Committee on Procedure

The Committee on Procedure of the Federated American Engraving Societies, of which Calvert Townley is chairman, held a meeting on July 14 at which the following action was taken:

"The invitation to send representatives to the Pan Pacific Commercial Conference in September was accepted. Appointment of a representative to attend the Engineering Congress in Rio de Janeiro in September was authorized. The president was also authorized to co-operate with the necessary authorities in appointing a committee of engineers to make a trip to China to form personal contacts and encourage friendly relations.

"The return of patents from the Chemical Foundation to the Alien Property Custodian was considered by the committee following which a resolution was addressed to President Harding requesting that action be delayed until representatives of the chemists, chemical engineers and manufacturers, and others could be heard. It furthermore implored that nothing be done which would in any way tend toward the ultimate return, to former owners, of patents and other property lawfully sequestered and sold to Americans.

"Revision of the mining laws proposed in H. R. 7736 was approved by the committee and council directed to use its influence in furthering the passage of the bill subject to committee amendments. The executive secretary is in communication with the chairman of the mines and mining committee on behalf of this legislation.

"The committee approved the opinion that the following bills were not within the scope covered by the activities of the American Engineering Council; The Bacharach bill affecting public utilities companies, the Merchant Marine bill, the Trade Associations Regulating bill and the Ship Subsidy bill. It approved the principle of the hydraulic laboratory bill but recommended that no special exertion be made in favor of it until a special committee of the Boston Society of Civil Engineers, to be appointed at the request of Council, could review the subject and advise the Executive Board."

In connection with the above action on the chemical patents, Dean M. E. Cooley, president of the F. A. E. S., makes the further announcement: "It is of importance to note that the Federated American Engineering Societies speaks concerning national problems for thirty odd national, state and local engineering societies. The federation, therefore, speaks on behalf of some 55,000 engineers."

Philadelphia Sells Bonds

A $6,000,000 issue of 4 per cent, 20-50 year improvement bonds, redeemable at 103 on 30 days' notice, has been sold at 3.93 + by the City of Philadelphia. This was the most favorable yield rate among 16 issues totalling nearly $15,000,000 reported by the New York *Times* for the week ended July 28. All but 3 of the 16 sales were at a yield rate of less than 5 per cent, one being at 5, one at 5.10 and one at 5.50.

Road Builders Give Views on Priority Order

Delay to Work Seen in Reducing Supply of Railway Cars for Highway Materials

IN answer to a telegraphic request for their views on the probable effect of railway car priority orders from the Interstate Commerce Commission on the road building program, state highway officials have sent *Engineering News-Record* the following replies:

Texas—On 90 per cent of our highway projects under construction crushed stone, gravel and sand are shipped in by rail and the same will apply on 800 miles of new highway work to be let in the near future. The shipping of such materials only upon priority orders issued by the Interstate Commerce Commission will greatly retard delivery of necessary road-building materials and will undoubtedly increase the cost of highway work as well as retard completion of work under contract. —*J. D. Fauntleroy, state highway engineer.*

Washington—Commerce Commission priority orders will not seriously affect our road-building program. Much of the aggregate for paving and bridges is produced from pits located within truck haul of the jobs. Contractors have stocked ahead with cement. Some of the contracts are served by water transportation. Railroads feel confident they can keep contracts going.—*James Allen, state supervisor of highways.*

California—So far as I am aware, the Interstate Commerce Commission priority order concerning railroad freight movements is limited to states east of the Mississippi River. Were this order to apply west of the Mississippi River chaos would be the result so far as our road-building operations are concerned, since we have several million dollars' worth of work under contract and are at the height of our road activities. The condition must be extremely embarrassing in the Eastern states which are in a like condition, and it appears to me to be extremely stupid to promulgate such an order without giving adequate consideration to the road-building program of the country.—*A. B. Fletcher, state highway engineer.*

Indiana—Commerce Commission priority order shows no noticeable effect to date.—*C. Gray, chief engineer, state highway commission.*

Kansas—Priority orders of Interstate Commerce Commission, if enforced in this state, will place all road projects of concrete, brick, and bituminous macadam at standstill. Practically all this work involves rail shipments, and shortage of aggregate will result in shutting down a contract, as none of the contractors has been able to store sufficient material in advance.—*M. W. Watson, state highway engineer.*

Maryland — Commerce Commission priority order has not affected road building program because sufficient material was in transit when issued to keep work moving. However, all material people are declining further shipments because of this order and within a week we expect an entire cessation of road building work in this state.—*J. N. Mackall, chief engineer, state roads commission.*

New York—If the conditions anticipated by the Interstate Commerce Commission's priority order should develop to the extent that it is necessary to enforce it strictly, it will of necessity seriously interfere with our road-construction work. A modification of this order permitting the use of open top cars for the loading of road-building materials when the point to which these shipments are destined is in the general direction of the empty return movement to the mines would be of material assistance. — *Fred W. Sarr, first deputy commissioner of highways.*

Virginia—Priority orders issued by the Interstate Commerce Commission giving preference to the handling of fuel, food products and live-stock up to date have not greatly interfered with our road building in this state. At one

Coal Shortage Threatens Shutdown of Cement Mills

The effect of the coal shortage on industrial operations, already noticeable in reports from New York stating that some of the large steel mills will probably have to shut down unless the coal strike is settled within the next few weeks, is also being felt by the cement industry and the difficulty of obtaining coal has caused a number of plants to cease operations for the time being. A statement issued by the Portland Cement Association in Chicago points out that the cement industry is the fourth largest consumer of coal in the country, over 7,000,000 tons being consumed at cement mills every year. Many of the mills have been having difficulty in securing coal for some time. With the regular source of supply shut off by the strike the mills have been forced to secure coal from more distant mines, at higher prices and a longer haul. As many of these sources are now cut off the situation has become acute and unless the strike adjusts itself in a few weeks more of the plants will be closed, or operated on part time.

Coming at a time when the country is experiencing one of the greatest building booms in its history, a shortage of cement would have a serious effect on every class of construction operation. As cement enters into practically every building that is erected the cutting off of the cement supply through the coal strike would tie up many of the building projects. A similar effect would be felt by the road construction industry.

In addition to the coal strike, the railroad strike has a direct effect on the cement supply. The equivalent of 377,000 box cars of 50-ton capacity each were required to haul last year's cement output to the consumer, and if the strike ties up transportation it will be impossible to get the cement shipped to the points where it is needed.

or two points our work has been somewhat delayed, but nothing of a serious nature has developed and we are hoping that the situation will improve rather than get worse.—*H. G. Shirley, chairman, state highway commission.*

Pennsylvania—On receipt of advice from Washington on the issuance of Service Order No. 23 of the Interstate Commerce Commission, this department immediately outlined a program of procedure similar to that used during 1920. We are in touch with all contractors and are now receiving statements from them covering their material requirements daily, and are preparing full data so that, if steps can be taken to remedy the situation, we will have the necessary data to reinforce our requests. It is too early to give a reasonable prediction as to the effect of the order. While we are hopeful that the situation will not be as difficult as in 1920, still the strike situation, particularly as it affects the coal fields of Pennsylvania, would seem to point to a very marked decrease in the number of available hopper-bottom cars on the resumption of coal production. Therefore, we are not overly optimistic, particularly as to shipments after Aug. 25. We are recommending to all contractors the stocking and storing of materials to their maximum capacity *now.* —*W. D. Uhler, chief engineer, state highway department.*

Massachusetts—I do not know exactly what priority orders may be contemplated, but assume that they will refer only to coal. From what I can learn by interviews with New England railroad officials, such priority orders would have little effect on our road-building program as there is apparently not sufficient coal to be shipped to interfere seriously with the shipment of other materials.—*A. W. Dean, chief engineer, state highway department.*

Oregon—Coal strike priority order of Interstate Commerce Commission will not affect Oregon road work, according to highway officials of that state, as sand and rock from local sources are used almost exclusively. However, should the railroad strike situation reduce the supply of covered cars, that would materially interfere with proposed work by delaying cement and asphalt deliveries.—*State highway commission.*

New Jersey—We have no definite information as to the exact context of the priority orders, so that it is difficult to know the extent of them. We have, however, tried to anticipate the issuance of such orders and have telegraphed previously to all contractors doing work in this State, advising them to increase their stock of road materials so that their work would not be held up because of orders which might be issued in the future by the Interstate Commerce Commission. We feel that this has helped to some extent. Another great advantage to the contractors in New Jersey in this connection is the fact that our specifications provide that contractors may be paid not to exceed 80 per cent of the value of materials on the ground but not in place, and this is a decided advantage to the contractors in the condition which we are confronting at the present time.—*T. J. Wasser, state highway engineer.*

FOR NATIONAL ENGINEERING MUSEUM AT WASHINGTON

A committee of the American Society of Mechanical Engineers, originally appointed to co-operate in the collection of historical material bearing on the work of Cornelius H. DeLamater and Capt. John Ericsson, has started a movement to establish an engineering museum in connection with the National Museum at Washington. The plan has the support of the Smithsonian Institution. The committee invites requests for further information from engineering societies and alumni associations of engineering schools that may be interested, which should be addressed to Joint Committee on the National Engineering Museum, Engineering Societies Building, 29 West 39th St., New York City.

Report on New York Subway Fire Exonerates Pyrene

Report has been made by the New York Transit Commission of its investigation of the fire that precipitated a near-panic on a Lexington Ave. subway train on July 6. (See *Engineering News-Record*, July 13, 1922, p. 80). The commission has found that the fire was caused by a short-circuit on a panel board in the vestibule of one of the cars and that the smoke and fumes liberated were from burning insulation, rubber, paint and varnish. There were no fatalities and those that were overcome were affected by the smoke from the burning insulation and by the haste with which they climbed the 75 ft. to the surface.

Immediately after the fire many statements were made indicating that passengers had been overcome by fumes generated by the use of Pyrene extinguishers, and pending the investigation their use had been restricted by the subway management. The inquiry reveals no ground for these statements, and the investigators recommend resumption of the use of the Pyrene to extinguish electric-arc fires.

Hearings on Need for Hydraulic Laboratory Soon to Begin

The Senate Committee on Commerce has authorized a thorough investigation into the advisability of establishing in Washington a national hydraulic laboratory. This action is taken because members of the committee are unanimously of the opinion that insufficient attention has been given to the scientific side of flood control. A sub-committee was appointed to hold hearings and to conduct the investigation. Senator Ransdell, of Louisiana, was chosen to head the sub-committee; Senator Dupont, of Delaware, and Senator McNary, of Oregon, are the other members. The Secretaries of War, Interior and Commerce have been requested by the sub-committee to report as to the need for such a laboratory and as to their opinions upon its value.

The initial witness probably will be John R. Freemen, president of the Am. Soc. C. E., at whose suggestion this legislation was initiated.

Two Brooklyn Bridge Cables Shift on Saddles

City Commissioner Recommends New East River Bridge and Rebuilding Old

Two of the four main cables of the Brooklyn Bridge across the East River at New York slipped in their saddles recently, according to Edward A. Byrne, chief engineer of the Department of Plant and Structures, New York City. The information was given in connection with a request by Commissioner Whalen of the department, to the Board of Estimate and Apportionment, for authorization to build a new bridge near the Brooklyn Bridge, as a preliminary to the rebuilding of the present structure. An additional bridge is needed by the steadily increasing traffic, and it is not possible to modernize or increase the traffic capacity of the Brooklyn Bridge before a new structure is ready to take its traffic during the reconstruction.

The cable movement, which was noticed on June 15, affected the two north cables at their west or Manhattan tower support. The north or A cable moved $1\frac{3}{4}$ in. in the direction from the shore span to the main span, and the next or B cable moved $\frac{1}{2}$ in. in the same direction.

No other change of condition in the bridge has been discovered in the regular inspections or in special examinations carried out since the movement was noticed. In particular Mr. Byrne states that the anchorages and towers show no change in any respect and are in excellent condition, and that the suspended structure also is normal.

The cable movement is regarded as a readjustment of strains probably connected with a similar movement in 1898, when trolley cars began operating over the bridge. The southerly cables showed the most movement at that time, while the north cable had little or no movement. That motion was a slipping of the cable saddles on their supports, the rollers having been rusted fast during the preceding years. Since that time the saddles have been blocked. The present movement was a slipping of the cables in the saddles.

Hoover Heads Commission to Direct Distribution

Secretary Hoover has been appointed by President Harding to be chairman of the governmental commission that will direct distribution of the available supplies of coal and other necessities during the current railroad and coal strikes. The power vested in this commission is to be exercised subject to the needs of the emergency. Priority in transportation will be given to essentials in the following order: Food, feed for live-stock, live-stock, perishables, coal, coke, and fuel oil. In the movement of coal preference is to be given to transportation agencies, public utilities, ice and refrigerator plants, hospitals and other public institutions.

The secretary has asked the co-operation of the state authorities and commissions in carrying out plans for regulation and will make every effort to handle the situation through local agencies.

Start Last Traffic Run on Bates Test Road

Chief Engineer Older Comments on Indications of Results Thus Far Secured

The $300,000 Bates experimental road sections near Springfield, Ill., are now being traversed by the last and heaviest loading originally planned, 8,000 lb. per rear wheel. Many parties have visited the road at the invitation of the Illinois State Highway Department but the largest delegation so far comprised 60 members of the Detroit Automobile Club, state and county highway officials of Michigan and Wisconsin, who made an inspection, July 24.

Clifford Older, chief engineer, in explaining the results (which will be summarized in *Engineering News-Record* next week) indicated that with the labatory tests corollary with the road tests rational designs could now be made with definite predetermined factors of safety. In general the findings, he said, are as follows:

Fatigue tests on 6-in. cantilever beams of concrete indicate that several million applications can be made if the load is less than 50 per cent of its amount at the point of rupture. When the load is increased 10 per cent breakages occur with a few thousand applications.

The result on pavements of impact from a drop of about $\frac{3}{8}$-in. is less than the result of static loads. Curling of the edges at night, due to temperature changes, is nearly $\frac{1}{4}$-in., and has been proved beyond a doubt. The night breaks under traffic at edges have been three times as frequent as the day breaks. In consequence, the design for corners, the weakest place, is the critical feature. Practically all failures have started from corner breaks. It is significant that no early breaks have occurred on the north side of the road where the drivers keep the outside wheel about 3 ft. from the edge; all breaks have occurred on the south side where wheel loads are at the edge.

Subgrade Observations

Subgrade observations indicate continuous moisture content which is not affected by drains. Mr. Older was particular to point out that this referred to the brown loam of Illinois in which capillary attraction was strong and held about 25 per cent of moisture throughout the summer, with rises in spring and fall to 40 per cent. He concluded that money for drains in this type of soil is thrown away.

The 5-in. slabs are beginning to break up under the 8,000-lb. wheel loads after about 2,000 trips. This loading is the maximum permitted by the Illinois state law. For the earlier loadings 3,000 trips were made for each increment of increase, but for the last loading it is planned to continue the test until 10,000 trips have been made. It is unlikely that this will have any effect on the 8- and 9-in. sections. If it is decided to break these heavier slabs, heavier trucks will have to be provided as the sixteen units now in use carry a 1-ton overload.

Expressions of opinion indicated that many views held by the visitors were being abandoned. The questionable value of drainage and use of broken stone under pavements were particularly debated. On the other hand the Wisconsin and Michigan engineers expressed a feeling of satisfaction that their present designs were adequate. From those who were looking for the big result one thought seemed predominent, viz., that in some way truck makers and road designers were going to be able to get down to a definite basis of design, the truck to be reasonably limited and the road to care for that limit. Mr. Older feels that ultimately zones will be prescribed with 8- or 10-in. slabs built in and around large centers and perhaps as thin as 4-in. slabs provided in strictly rural territory.

The Engineer in Public Life

M. T. CALEF

M. T. Calef was elected to the state legislature of Indiana in 1920. He introduced the Engineers' Registration Law in the 72nd Indiana General Assembly of 1921; was author of two road bills and member of the following committees: Roads, county and township business; manufacturing and commerce; claims; and public bills and swamp lands.

He was born in River Sioux, Iowa, 34 years ago, on a farm of which he tired, going west in 1906, to Baker, Ore., where he became interested in hydro-electric work, from camp cook to lineman. He worked his way through Oregon State College and was graduated in 1911 with the degree of B.S. The next two years were spent with the Warren Construction Co. of Portland, Ore.

From 1913 to 1916 Mr. Calef attended the postgraduate school of highway engineering at Columbia University, taking the degree of Master of Engineering. He then became road engineer for the Rocmac interests of Philadelphia and Toronto. In 1916 he went to the State of Washington where he engaged in paving and road construction. That same year he moved to South Bend, Ind., where he was district sales engineer for the France Stone & Slag Co. of Toledo until 1921. He then organized the Highways Improvement Co. of which he is president and treasurer.

Mr. Calef is a charter member and first president of the St. Joseph Valley Chapter of the American Association of Engineers. He is a member of the South Bend Chamber of Commerce and is the inventor of several forms of road-construction machinery.

Trade Commission Member Sworn In

On June 30 Judge Vernon W. Van Fleet, former judge of the Superior Court at South Bend, Ind., was sworn in as a member of the Federal Trade Commission.

Announces Narrows Tunnel Staff

The chief engineer of the Board of Estimate and Apportionment, of New York City, announces the appointment of the staff that will prepare plans for the Brooklyn-Richmond freight and passenger tunnel, generally known as the narrows tunnel. The more important positions provided for are:

Administrative: Arthur S. Tuttle, chief engineer and Herman H. Smith, deputy chief engineer; D. W. Coe, resident engineer; William J. Shea, and Francis H. Phipps, assistant engineers; Leon K. Merrill, auditor; and William M. Conant, statistician.

Consultants: Glen E. Balch, on dredging; Wilson S. Kinnear, on railroad and trench tunnel design and construction; Frederick C. Noble, on tunnel design and construction; Henry B. Seaman, on structural design; John F. Sullivan, on project; and Silas H. Woodard, on tunnel design and construction.

Design and construction staff: Jesse B. Snow, tunnel engineer; Charles D. Drew, principal assistant engineer; William McK. Griffin, resident engineer; Clarence K. Conard, railroad engineer; W. C. Lancaster, electrical engineer; John H. Quimby, designing engineer; Robert C.. Strachan, Charles J. McGronan, Melvin D. Casler and Edward M. Law, assistant engineers.

Plan Large Road-Contract Lettings in Missouri

Several million dollars' worth of highway contracts, it is expected, will be let in Missouri before the first of the year as the result of the designation of a 1,500-mile system of primary state roads in a report just submitted to the state highway commission by Rollen J. Windrow, consulting engineer and assistant to the chairman, and B. H. Piepmeier, chief engineer. Missouri has already voted $60,000,000 of bonds to be used in the construction of 76,000 miles of state roads. The law provides for the selection by the commission of 1,500 miles of this system to be classified as primary or trunk-line routes. The commission has planned to hold a public hearing this week to consider the recommendations of its engineers and will then reach a final decision regarding the issuance of $10,000,000 at once to enable work to be started.

The state highway department has plans prepared for a large mileage of the recommended system and everything is in readiness for letting contracts as soon as money is available from the sale of the bonds. The 1,500-mile system was selected to connect the principal centers of population and not primarily to form connection with adjoining states. The system connects 26 cities containing 1,453,891 people.

Cresson to Study Foreign Ports

B. F. Cresson, Jr., chief engineer of the Port of New York Authority, has sailed for Europe, where he will inspect the principal ports. He plans to visit Liverpool, Manchester, Glasgow, London, Southampton, Copenhagen, Stockholm, and possibly the German ports; and will study particularly the operation and management of the Port of London under the Port of London Authority.

Engineering Societies

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal, Que.; Pro- [illegible] Sept. 5-7.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual [illegible] Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

The American Association of Engineers at a recent meeting of the Board of Directors, appointed the following committee chairmen: Qualifications, R. C. Kellogg; practice, E. E. Carpenter; services and fees of practicing engineers, L. E. Ayres; salaries of engineers in teaching service, C. J. Tilden; engineering education and classification of engineering schools, Frederic Bass; classification of engineering positions, A. B. McDaniel; chapter activities, J. P. Kelly; publications, A. N. Johnson; political policies, Raymond Burnham; auditing, C. A. Hoglund; legislative, W. W. DeBerard; salaries of engineers in public service, S. C. Hadden; railroad advisory, W. C. Bolin; amplification of ideals and objects, F. H. Newell.

The Connecticut Society of Civil Engineers held its annual outing at the Connecticut Agriculture College, Storrs, Conn., July 25. Besides an elaborate sports programme there were several short addresses including one by President Beach of the College on "What the College is Doing for Connecticut."

Personal Notes

FRANK RYNEARSON has been elected as road supervisor for the borough of DuBoistown. He has served as a road supervisor throughout central Pennsylvania for twenty years.

C. R. HORNE, resident bridge engineer on the Choctawhatchee River Bridge, has severed his connection with the Florida State Road Department and has accepted a position with the U. S. Bureau of Public Roads.

H. D. BARNES, F. S. PICKERING and L. F. GOFF have recently been appointed by the Kansas State Highway Commission as county engineers of Butler, Johnson and Rawlins Counties, respectively.

FRANK A. RUSSELL has been elected professor of engineering at the University of Kansas, to succeed Prof. C. C. Williams who recently resigned to become professor of civil engineering at the University of Illinois.

CHARLES D. CAMPBELL, of Hamilton, Ont., has been appointed city engineer of Belleville, Ont. He succeeds [illegible]. He was formerly resident engineer of the Galt, Hespeler & Preston R.R.

ARTHUR H. BICKERSTAPH has recently opened an office in Titusville, Pa., for the practice of surveying and mapping.

JAMES AUSTIN MORTLAND, who recently resigned as bridge engineer to the Florida State Road Department, has opened a consulting engineering office in Tampa, Fla.

W. S. EARLE, division engineer for Florida State Road Department, has resigned to take charge of the construction of roads for Seminole County.

W. H. STEINER has been appointed district engineer in charge of the Des Moines office of the Portland Cement Association to succeed H. L. TILLSON, resigned. Mr. Steiner has been connected with the Association for the past three years, most of that time having been spent in Iowa. He was also city engineer of Marshalltown, Iowa, for ten years.

L. L. FIELDER, general foreman for the Willite Road Construction Co., Sparta, Mich., has been made superintendent of road construction.

JOHN A. CONNELL, former resident engineer with Lockwood Greene & Co., Boston, Mass., has become associated with Tooker & Marsh, New York City, architects and engineers as superintendent of construction.

FRANK A. DANFORTH, topographic engineer with the U. S. Geological Survey, has returned from a two-year assignment in the Hawaiian Islands and has been assigned to work in the vicinity of Frankfort, Ky.

GEORGE CALDER has been made resident engineer for the city of Sacramento, Cal., on the uncompleted part of the filtration project for which work bids are to be received August 24. Mr. Calder succeeds C. G. Gillespie. He has been connected with the filtration project since its construction, having been in charge of making plans for the remainder of the project.

PROF. FREDERICK K. MORRIS has resigned as professor of geology at Pei Yang University, China, to act as an assistant to DR. C. P. BERKEY, who is chief geologist of the Third Asiatic Expedition under Dr. Roy Chapman Andrews. Dr. Berkey has been professor of geology of the University of Columbia for thirteen years, but is now on leave of absence.

J. H. KIDD of Kingsport, Tenn., has been elected city engineer of Knoxville. He assumed his new duties August 1.

CHARLES C. SMITH has severed his connection with the general contracting firm of Scarborough, Smith & Davis, San Angelo, Texas, and is now a partner in the contracting firm of O'Connor & Smith.

E. A. WOHLFORD, formerly associated with Mees & Mees, consulting engineers, Charlotte, N. C., specializing [illegible] has joined the Thies-Smith Realty Co. of that city. Mr. Wohlford is engaged in sales work as well as in estimating and general engineering practice

Obituary

GERARDUS HARRISON, who was with the consulting engineering firm of H. and C. J. Goldmark, New York City, died July 24, aged 34 years. He was graduated from Cornell University in 1910, since which time he had been actively engaged in the practice of engineering. During the war he was in charge of important government construction work at the plant of the Lima Locomotive Works at Lima, Ohio. Other important work with which he was connected included the erection of the two foundries of the Canadian Locomotive Works at Kingston, Ont. He was an associate member of the American Society of Civil Engineers.

EDWARD N. RALEIGH, principal assistant engineer of the Department of Public Works, Borough of Manhattan, New York, died July 16, aged 42 years. He was connected with this department for some twenty years. His early work was in connection with the Riverside Drive Improvement north of the Manhattanville Valley. In later years he had general charge under the chief engineer of the designing, construction and maintenance of the sewers, pavements, viaducts and all other public works under the borough president's jurisdiction.

WILLIAM A. THOMPSON, vice-president of the Texas Co., New York, died in that city July 24, aged 48 years. Mr. Thompson was in charge of the export department, northern territory sales, and asphalt sales, and as president of the Texas Steamship Co. was well known as a shipping man. Early in his business career he became interested in shipbuilding in Duluth, and later on the Mississippi. Besides being a director and member of several corporations he was a member of several New York clubs, the Engineers Club being among them.

Business Notes

MAURICE L. MILLER, engineers, is the name of a consulting hydraulic and sanitary engineering firm, recently organized in Denver, Colo.

EDWARD C. DILWORTH has opened a consulting engineering office at 302 Walsh Building, Pittsburgh, Pa. He will pay particular attention to industrial building, retaining walls, bridges, reinforced concrete work and foundation work.

E. R. WIGGINS, formerly with the Chilton Co., Philadelphia, as technical editor of the *Chilton Tractor Journal*, has joined the sales department of the Holt Mfg. Co., Peoria, Ill. He will do special work as a sales engineer. Mr.

Wiggins, in addition to his work with the Chilton Co., has been connected with the J. I. Case Threshing Machine Co., Racine, Wis.; The Aultman & Taylor Machinery Co., Mansfield, Ohio, and Deere & Co., Moline, Ill., doing engineering experimental work in tractor development.

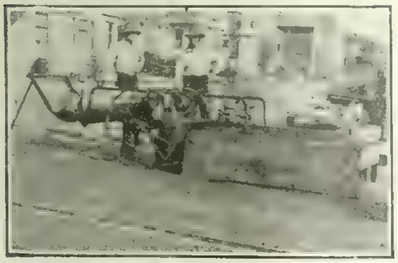
J. A. Ross and J. E. Bellows, formerly with the S. A. Woods Machinery Co., have formed a partnership for handling corrugated cutter and knife equipment under the firm name of Ross Cutter & Machine Co., Dorchester, Mass.

James A. Beaubien, formerly vice-president and general manager of the Weber Subterranean Pump Co., has become manager of the New York office of the Pennsylvania Pump & Compressor Co., Easton, Pa.

Equipment and Materials

Asphalt Surface Heater

The Hauk Manufacturing Co., Brooklyn, N. Y., has put on the market an asphalt surface heater and patcher which uses kerosene as a fuel. The heater is made in two sizes with tank capacities of 25 and 50 gal. and with two and three burners; the weights are, respectively, 460 and 860 lb. The device consists of a steel frame mounted on two wheels, as shown in the illustration. The tanks are of galvanized steel equipped with quick-acting hand pump, filling cocks, air-release and back-pressure valves and pressure



gages (100 lb.). The hood is of sheet steel lined with ⅜-in. asbestos board. Each burner is controlled individually and the flame is prevented from striking the pavement directly.

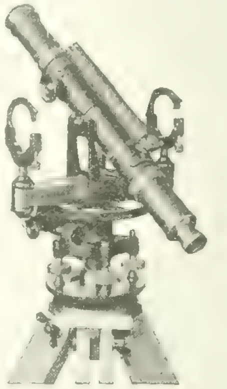
Crowding Engine Eliminated in Gas-Operated Shovel

By a special arrangement of cables and sheaves a separate crowding engine is eliminated in the design of the new gas shovel which the Northwest Engineering Co., Green Bay, Wis., has just released for sale. The shovel is mounted on crawlers and is in the form of an attachment that can be applied to the Northwest crane or dragline by simply laying down the crane boom and mounting the shovel boom. The new shovel, its manufacturers claim, will grade a 30-ft. flat width, 4 ft. below grade, and handle a ¾-yd. dipper without taxing the engine, which develops 50 hp. at 800 r.p.m. As regularly equipped, power is furnished by a gas engine, but where electric current is available motor equipment may be substituted. The operating dimensions of

the shovel are: Width, 9 ft. 8 in.; length of boom, 23 ft.; length of dipper stick, 15 ft. 6 in.; working angle of boom, 40 to 50 deg.

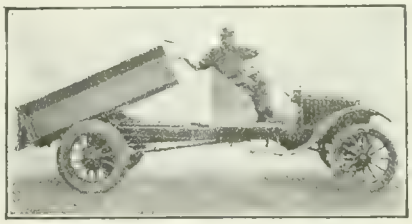
Combined Level and Transit

A combined level and transit, one of the sterling line of instruments, has been developed by the Warren-Knight Co. of Philadelphia. Conversion from one type of instrument to the other, it is claimed, is possible in 10 sec. without the use of detachable parts. The telescope is 13½ in. long and the level vial 5 in. long. The wyes are provided with patent quick-opening lock screws which may be operated without jarring the instrument out of level. For use as a transit the instrument is equipped with a horizontal circle 4½ in. in diameter, graduated to degrees with vernier reading to 5 min. When used as a transit the telescope is carried on trunnions in permanently attached hinged uprights, as shown in the accompanying illustration; when converted into a level these uprights are folded down out of the way against the level bar.



Dump Body for 1-Ton Truck

For use on a 1-ton Ford truck the Griscom-Russel Co., New York City, is manufacturing the Jiffy all-steel dump body, which may be operated without the necessity of the driver leaving his seat. The body has a pivot scale-balance 5 in. in front of the rear axle, eliminating any hoisting device. It is made of No. 10 gage steel, has a capacity of 1½ cu. yd., and weighs 600 lb. The tail-gate opens automatically when the body reaches an inclination



of 45 deg. The overall height from ground is 4 ft. 7 in., making loading easy and avoiding the danger of overturning. The inside dimensions are: length, 72 in.; width, 42 in.; depth, including flareboard, 18 in. The body is attached to the truck chassis by four bolts.

The body and sides are in one piece without seams and a heavy channel-iron subframe is electrically welded to the body. There are no wooden parts in this equipment.

Out-of-the-Ordinary Trade Publications

Brass and Copper Pipe—The Copper and Brass Research Association, New York City, has issued, in the form of a wall chart, a house piping plan and table of sizes of pipe to be used under varying conditions of service. One table indicates the properties—weight, diameter, etc.—for brass and copper pipe ranging from ⅛ to 7 in. Other tables show the estimated rate of draft of water for bathroom, laundry, etc., capacities of water piping in buildings, and sizes of supply branches to fixtures.

River Bank Protection—The Woods Bros. Construction Co., Lincoln, Nebr., in a 32-page illustrated pamphlet, describes its current-retard system of checking bank erosion and causing the deposit of sediment in front of the attacked or threatened spot. The retards are practically permeable spur dikes composed of masses of trees lashed together and attached by anchor cables to concrete piles buried in the river bed. These piles are of the Bignell type, having pipes embedded in the concrete for water jets which facilitate the sinking of the pile through any loose material. In silt-bearing streams the checking of the current causes sedimentation to begin at once and to increase rapidly as the sand bar builds up. Numerous examples of this protection and reclamation work are described and there is mention also of the use of the Bignell piles in foundation work.

Hydraulic Turbines—The Pelton Water Wheel Co., of San Francisco and New York, has issued a 15-page illustrated pamphlet describing the hydro-electric installation at Kern River, Plant No. 3 of the Southern California Edison Co., by Ely C. Hutchinson, vice-president and general manager of the Pelton company. The hydraulic prime-mover equipment for this plant is notable since it comprises two 25,000-hp. vertical turbines operating under a head of 810 ft., the highest-head reaction turbines in the world.

Motor Trucks—The Acme Motor Truck Co., Cadillac, Mich., describes seven models of motor trucks ranging in capacity from 2,000 to 12,500 lb. in a 42-page illustrated catalog just issued. Detailed specifications are given for each model and several pages are devoted to body features covering a variety of types. One page is devoted to a tabulation of weights of materials ordinarily hauled by motor trucks.

Business Side of Construction

Facts and Events that Affect Cost and Volume

July Contracts 34 Per Cent Under Preceding Month

Decrease of $63,168,094 from June, 1922—$13,162,857 Greater Than Same Month Last Year

Important engineering contracts awarded in the United States during the month of July totaled $116,670,906, an increase of $13,162,857 or 12½ per cent, over the corresponding period of 1921. The July total for the United States and Canada, however, represents a falling off of $63,168,094, or 34 per cent, from the month preceding. Canadian contracts for July totaled $2,503,000 as against $6,897,000 for June. These figures are compiled from Construction News and involve large engineering contracts only, with a minimum of $25,000 on public works, $40,000 for industrial construction and $150,000 in the case of commercial buildings.

Lettings in the Middle Atlantic states reached $35,438,278 as against $34,652,557 in the Middle West, or nearly the same in each section. These two groups have surpassed the others in numbers and values of contracts let since the beginning of the year; but in only two instances, namely in January and June, has the Middle West exceeded the Middle Atlantic states in values of contracts awarded. July lettings west of the Mississippi fell 44 per cent, and in the Middle West 47 per cent below June.

Federal Government work represented the only classification showing a gain, in July, over the preceding month. Bridge building dropped nearly 50 per cent and industrial construction over 52 per cent during the month.

Business Briefs

Steel and iron output fell off only 5 or 6 per cent in the last two weeks, but the combination of coal and railway strikes will greatly decrease production unless a settlement is soon reached. See Ups and Downs of the Market, this issue.

Business for the week ending July 26 totaled $8,228,000,000, a decrease of 5 per cent from the preceding week, which is customary after the mid-month week.

German mark touched new low, 0.15⅜c.

Liberty bonds continue to advance.

Money can be had for 3@4 per cent on call, 4@4½ up to six months.

Railway equipment buying heavy as result of strikes. Several hundred new locomotives bought, while freight-car orders run into the thousands. New York Central R.R. ordered 150 freight locomotives last week. Illinois Central ordered 1,000 gondola cars.

Seasonal Employment Among Building Trades Workers

Study of 92,300 Cases in New York Reveals Interesting Figures.—Recommendations Made.

Results of an analysis of seasonal employment among the building trade workers in New York City made by the New York Building Congress show that among a total of 92,300 actual cases studied there is an average employment of 83 per cent during the entire year, with the lowest point at about 50 per cent in December and the peak in May, June, July, August, September and October. In many of the trades employment runs 100 per cent during the spring, fall and summer months. Though the congress did not investigate the conditions of employment among all the 150,000-odd building trade workers in New York, it considered that it made a sufficient analysis upon which to base general conclusions and recommendations.

The chart shows the results of the investigation classified according to occupations. The chart indicates the number of cases investigated. Although the congress is aware of the fact that an entire cure for seasonal unemployment is impossible because of weather, opportunity for investment, emergency and will of the owner or

Engineering News-Record Construction Cost Index Number

August, 1922	173.40
July, 1922	169.70
August, 1921	193.07
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is 3.7 points higher than last month, due to continued stiffening in prices of steel and lumber. Steel is now $1.70@$1.80, Pittsburgh mill. Cement remains at $2.05 net in Chicago. Lumber is $2 higher in New York. Common labor remains at 44c. as an average for the country. Thus, general construction cost is 10 per cent cheaper than one year ago and 37 per cent under the peak; it is 73 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
July, 1922	118
June, 1922	187
July, 1921	90
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 118 for the month of July, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 118, for July, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA IN JULY, 1922

	[illegible]	[illegible] Atlantic	[illegible]	[illegible] West	West of Mississippi	Western	Canada	Total
[illegible]	[illegible]	$1,283,000	[illegible]	$209,000	$589,000	$199,000		$3,274,000
[illegible]	[illegible]	250,000	1,202,000	1,468,000	76,000	692,000	$235,000	3,946,000
[illegible]	1,470,000	421,000	569,000	452,000	1,127,000	119,000	721,000	4,879,000
[illegible]		22,000	25,000	50,000	223,000			320,000
[illegible]	1,682,000	8,222,000	4,564,000	9,019,000	5,821,000	3,525,000	703,000	33,536,000
[illegible]	[illegible]	[illegible]	1,490,000	5,066,000	211,000	1,753,000	350,000	11,616,000
[illegible]	[illegible]	[illegible]	3,638,000	16,662,000	2,045,000	4,773,000	494,000	50,834,000
[illegible]	[illegible]	[illegible]	1,320,589	1,494,557	1,146,730	239,352	.....	7,099,906
[illegible]	50,000	1,316,000	419,000	232,000	75,000	1,577,000	....	3,669,000
Total	[illegible]	[illegible]	$13,844,589	$34,652,557	$11,313,730	$12,877,352	$2,503,000	$119,173,906

speculator, it considers that certain recommendations can be based upon the analysis made. Such recommendations include:

1. Establishment of a wider range of rental period dates.

2. Regulation of government, state, city, religious and educational building construction so that it may come during the low period of employment wherever possible.

3. Regulation of construction of new buildings and additions erected for the owner's prearranged occupancy without regard to investment returns so that it will come during the low period of employment.

4. Encouragement of a plan to begin work on March 1 instead of May 1, thereby bringing labor demand two months ahead of the demand peak.

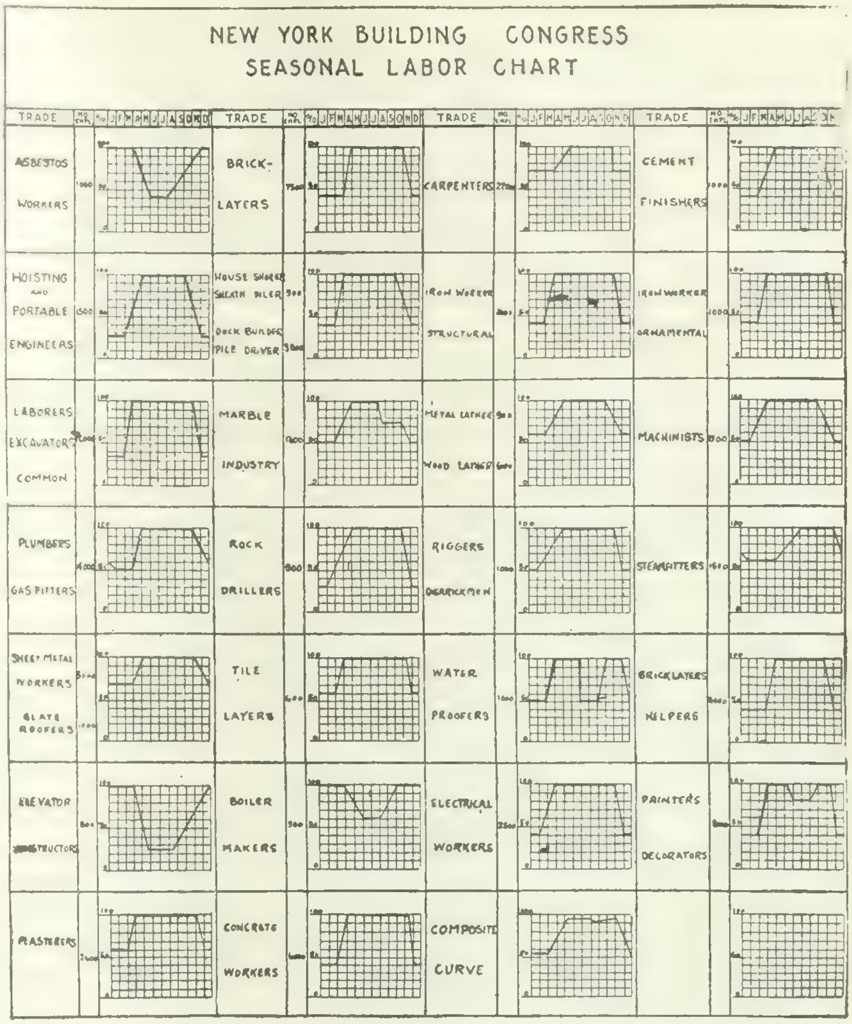
5. Planning maintenance and repair work to come during a season of low demand for labor.

6. Adaption wherever possible of the demand for "inside" and "outside" work to the labor available.

The New York Building Congress would carry into effect its recommendations by distribution of published matter on the points in newspapers, magazines and trade journals and by discussions and resolutions among various civic and fraternal labor organizations.

The Committee on Seasonal Employment, which made the investigation, was composed of Walter Roberts, chairman; Charles E. Mack, Roswell D. Tompkins, Fitz-Henry Faye Tucker, H. H. Watters and Frank L. Glynn.

Bond Market steady last week owing to brighter outlook in strikes and reparations. Brisk demand for municipals, without advances in bid prices; dealers pointing to scarcity in this class.



Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron.—Growing scarcity advances price of No. 2 foundry, 50c. in Pittsburgh; $1 in Philadelphia and $2 in Birmingham, New York, Cincinnati and Chicago. Basic up 50c. in Pittsburgh and Philadelphia and bessemer, 50c. per gross ton in Pittsburgh.

Railway Supplies.—Light rails up 10c. per 100 lb. in Birmingham and $3 per ton, f.o.b. Pittsburgh. Rails (8@45 lb.) in Pittsburgh, $10 per ton cheaper than one year ago.

Pipe.—Cast-iron pipe down 50c. at Birmingham mill and $1.40 in Chicago but rose $2.50 per ton in New York, during month. Wrought pipe prices unchanged despite increased demand. Sewer pipe advanced ½c. per ft. in Atlanta. Price tendency upward, in all clay products, due to fuel situation. Philadelphia and Minneapolis, however, report very slight drop in price of sewer pipe.

Road and Paving Materials.—Asphalt, both in package and in bulk, up $4.50 per ton in Minneapolis. Wood-paving blocks advanced 10c. in New Orleans, due to higher lumber prices. Philadelphia quotes reduction of 32c. per sq.yd.

Sand, Gravel and Crushed Stone.—Both sand and gravel advanced 15c. per cu.yd. in Seattle, due to labor and transportation conditions. Crushed stone, 1½-in., down 40c. per cu.yd. in Montreal.

Lime.—Common hydrated lime quoted at $13.11 as against $12.29 per ton in New York. Atlanta reports advance of 50c. per ton on hydrated finishing and 5c. per bbl., 180-lb. net, on common lump. Brick shortage preventing scarcity of lime. San Francisco, however, quotes common hydrated at $16 as against $18 per ton last month.

Cement.—Higher fuel costs cause mill advances of 10c. at Steelton, Minn.; Leeds, Ala., and Hannibal, Mo. Mill rise reflected in following advances: f.o.b. Duluth, 12c.; San Francisco, 8c.; Minneapolis, 10c.; Atlanta, 16c. and St. Paul, 10c. per bbl. Reductions of 5c. in Atlanta and 10c. per bbl. in Montreal.

Steel.—Steel shapes, plates and bars quoted at $1.70@$1.80, f.o.b. Pittsburgh, as against $1.60@$1.70 per 100 lb., last month. Quotations of $1.70 increasingly difficult to obtain; as high as $1.90@$2 quoted on plates and $2 per 100 lb. on shapes, for immediate deliveries. Curtailment of coal deliveries causing decreased production at mills. Structurals up 15c. in New York warehouses. Blue annealed sheets, base size, up 15c. in New York and 20c. per 100 lb. in San Francisco. Triangle mesh and wire nails higher at mill.

Brick and Hollow Tile.—Despite scarcity and increased demand common brick quoted in New York at $20, wholesale, as compared with $21 per M. one month ago. Philadelphia quotes rise of 50c. per M. but slight drop reported in Pittsburgh. Advances in hollow tile in Chicago, Atlanta, Montreal and Seattle, due to fuel shortage.

Lumber.—Despite declines in buying, price advances exceed reductions throughout the country. Long leaf yellow pine up $2@$3 in New York and down $2 per M. ft. b.m. in Chicago. Yellow pine structural timbers, base sizes, advanced in Minneapolis, Philadelphia, Birmingham and Atlanta; down in Montreal and Dallas. Douglas fir up in Minneapolis and Philadelphia; lower in Denver. Hemlock and spruce up in Philadelphia; down in Denver.

Scrap.—Iron and steel scrap prices weaker. Railroad malleable cast, however, quoted in New York at $12 as against $11 per gross ton.

Explosives.—Average drop of ½c. per lb. on dynamite, over country.

Little Construction Machinery Exported in May

Perhaps the chief interest in the figures of construction machinery exported from the United States in May, as reported by the Department of Commerce lies in the small volume represented. Only 226 units were exported, worth but $376,832. Of these, 196 were hoists and derricks. Except for a few hoists and derricks, nothing was shipped to Europe. As might be expected, Canada, Mexico and Japan appear to offer the best markets. Seven power shovels, nine cranes and four hoists went to Canada. Japan took one shovel, 339,873 lb. of dredging machinery, five cranes and seventeen hoists. Mexico received 207,156 lb. of dredging machinery, one crane and fourteen hoists and derricks.

Coal Loadings Gain 8,338 Cars

Freight loadings totaled 860,907 cars during the week ending July 15, compared with 718,319 for the preceding week, which included a holiday. This represents an increase of 142,588 cars, according to the American Railway Association, or practically the same number as loaded during the week of June 17. Compared with the corresponding week in 1921, an increase of 86,023 cars is shown and a decrease of 81,944 as against the same week in 1920.

Coal loadings amounted to 77,334, an increase of 8,338 cars over the preceding week.

Labor Rates and Conditions Throughout the Country

With marked improvement in the granite and textile situations, over conditions existing a month ago, and settlements effected in the minor manufacturing strikes, the two principal disturbing factors are now concentrated in the railway and coal controversies.

Uncertainty of fuel supplies and impending car shortages, caused by the combined effects of the two strikes, have definitely retarded business, during the last month.

In addition to the strike situation, comes an ever increasing shortage of common laborers as well as skilled building trades mechanics, throughout the country. What little unemployment remains among common laborers is confined to the large centers of population, while building trades employers are making concerted efforts to divert the common labor supply to the outlying districts where it is most needed at present.

Increases of 10c. per hr. for common laborers are reported in Atlanta and Pittsburgh as well as in several smaller municipalities; while Montreal quotes a decrease of 5c. per hr.

The general tendency in all construction trades is toward either stabilization of the present wage scales or actual advances in pay. Hodcarriers in New Orleans, however, have been reduced 10c. per hr., pending settlement of a wage dispute. That, and the slight reduction in Montreal constitute the only wage cuts noted in twenty-one cities reporting to *Engineering-News Record.*

Latest Department of Labor reports show gains in employment in all industries excepting stone, clay and glass products. Local labor conditions as reported by *News-Record* correspondents are given as follows:

New Orleans. — Fair demand for skilled labor; common labor plentiful. No big construction under way. Negotiations with hoisting engineers and hodcarriers have not been concluded. Men are working at the old scale, without contract.

Birmingham.—Common labor becoming scarcer; many men leaving the city for higher wages elsewhere.

Detroit. — Supply of building trades mechanics about equal to the demand. Volume of construction falling off slightly, due to higher building materials prices and wage demands.

Montreal. — Scarcity of bricklayers and plasterers; all other trades plentiful.

Philadelphia.—Bricklayers and piledrivers scarce; fair supply of other crafts.

Pittsburgh.—Not enough bricklayers and carpenters. Plenty of hodcarriers and common laborers but barely enough hoisting engineers and structural ironworkers.

New York. — The situation in New York is mainly one of a shortage of bricklayers and plasterers. However, construction activities have not been hampered by strikes or serious wage controversies. Slight differences have existed between the two separate and district building laborers' unions in the city, namely, the Independent Bricklayers' Helpers' and Building Laborers' Union and the International Hodcarriers', Building and Common Laborers' Union. The former, with a membership of 17,000, has entered into agreements with the Building Trades Employers' Association, to maintain the hodcarriers' wage schedule of 87½c. per hr. for the balance of the year. This organization is not affiliated with the American Federation of Labor nor is it opposed to that body. The International Union, however, is a part of the Federation, covering the same trades and at the same wage rates. Cement and concrete laborers continue under the 1921 schedule, 81¼c. per hr., with a plentiful supply of men. Pick and shovel men, although unionized, have entered into no agreements with the employers and operate at the rate of 60c. per hr. Nonunion laborers receive as low as 44c. per hour.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$0.70	$0.30	......	$0.65	+$0.30
Baltimore	[illegible]	.80	.87	.54	$0.74	1.00	.30
Birmingham	1.00	.75	.50@1.00	.15@.25	......	1.00	.15@.20
Boston	[illegible]	.90	.90	.60	.90	.90	.55
Cincinnati	1.25	.95	.95	.72½	.77¼	.95	.40
Chicago	1.10	1.00	1.10	......	1.10	1.05	.72½
Cleveland	1.25	1.04@1.10	1.04	.60	.91	1.10	— .57½
Dallas	1.00	1.00	1.00	.60	1.00	1.00	.25
Denver	[illegible]	1.00	1.00	.75@.81¼	1.00	1.03⅛	.35@.50
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.07½	1.00	1.00	.80	1.07½	1.07½	......
Los Angeles	[illegible]	1.00	1.00	1.12½	.87½	1.00	.56¼@.62½
Minneapolis	1.00	.80	.80	.65	......	.80	.35@.50
Montreal	[illegible]	.65	.50	.35	.50	.55	— .25@.30
New Orleans	1.00	.85	.90	—.50	.80	1.00	.35@.40
New York	[illegible]	1.12½	1.25	.87½	1.00	1.12½	.44@.60
Pittsburgh	[illegible]	1.12½	1.00	.80	1.00	1.00	+.50@.60
St. Louis	1.25	1.12½	[illegible]	.85	1.00	1.05	.35@.40
San Francisco	[illegible]	1.00	1.00	.75	1.00	1.12½	.47½@.50
Seattle	[illegible]	.80	.90	.70	1.00	.80@.90	.50@.60
Philadelphia	1.00	.90	.90	.75@90	1.00	.90	.25@.35

Price changes since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$25 50†	$24.50
Northern Basic....	26 52†	19.00
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	[illegible]	22.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	31 66†	30.26
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	20 50†	20.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25 @ 2.75 sil.).........	28 32†	22.50
Virginia No. 2 (silicon 2.25 @ 2.75)............	29 74†	29.74*
Basic.	26 00†	21.50†
Grey Forge......	26 00†	21.50
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	24.50†	20.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)....	27.17†	26.66
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	25 50†	22.00
Basic....	25 50†	20.50
Bessemer............	25.50†	22.50

*F.o.b. furnace. † Delivered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails..	$40.00	$45 00		$40.00
Standard openhearth rails..	40 00	47 00	$40 00	40 00
Light rails, 8 to 10 lb......	**35 00**	45 00	**1 70***	1 60@**1.70***
Light rails, 12 to 14 lb..	35 00	45 00	**1 70***	1 60@**1.70***
Light rails, 25 to 45 lb	**35 00**	40.00	**1.70***	1.60@**1.70***
Rerolled Rails............	28.00	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1 35	$1 50
Chicago, Hardwood and Red Oak........	1.20	1 30
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco...... Green Douglas Fir	.85	1 10
San Francisco, Empty Cell Creosoted, Douglas Fir	1.86	2.30
St. Louis, White Oak*........................	1 10	1 44
St. Louis, Red Oak*........................	97	1 17

St. Louis (creosoted)...............No. 1, $0 86; No. 2, $0 96; No. 4, $1.28

*Standard specifications 38c. per tie additional. Zinc chloride process 27c. per tie additional.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, 9/16-in. and larger..........	$2.25@**2 35**	$3.00	$2.55	$3 00	$4.10	$2.80
Track bolts..........	3.00@**3 50**	4.00	3 65	4 25	5 10	3 80
Standard section angle bars..............	2.40	2.75	2.40	3.00	4.00	3.00

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3..........	71	58½	¾ to 1½	44½	29½

LAP WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2..............	64	51½	2..............	39½	25½
7½ to 6.........	68	55½	2½ to 4	42½	29
6 to 8..........	65	51½	4½ to 6.......	42½	29½
7 to 12........	64	50½	7 to 12	40½	27½

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	69	57½	¾ to 1½... ...	44½	30½
2 to 3	70	58½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2....... ..	62	50½	2	40½	27½
2½ to 4.........	66	54½	2½ to 4.........	43½	31½
4½ to 6....	65	53½	4½ to 6..	42½	30½
7 to 8	61	47½	7 to 8	35½	23½
9 to 12.........	55	41½	9 to 12.........	30½	18½

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	66%	62½%	59%
2½ to 6 in. lap welded	61%	59½%	56%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	53%	48½%	45%
2½ to 6 in. lap welded	47%	45½%	42%

Malleable fittings, Class B and C, from New York stock sell at **list less 10%**. Cast iron, standard sizes, *32-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Current	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.........	*$41.50*	**$58 30**	$53 30	*$49.20*	$43.70	$55.00
6 in. and over	*37.00*	**53 30**	48.30	*45.20*	39.70	51.00

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$40 00	$50 00	..	$50.00	.....	$55.00
4	50 00	60 00	$80.00	60.00	$76.50	65.00
5	80.00	90.00		80.00	97.75	84.00
6	100 00	115.00	140 00	100.00	127.50	110.00
8	150.00	185.00	200.00	150.00	212.50	181.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.16	$0 087	..	..	$0.12	$0 12	......
4........	.16	087	$0 09	$0 0875	.12	15	$0 18
5...........	.22	1305	.1125		.18	.18	.165
6...........	.22	1305	.135	1225	.18	21	.25
8......	.37	203	.225	20	28	30	.35
10	.54	3045	.2925	28	42	42	.....
12.	.70	.3915	.3825	.36	54	54	.80
15..	1.20†	.522	5625	.52	72	90	.....
18..	1.65†	725	.765	.68	1.00	1.32	.....
20	2.10†	87		.92	1 20	.....	.....
22...	2.70†	1 16		..	1 60	.....	.....
24	3 05†	1 305	1.50	1.20	1 80	2 16	2.40
27	4.70†	2 34	....	2 00	3.75†	3 00	.....
30	5.20†	2 59	....	2.45	4 75†	3 60	.....
33..	6 70†	3.51	....	3.00	5 50†	..	.....
36.............	7.70†	4.00	....	3.25	6 00†	.. ..	.....

	3	5	8	12	24	36
Boston..............	$0 105	$0 1575	$0 245	$0 4725	$1 575	$4.408
Minneapolis..........	.		40	[illegible]	[illegible]	*5 66* †
Denver...............	.135*	.18*	.27	47	1 70	.....
Seattle...............	.13	...	.32½	65	2 34	....
Los Angeles...........	11*	165*	.275	495	1 65	.....
New Orleans..........	.. .	.106	.27	.459	1.755†	.....
Cincinnati............	096	144	224	.43	1.44	4.382†
Atlanta...............	**09***	**135**	**.22**	**375**	**1 45**	.....
Montreal, *delivered*.....	.30*	45*†	.70	1.35	4.50†	..
Detroit	.099	.1485	.231	.4455	1.935	5.125†
Baltimore	.1225	2275	.35	.6870	2.29	5.23
Kansas City, Mo.....	.15*	.21*	.335	60	2 41	4.74
Philadelphia ...	105	.1575	[illegible]	*.4725*	*1.575*	*3.5875*†

*4-in., 6-in., 9-in., respectively. †Double Strength

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Current	One Year Ago
New York, 45% asphalt......(at terminal)	$0.05	$0 05½
New York, 65% asphalt......(at terminal)......	.045	.05
New York, binder...........(at terminal)......	**0575**	.06½
New York, flux.............(at terminal)........	**.055**	.05½
New York, liquid asphalt....(at terminal)........	.06	.07
St. Louis, 30-50% asphalt (*f.o.b.*) *Wood River, Ill.*	.05	.02¾*
Chicago, 40-50% asphalt	**05½**	.06
Chicago, 60-70% asphalt	**05½**	**.06½**
Dallas, 40-50% asphalt..............................	.10	.10
Dallas, 60-70% asphalt	13	.13
Dallas, 75-90% asphalt..........................	15	.15
San Francisco, binder, per ton..................	13 00†	**15.00**

* Freight $21 75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbl. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (Grade D) (Mexican)	$17.00	$13.00
Boston (Mexican)	18.50	14.00
Chicago (Standard)	20.50	14.00
San Francisco, f.o.b. [illegible], Oleum, Cal	19.50*	13.00*
Dallas (Texas)	35.00	27.00
Seattle "D" grade (California)	23.75	13.00*
Denver (California)	40.00	
Minneapolis f.o.b. Twin Cities (Mexican)	33.50	28.00
St. Louis (Mexican)	22.35	14.00
Baltimore (Mexican)	18.00	13.00
Los Angeles, [illegible], Bakersfield [illegible]	22.50	15.00
Montreal (Mexican)	28.00	21.00
Atlanta (Mexican)	22.00	16.50
Detroit (Mexican)	19.00	15.00
Cincinnati (Mexican)	32.00	28.00
Maurer, N. J. (Trinidad or Bermudez)	28.50	26.50
Maurer, N. J. (Mexican)	18.50	16.50
Philadelphia (Mexican)	18@20	15.00
Kansas City, petroleum	28.83	22.83

*Freight to San Francisco, 80c. per ton.

†f.o.b. Richmond, Cal.

NOTE—Barrels or drums are optional [illegible]. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York [illegible]	5-in granite, 28@29 blocks per sq.yd.	$131.75 per M
Chicago	About 4x8x4 dressed	3.20 sq.yd.
	About 4x8x4 common	3.00 sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M
Boston	5-in. granite	125.00 per M
Atlanta	Granite	2.00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	100.00 per M
Baltimore	Granite	2.00 sq.yd.
Montreal [illegible]	Granite	100.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 sq.yd.
Cincinnati	Granite	3.84@4 sq.yd.
St. Louis	4x8x4 dressed	3.35 sq.yd.
	4x8x4 common	3.00 sq.yd.
Kansas City	No. Granite	3.95 sq.yd.
Philadelphia	Granite	125.00 per M.

FLAGGING—

New York	Bronx	$0.25	sq.ft.
	Manhattan, 4 ft	.26	sq.ft.
	Queens, 5 ft	.26	sq.ft.
	6x20-in. cross-walk	1.00	lin.ft.
Chicago	18 in. wide	.99	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York ([illegible])	3	16	$2.04
New York ([illegible])	3	16	2.17
New York ([illegible])	4	16	2.36
Boston	3	16	2.17
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50
St. Louis	3½	16	2.50
St. Louis	4	16	3.00
Seattle	4	16	Off market
Minneapolis	3½	16	2.09
Atlanta	3½	16	2.30
New Orleans	3	16	1.70
New Orleans	3½	16	1.90
New Orleans	4	16	2.10
Dallas	4	18	3.90
Baltimore	3½	16	3.44
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.10
Kansas City	4	16	2.15
Philadelphia	3½	16	[illegible]

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$1.75	$2.25	$1.75	$2.25	$1.00	$1.25
Denver	1.75	2.00	1.75	1.80	0.75	1.60
Chicago	1.80	2.25	1.80	2.25	1.80	2.25
St. Louis, [illegible]	1.25	1.45	1.30	1.45	1.10	1.60*
Seattle	1.25	1.50	1.25	1.50	1.25	1.50
Dallas	2.25	3.50	2.25	4.00	2.25	3.00
Minneapolis	1.50	2.00	1.50		1.00	1.00
Cincinnati	1.87½	2.25	1.87	2.25	1.43	[illegible]
San Francisco	2.25	2.25	2.25	2.50	1.50	1.50
Boston	2.40	2.65	2.40	2.65	1.65	2.00
New Orleans	2.08½	2.85	2.08½		1.35	1.35
Los Angeles, per ton	1.50†	1.45†	[illegible]†	1.45	1.35†	1.30
Atlanta, per ton	1.85	2.35	1.85	[illegible]	1.15	[illegible]
Detroit	2.60	2.25	2.60	2.25	2.00	2.25
Baltimore, per ton	1.40	1.40	1.60	1.60	2.00	.70
Montreal, per ton	1.25	1.50	1.50	1.50	1.25	1.25
Birmingham, per ton (Crushed slag [illegible] of gravel)					1.28	1.60‡
Philadelphia	1.[illegible]		1.[illegible]		1.60	
Kansas City	2.00		2.00	..	1.20	

* Fine white sand: Pacific, $5 per ton; Ottawa, $6.

† Freight from quarry to Los Angeles is 85c. per ton, and is included in above price.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.65	$1.90@2.00	$1.75	$1.90@2.00
Chicago	1.60	2.50	1.60	2.50
St. Louis *delivered*	1.65	1.60*	1.65	1.60*
Dallas, *delivered*	2.73	2.80	2.73	2.80
San Francisco	2.25	2.25	2.25	2.50
Boston, *delivered*	3.00*	3.00*	3.00*	3.00*
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City, *at plant*	2.10	1.25	2.10	1.40
Denver	3.50	....	3.50	
Seattle *delivered*	3.00	3.00	3.00	3.50
Atlanta	1.90*	2.25*	1.90*	..
Cincinnati *delivered*	1.75	2.06	1.75	2.06
Los Angeles	1.75*	.90*	1.85*	1.00*
Detroit	1.90*	2.00*	1.90*	2.00*
Baltimore	1.75*	1.75*	1.65*	1.75*
Montreal	*1.50**	2.00*	2.00*	2.10*
Birmingham *delivered*	3.20	3.20	3.10	3.10
Phildelphia	1.70*	....	1.55*	....
Pittsburgh	2.85		2.85	....
Cleveland	3.00*		3.00*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
East Canaan, Conn	1.25	1.35	4.00	1.00
Easton, Catasaqua, Pa	1.00	1.00	2.00	0.90
Birmingham, Ala	*0.75*	0.75		0.25
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20		1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$15.80@$16.17	$13.11	$3.63½*	$2.75@$3.14½*
Chicago	18.00	.....	.....	1.40†
St. Louis	23.20	20.00	2.35†	....
Boston	23.00	19.00	3.30†	3.00†
Dallas	25.00	....	....	2.50†
Cincinnati	15.10	12.50	10.75‡	12.50‡
San Francisco	22.00	[illegible]	....	1.75†
Minneapolis	29.00	22.00 (white)	1.70†	1.40†
Denver	24.00		....	2.70†
Detroit	18.00	16.00		17.00‡
Seattle *paper sacks*	24.00		2.80†	....
Los Angeles	30.00	30.00	3.00*	3.00*
Baltimore	15.00	13.00		12.00‡
Montreal	21.00	21.00	15.00‡	11.00‡
Atlanta	23.00	13.00	2.00†	1.80†
New Orleans	....	17.25	1.75†	..
Philadelphia	13.00	12.00	10.50‡	9.50‡

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.70, Sheboygan $1.55. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.60	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	1.77	1.87
Boston (Rosendale) per bag	.80	0.95@1.05
St. Louis (Carney hydrated)	2.10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York, del. by truck	$2.40@2.50	$2.40@2.50	$2.60@2.70
New York, alongside dock to dealers	2.10	2.10	2.10
Jersey City, del. by truck	2.28	2.28	2.89
Boston	2.50	2.50	2.86
Chicago	2.05	2.05	2.17
Pittsburgh	2.09	2.09	2.17
Cleveland	2.31	2.31	2.43
Detroit	2.33	2.33	2.43
Indianapolis	2.26	2.26	2.43
Toledo	2.33	2.33	2.49
Milwaukee	2.22	2.22	2.39
Duluth	2.14	2.04	2.10
Peoria	2.26	2.26	2.45
Cedar Rapids	2.33	2.33	2.51
Davenport	2.28	2.28	2.47
St. Louis	2.20	2.20	2.90
San Francisco	2.71	2.63	3.09
New Orleans	3.20	3.20	3.20
Minneapolis	2.39	2.29	2.41
Denver	*2.85*	2.90	3.10
Seattle	2.90	2.90	3.10
Dallas	2.25	2.25	2.60
Atlanta	2.50	2.34	2.75
Cincinnati	2.39	2.39	2.57
Los Angeles	3.30	3.30	3.21
Baltimore, del. by truck	2.50	2.50	3.58
Birmingham	2.10	2.10	3.05
Kansas City	2.40	2.40	3.20
Montreal	*2.78*	2.88	2.75
Philadelphia	2.31	2.31	..
St. Paul	2.39	2.29	2.41

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind	$1.80	Mason City, Ia	$1.95
Universal, Pa	1.85	Hudson, N. Y.	2.00
Steelton, Minn	1.95	Leeds, Ala	1.95
Fordwick, Va	1.95	Hannibal, Mo	1.95
Mitchell, Ind	1.95	Lehigh Valley District	1.90
LaSalle, Ill.	1.70	Kingsport, Tenn	1.95
Iola, Kan	1.95	Richard City, Tenn.	1.95

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	Dallas	San Francisco
032	22	$0 74	$0 95	$0 81	$1 15	$1 15
049	28	94	1 23	1 04	1 46	1 48
068	35	1 14	1 48	1 26	1 80	1 80
093	45	1 46	1 91	1 61	2 30	2.32
126	57	1 80	2 35	1 99	2 86	2 87
153	68	2 14	2 81	2 37	3.40	. . .
180	78	2 46	3 22	2 73	3 93	. . .
245	103	3 24	4 25	3 59	5.15	. . .
287	119	3 75	4 90	4 15	5.96	6 01
336	138	4 35	5.69	4 82	7.32	. . . .
395	160	5 04	6 60	5 58	8.00	. . . . .
PAVING						
036P	17	$0 56	$0 72	$0 62	$0.88	. . . . .
053P	24	79	1 02	87	1 24	. . . . .
072P	31	99	1 29	1 10	1 57	. . . .
097P	40	1 28	1 67	1 42	2 02	. . . .
049R	24	79	1 02	87	1 24	. . . .
067R	31	99	1 29	1 10	1 57	. . .
089R	40	1 28	1 67	1 42	2 02	. . .

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft long, or 600 sq ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd for painted are as follows:

Gage	Weight	*New York	Chicago	St Louis	San Francisco	Dallas
27BB	2.3	$17 50	$20 39	$21 25	$23 87	$25 50
26BB	2.5	17 50	22 00	22 75	26 21	27 56
25BB	3.0	20 00		27 10		30 71
24BB	3.4	21 50	26 33	29 25	27 90	33 16
22PO	4.33	21 50	31 00	31 75	. . . . . .	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
¾ and larger	$1 60@1 70	$1 85	$2 73	$2 60	$2 47½	$3 50	$2 55
⅝ and larger	1 65@1 75	1 90	2 78	2 65	2 52½	3 55	2 60
½ and larger	1 70@1 80	1 90	2 83	2 70	2 57½	3 60	2 65
⅜ and larger	1 85@1 95	1 95	2 88	2 85	2 72½	3.75	2 80
¼ and larger	2.10@2.20	1 95	2 93	3 10	2 97½	4 00	3.05

Includes 15c charge for cutting to lengths of 2 ft. and over.

Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	$1.70	$2 25	$3 25	⅜	$1 95	$2 50	$3 50
⅝ in.	1.75	2 30	3 30	¼	2 20	2 75	3 75
½	1 80	2 35	3 35				

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	23.50	$24.60	$18 40	$40 00†	$45 00†
New York (at dock) . . .	20.00	21.00	15@15.50		
Chicago	11 00	11 00	12 00	34 00	42 00
St. Louis, salmon . . .	14 00	14 00	17 00		28.00
Denver, salmon	12 00	12 00	14 00	. . . .	.
Dallas	11 15	11 15	12 50	no market	
San Francisco	15 00	15 00	18 00	. . . . .	.
Los Angeles (del.)	15 00	15 00	15 50	(not used)	
Boston (del.)	16 00	16 00	18 00	42.00†	47 50†
Minneapolis (del.)	17@18	17@18	17 00	. . .	43 00
Kansas City	14 50	14 50	15 50	. . .	. . . .
Seattle	14 00	14 00	14 00	44 00	. . . . .
Cincinnati	15 00	15 00	19 00	41 00	36.50
Montreal	16 00	16 00	18 00	.	68 00
Detroit (del.)	16.50	16 50	16 25@18	36 50	39.50@41
Baltimore (del.)	20 00	20 00	25.00	36 00‡	. . .
Atlanta	11 00	11 00	10 00		. .
New Orleans	12 50	12 50	14 50	. . . . . .	. . .
Birmingham	12 00	12 00	12 00	. . . . . .	. .
Philadelphia	1750@18.50	17@18	16 50@17.50	. . .	44.00
Pittsburgh (del.) .	16 00	16@18	.		.
Cleveland .	14 00	14.00		. . . . . .	

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current on Trucks*	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12.	$0 11120	$0.12320	$0 0741	$0 10	$0 0635	$0 108	
6x12x12 . . .	.16670	.1642	1 0190	.	.08	156	. .
8x12x12 . . .	.20840	.219	1 3900	10	12	244	$0 17890
10x12x12 . . .	. . . .	. . .	1 7320	.	.16		21050
12x12x12 . . .	. . . .	. . . .	1 9790		.185	.	27370

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0 94	$0.177	$0 244
Minneapolis (f.o.b. cars)	076	12475	220
Minneapolis (delivered)	086	14025	248
Cincinnati	0670	1263	175
Kansas City	085	167	.270
Denver	08	.145	21
Seattle (delivered)	11	25	36
Los Angeles factory	095	.176	22
New Orleans	12	.23	36
Detroit (delivered)	070	135	225
Montreal	09	16	.30
Baltimore	14	25	.39
Atlanta	0776	1453	. . .
Dallas	115	.	. . . .
Birmingham	10	17	.
Pittsburgh (del.)	.068	.128	.179
Cleveland	.065	.143	

San Francisco, Philadelphia, Atlanta, New York, quote on hollow partition tile

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	1 70@1 80	$1 95	$2.83	$4 00	$2 57½	$2 68	$3 10
Channel, 3 to 15 in .	1 70@1 80	1 95	2 83	4 00	2 57½	2 68	3 10
Angles, 3 to 6 in., ¼ in. thick	1 70@1 80	1.95	2 83	4 00	2 57½	2 68	3 10
Tees, 3 in. and larger . .	1 70@1 80	1 95	2 83	4 00	2 57½	2 68	3 10
Plates	1 70@1 80	1 95	2 86	4 00	2 57½	2 68	3 10

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse: New York Current	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$2.40	$3 70	$4 40	$3 10	$3 09½	$4.25	$5 50
CONE HEAD BOILER							
¾ in. and larger	2 50	3.70	4 50	3.20	3.19½	4.35	5 65
⅝ and 11/16	2.65	3.86	4 65	3 35	3.35½	4.50	5.80
½ and 9/16	2.90	4 10	4 90	3.60	3 59½	4 75	6.05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2 40@2.50	$2 10	$3 90	$5 00	$3.25	$4 95
Cut	2 25	5 50	5 65	7 75	. . . .	5 00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square, f.o.b., as follows:

	New York: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.
No. 1 grade . .	$2 10	$2 55	$3.00	$1 90	$2 35	$2 80
No. 2 grade	1.85	2.15	2 55	1 70	2.00	2.40

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2 20 for smaller quantities f o b. Philadelphia

Single shingles, red and green slate finish, cost $5.50 per package (sufficient to cover 50 sq.ft.) in carloads; $5.75 in smaller quantities, in Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia. l c.l., $5 75

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft.	$2 00
Tar pitch (in 400-lb. bbl.), per 100 lb.	1.60
Asphalt roofing (in barrels), per ton, f.o.b. plant*	40.50
Asphalt felt (light), per ton, f.o.b. plant*	64.50
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3,00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2 40@$2 60	$3.62½	$3 75	$4 35	$3 78
No. 12	2 45@2 65	3 67½	3 80	4 40	3 83
No. 14	2.50@2 70	3.72½	3 85	4 45	3 88
No. 16	2.70@2.90	3.82½	3.95	4.55	3.98
Black					
*Nos. 18 and 20 . . .	3.00@3 25	3 70	4 30	5 45	4 15
*Nos. 22 and 24 . . .	3.05@3.30	3.85	4.30	5.50	4 20
*No. 26	3.10@3 35	4.00	4.35	5.55	4.25
*No. 28	3.15@3 40	4.30	4.45	5.65	4.35
Galvanized					
No. 10	3.15@3.35	4.30	4.45	. . . .	4.35
No. 12	3.25@3 50	4 40	4.55	5.60	4.45
No. 14	3 25@3 50	4 40	4 55	5 60	4.45
Nos. 17 to 21	3.55@3 80	4 60	4 85	5 90	4.75
Nos. 22 and 24	3.70@3 95	4.85	5 00	6.05	4.90
*Nos. 25 and 26 . . .	3 85@4 10	5 00	5.15	6.20	5.05
*No. 28	4.15@4.40	5.30	5.45	6.50	5.35

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Current	One Year Ago	Chicago: Current	One Year Ago
Raw in barrel (5 bbl. lots)	$0.91	$0 80	$1 01	$0.75

WHITE AND RED LEAD—Base price in cents per pound

	Red				White	
	Current		1 Year Ago		Current	Yr Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	12 50	14 00	13 00	14 50	12 50	13 00
25 and 50-lb. kegs	12 75	14 25	13 25	14 75	12.75	13 25
12½-lb. keg	13.00	14.50	13 50	15 00	13 00	13 50
5-lb. cans	15.50	17.00	16 00	17 50	15 50	16 00
1-lb. cans	17 50	19 00	18 00	19 50	17.50	18 00

LUMBER

Prices wholesale to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional

	6, 8 and 12 Ft.	10, 16, 18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$28 00	$31 00	$31 00	$33 00
3x6 and 8	28 00	31 00	31 00	34 00
4x4-6 and 8	28 00	31 00	32 00	35 00
3x10 and 12	28.00	31.00	32 00	36 00
3x14	32.00	33.00	34.00	36.00
4x10 and 12	28.00	31.00	32.00	35 00
4x14	32.00	33 00	34 00	36 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$30 00	$33 00	$35.00
6x14	32 00	35 00	37 00
8x10	30.00	33.00	35.00
8x14	32 00	35 00	37 00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22–24 Ft.
3x 4 to 8x8	$38 00	$39 00	$41 50	$43 50
3x10 to 10x10	43 00	44 00	44 00	46 00
3x12 to 12x12	46@47	47@48	47 00	49 00
3x14 to 14x14	50@52	51@53	52 00	54 00
3x16 to 16x16	55@57	56@58	56 00	58 00
3x18 to 18x18	65 00	66 00	63.00	65.00
4x20 to 20x20	75 00	76 00	73 00	75 00

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$50.00	$52 00	$55.00	$45 00	$54 00	$52 00
Seattle		23 00		......	...	23 00
New Orleans	30.00		......	......	35 00	
Baltimore	36 45	......	......	......	38 50	
Cincinnati	39 00	50 00	......	......	40 00	64 00
Montreal	50.00	50 00	35 00	38.00	78 00	50 00
Los Angeles	....	44 00	43 00	......	.....	44 00
Denver	.....	36 25	36 25	36.25	.	37 25
Minneapolis	46 00	41.00	40 00	.....	49 00	41 00
Atlanta	35 00	....	....	.....	40 00	. .
Dallas	37.50	....	.....	.....	38 00	
Kansas City	33 00	34.00	.....	....	36 00	35 00
Birmingham	28 00	....	.....	.....	33 00	
Philadelphia	38 00	39.00	43.00	48 50	47 00	39 00
Detroit	41 25	44 00	.		47 00	46 00
St. Louis	35.00	. .	.		38 00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$47 00	$48 00	$32 00	$45 00	$48 00
Seattle	......	15 50	..	...	16 50
New Orleans, at mill	70.00	.....	.....	37.00	
Baltimore	35.00	.....	.....	36.45	. .
Cincinnati	62.50	80 00	.....	33.50	
Montreal	39.50	45 00	27 00	45.00	45.00
Los Angeles	....	37 00	36 00	.. ..	43.00
Denver	....	[illegible] 25	[illegible] 25	.	33.75
Minneapolis	45 50	38 25	36 25	41 75	38 25
Atlanta	22 00	.....	.....	26 00	.. .
Dallas	37 50	30 00	....	40 50	..
Kansas City	35.00	34 50	.....	20.00	31.00
Birmingham	25 00	.....	.....	28 00	.. .
Philadelphia	31.00	37.50	44.00	33.00	37.50
Detroit	42 75	35 00		40 25	38.75
St. Louis	36.00	.....	.....	35.00	.....

Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.
Birmingham—Quotes carload lots, f.o.b. sidings. $2.00 additional per M. ft to contractor.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers prices to contractor on large projects.
St. Louis—Wholesale price to contractors, $4 50@ $6 per M ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire, nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.

Baltimore	$0 315	Detroit	$0 295
Birmingham	69	Kansas City	735
Boston	.365	New Orleans	575
Buffalo	.265	New York	34
Chicago	34	Pacific Coast (all rail)	1.50†
Cincinnati	.295	Philadelphia	.325
Cleveland	.215	St. Louis	43
Denver	1 275*	St. Paul	595

* Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000 lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago

Current	One Month Ago	One Year Ago
$1.65@1.85	$2 00	$2 00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	30%
Patent flattened strand, special and cast steel	30%
Patent flattened strand, iron rope	15%
Plow steel round strand rope	45%
Special steel round strand rope	40%
Cast steel round strand rope	32½%
Round strand iron and iron tiller	15%
Galvanized steel rigging and guy rope	17½%
Galvanized iron rigging and guy rope	+2½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft., ⅝-in., 6; ¾-in., 4½; 1-in., 3⅓; 1⅛-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0 20	New Orleans	$0 17½
New York	17	Los Angeles	16½
Chicago	19	Seattle	.18
Minneapolis	19½	St. Louis	21
San Francisco	17	Montreal	30
Atlanta	20½	Detroit	.19
Denver	.20	Baltimore	.20
Cincinnati	20	Kansas City	18½
Dallas	.29	Birmingham	.20½
Philadelphia	.18½		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0 29	$0.32
Boston	.24	.275
Kansas City	.24	.2750
Seattle	175	.195
Chicago	2450	.2750
Minneapolis	2092	.2295
St. Louis	2475	.2775
Denver	.1775	.2075
Dallas	29	.375
Los Angeles	.23	.26
Atlanta	2525	.2825
Baltimore	.2550	.27
Cincinnati	.2350	.255
Montreal	.195	.235
Birmingham, *delivered*	.155	.175
New Orleans	.2675	.3025
San Francisco	195	.235
Philadelphia	.24	.27

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$11.50	$11.50	$12 00
Stove plate	12.50	12 00	13 50
No. 1 machinery cast	1[illegible].00	16.50	14.50
Machine shop turnings	7.00@7.50	4 00	5.00
Cast borings	7.00@10.00	5.50	6.75
Railroad malleable cast	12 00	12.50	10.25
Re-rolling rails	11.50@12.00	13.00	15.00
Relaying rails	28.50	30.00	15.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
½	$6.75	$5.50	$8.55
[illegible]	6.30	5.05	8.25
[illegible]	6 15	4 90	8 30

* Pittsburgh base in lots of 200 kegs or more $2.50@2 60

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

Volume 89 NEW YORK, AUGUST 10, 1922 Number 6

Criminal Negligence Hard to Prove

TIME and again it has been shown that it is well nigh impossible to punish any one for criminal negligence in building failures. The law's delays and technicalities usually serve to shift the onus of blame, or the requirements of proof are too rigid to permit successful prosecution. In three recent cases this has been found to be so—the dismissal of the first indictments against the various men connected with the Knickerbocker failure in Washington, the release of the owner of the Ferris wheel which blew down in one of New York's suburbs early in June and the exoneration by a coroner's jury of those concerned with the collapse of the Parkway Building in Philadelphia—which partly failed during reconstruction last month. Something more than the ordinary processes of law is required to guarantee punishment for building collapses.

Invidious Financing

THE senatorial minority report on Muscle Shoals noted in the news columns is one of the most naïve documents ever signed by public men. In effect these senators admit that most of the features of the Ford offer are reprehensible but they offer in defense that it is Henry Ford who is going to do these things and he can do no wrong. Most naïve of all is the defense of the sinking fund theory of payment for the use of government property. Why not carry this to its logical conclusion and solve the whole fiscal problem of government and taxation? Let the government borrow as much money as it needs at 3½ per cent and loan it at 4½ per cent. The increment could be used to run the country. Or do the senators and Mr. Ford think this fiscal method should be applied only to his activities?

Interstate Sewage-Works Zoning

INTERSTATE stream pollution control can best be effected by co-operation between the state authorities having jurisdiction on either side of the waters concerned. The Pennsylvania and New Jersey state health departments have given practical recognition to this fact and adopted a joint policy for their guidance in passing on plans for sewage-works along the Delaware River. This agreement is significant not alone as an instance of interstate co-operation in this field but also because it sets up different standards of sewage treatment for successive reaches of the river, varying with the uses to which the water is put. In other words, an interstate sewage-works zoning plan has been worked out by the engineers of the two state health departments and adopted by the departments, as detailed elsewhere in this issue. The agreement deserves careful study by every state department having control of sewage-works and stream pollution affecting interstate waters. Similar stream zoning is also desirable for waters wholly within a single state. Something of the kind is practiced by well-administered state health departments generally but few if any of them have reduced the practice to as clear-cut statements of policy as those adopted by Pennsylvania and New Jersey for the control of sewage-works on the Delaware. The fact that the Pennsylvania-New Jersey policy is not based on analytical standards is notable.

The Bates Road Tests

THE sixth and final run of traffic over the Bates experimental road is now being made under the direction of the Illinois State Highway Department. As each run has been completed the Illinois officials have issued a bulletin embodying observations on the condition of the 63 test sections into which the 2-mile road is divided. To date five bulletins have been issued and the data they contain is summarized elsewhere in this issue. So much interest has been manifested by highway engineers in the Bates road tests that a progress statement covering the observations to date will be widely studied. It should be understood, of course, that nothing in the way of final conclusions has as yet been issued by the Illinois department and that pending the completion of the final traffic run and an analysis of results made with a full knowledge of local conditions, judgment as to the relative merits of the various types of construction should be withheld. Involving a cost of $300,000 or more, the Illinois work constitutes one of the country's most important programs of research and has been the objective of inspection trips by hundreds of engineers and highway officials from other states. The mere fact that a certain section is recorded as a "failure" under a certain increment of traffic means nothing without a full understanding of the conditions which governed the construction of the section and the conduct of the test. The results published in this week's issue, therefore, should be viewed in the light of a progress report rather than as a source of data on which to base conclusions.

Simple Precautions Against Sea Water

THE Coney Island boardwalk, illustrated on another page, will not be directly over the ocean so that its concrete piles are not subjected to the alternate wetting by sea water and drying out during the out tide. It is, therefore, not in the critical location of the many similar concrete structures whose deterioration may be laid to direct sea water attack. A near-by municipal bath house, however, was equally removed from contact with the water but this did not save its reinforced-concrete members from breakdown that required extensive repair. With certain kinds of concrete, therefore, ocean exposure at Coney Island is dangerous. It remains to be seen whether the precaution taken in the new boardwalk will suffice. These precautions are simple—merely the greatest of care in mixing and placing the concrete, the use of a rich mixture and the covering of

the steel by at least 3 in. of concrete. The boardwalk is low and adequately braced that it will not suffer from the vibration that probably hastened the cracking of the high unbraced piers on the California coast and the workmanship on it is good. Five years from now an inspection of it will show whether some special panacea is required to make reinforced concrete stand up in sea water moisture.

Not in the Contract

CONTRACTING can be reduced, in instances, to a thorough business arrangement wherein only known factors enter. Clear specifications; amity, not enmity, between contractor and engineer; delivery of materials and prosecution of the work in accordance with preconceived plans; and absence of unforeseen difficulties; all these minimize the chance of the contractor's failing to make a profit. Under such conditions administration, superintendence and the personal element usually determine the margin of profit. But the perfect contract is rare. Besides, many contractors, particularly of the old school, are in the business because of the indeterminable factors entering particular contracts. The wagering instinct is strong in all humans and satisfaction of it is found by some in the contracting business. In the construction of the Coney Island boardwalk a new factor entered—a factor which easily could have been overlooked by the bidding contractor as being necessary to cover as a "contingency." The work has reached its peak during the height of the summer season. A hot day at Coney Island means a seething mass of humanity stretched along a mile or so of beach of an average width of around 100 ft. Jetting piles is a process watched by the curious thousands kept out of harm's way by police. Inability to secure access to the work at the most convenient points makes it necessary to drag concrete piles by tractor a maximum distance of 1,000 ft. Details concerning the difficulties the contractor must face in working with armies of men, women and children at his figurative elbow are unnecessary. Anyone who has been to Coney Island on a hot August afternoon can visualize them. But the fact remains that they are difficulties probably unaccounted for in the contract.

A National Engineering Museum

IN last week's issue we announced a movement, under the auspices of the American Society of Mechanical Engineers, to establish a national engineering museum at Washington. Doubtless the proposal will stir the imaginations of engineers throughout the land, largely because of the sentimental values involved. From the very fact that a museum must be located at one place the educational values are not quite so obvious. But having at the national capital an engineering shrine comparable with the South Kensington Museum, the Paris Conservatoire des Arts et Metiers and the Munich Deutches Museum must impart to the professions of applied science a consciousness of public appreciation that would be decidedly stimulating. The educational value of such a museum could be greatly enhanced by the compilation of a well-illustrated descriptive catalogue for distribution to technical reading-rooms, libraries and schools. Such a plan would bring about a more general acquaintance with the collection and would broaden its usefulness, promote its popularity and insure its support and development. This may seem to be but a detail to be considered later when the museum is a going concern. Perhaps it is. But we suspect that the announcement of such a purpose would help to win many valuable specimens from their present custody and otherwise further the project in its earliest stages.

An Intellectual Famine

MOST of us think of Russia in terms of peasants. When we picture to ourselves the woe that has come to that stricken land we see starving Moujiks and their famished children. So our charity has been directed toward keeping alive the spark of bare animal life. This work has been well done, and now Secretary Hoover tells us that the danger of famine is past. But now and then *Engineering News-Record* receives evidence that still another famine remains to be fought, not only in Russia, but also among other war-ridden peoples. A case in point is the letter of M. Stroganoff, which appears elsewhere in this issue. Another is found in an appeal recently received from a Russian professor of civil engineering who, through three dire years, has carried on his courses under most disheartening handicaps. He now bespeaks aid to print his texts for the benefit of his students, a step that hitherto has been beyond his means or those of his school. From Germany, too, comes a voice appealing for help to bring up to date the shelves of technical libraries. Now that the needs of the flesh have been met, we may with propriety turn to a consideration of the intellectual famine. In Russia, Germany, Austria, Poland—throughout eastern Europe, indeed, men of science have perforce subordinated their intellectual hunger to the physical needs of their compatriots, while their zeal has kept burning the lamp of scientific investigation and education. Prof. Winslow's request deserves more than a casual reading by those who may be in position to help.

Building Code Experts

NEW YORK STATE is to have a standard building code and, at the bidding of the legislature, the state industrial commissioner has appointed a committee, the chief purpose of which, according to reports, is "to lay down minimum standards of safety in the construction of motion picture theaters and other places of public assembly in order to prevent catastrophes such as those which occurred last winter when motion picture theaters in Brooklyn and Washington collapsed." Those two failures were due to structural insufficiency, which would not have occurred if the proper principles of structural engineering had been followed. A code intended to avoid such conditions should naturally be prepared, at least in part, by engineers, but who did Commissioner Sayer place on the committee? Labor leaders, actors and theatrical men, a health officer, a policeman, an illuminating engineer, a hotel man, two architects, two insurance men, and five building officials. Not one of these men, with the possible exception of the building officials, is competent even to pass upon the structural requirements of theaters, much less to establish such requirements themselves. Albany would appear to be a good place for engineers to start a campaign of public information as to the service the engineer can render the world.

Individual or Group

WITH many engineers and engineering societies it has become a favorite literary and oratorical sport to complain about the reluctance of the community to accord to the engineer his "rightful position of leadership" and to assume that this position can only be won by group action accompanied by abundant publicity. In this enthusiasm for concerted thought and performance there is danger that the individual's duty and responsibilities will be forgotten; if it is, there will be lost one of the most powerful agents of benefit to the profession and to the community.

Leadership is not a right; it is a power. In a democracy it is not bestowed upon a class or a group; more often it is gained by the individual through capacity to inspire confidence and to serve effectively. However numerous and all-pervading our societies, however eloquent our spokesmen, and however prolix our press-agents, engineers will not be acclaimed by the community because we "tell the world" how good we are. The leadership in public affairs that may be attained by the profession will after all be neither greater nor less than the aggregate leadership attained by the individual engineers that compose it.

Frequently we hear peevish outbreaks because lawyers seem to be preferred to enginers as leaders in public affairs. Lawyers do not become leaders *because* they are lawyers. They lead in public affairs, first of all, because they participate in public affairs. That, of course, is not the whole story. If they are to become leaders they must do more than merely participate. But at this very first step most engineers fall down.

How many engineers take an active part in the affairs of their communities? How many, for example, are members of their local Chambers of Commerce or of the other community organizations that interest themselves in public affairs? How many, in other words, even expose themselves to leadership? Some do, of course. The column "The Engineer in Public Life" in each issue of this journal is testimony of that. But the number is still too few, though our observation has been that when an engineer does show enough interest in public affairs to participate in works of this sort he is welcomed eagerly, and once he has gained the confidence of his lay associates his counsel is sought and he is quickly accorded such measure of leadership as his merit justifies.

Engineers can bring to their communities a vast deal of helpful and efficient service. We are inclined to agree with the comment of Professor Dunlap on another page of this issue that most engineers find it difficult to speak well or write well but we are unwilling to subscribe to his conclusion that they cannot think well. We believe that most engineers can think mighty well along the line in which they have been trained. But so much of his thinking travels the undeviating tangent of scientific truth that the engineer often skids mentally when he tackles the twists and turns of human nature. But if he is to take "his rightful place of leadership" this is the road he must learn to travel with confidence, speed and security.

Because of this disability and his difficulty in writing and speaking well, it happens frequently that the engineer is a poor salesman of his ideas. But this is an individual defect that must be cured in the individual. As Professor Dunlap suggests, his education can be designed to help him more than it now does. It can broaden his interests, teach him something of his relation to the industrial world in which he must work and give him a start in the art of writing and speaking well. But if he is to become the well-rounded man he must be to rank as a leader among his fellows he must develop these faculties by contact with his fellow men and by participation in community affairs to the limit of his time and ability. And he must do it himself. Obviously, dependence on the engineering society or the society press-agent is not going to strengthen his powers in this respect. If the engineer is going to swim in the sea of public affairs he must jump in himself.

If every engineer who thinks his profession should participate more actively in public affairs would join and take an interest in his local organization that deals with public affairs, the profession could exert more honest, constructive influence on the public welfare than in any other way. We might not get the word "engineer" on the front page of the newspapers as often as we could by going it alone with the aid of a press-agent; but such notice is ephemeral and of doubtful worth. A year of it will be outweighed in solid value to the profession by the intelligent service of one engineer on some public committee together with the lawyers, bankers and business men of the community. The value of such association to the individual engineer goes without saying.

The Seniority Issue

LAST week the railroad operators rejected the President's proposal for the settlement of the railroad strike. They objected to the restoration of seniority rights to the strikers as against the employees who remained at work and the new men employed.

To our mind the operators had to act as they did. The President has placed too small importance on the seniority issue. It is true that no additional compensation is involved. High seniority rating merely gives the right to select the better jobs, day in preference to night work, etc. Nevertheless, these are substantial advantages in the minds of the men—evidenced by the very fact that the strikers have held out against settlement until their seniority was restored.

But there is more involved than the value to the individual of the seniority rights. If the railroads were to submit to the President's proposal they could never again in case of a strike get employees to stay on their jobs or induce worth-while men to take the strikers' places. Only ne'er-do-wells would take jobs limited to the duration of the strike.

In this case there was clear warning to the shopcraft employees that they were jeopardizing their seniority rights. The chairman of the Railroad Labor Board warned them that they would lose their seniority, and that the men who remained in the service and those now entering it, would have rights "that the board could not ignore." With this warning, with the obvious justice of rewarding those who remained in the service and of assuring permanence to those who took the strikers' places, with the value placed upon seniority by the strikers themselves, we see no other alternative for the railroad executives than to reject the President's proposal.

As Woodrow Wilson said in one of his war messages "The right is more precious than peace."

Cincinnati Double-Deck Terminal for Electric Lines

Viaduct to Ohio Bridge — Concrete Station and Office Building — Structural Details — Over 1,400 Cars Daily Removed from Congested Streets

A DOUBLE-DECK terminal for interurban electric cars as an annex to a large office building, with a main passenger approach through an arcade in this building and with a viaduct connection from the upper floor to the Covington bridge over the Ohio River, is a recent development in the local transportation service at Cincinnati, Ohio. Both buildings are of reinforced-concrete construction except for steel framing where the track layout necessitates an unsymmetrical spacing of columns. Concrete footings of the spread and cantilever types in a sand and gravel formation constitute the foundation. Fig. 1 is a view of the main front of the building and Fig. 2 shows the two new viaducts flanking the bridge approach. Two electric lines operated by the Cincinnati, Newport & Covington Street Railway Co. on the Kentucky side of the river enter Cincinnati over two separate bridges. These lines serve the cities of Newport and Covington and several outlying towns. Originally the cars looped over a portion of the Cincinnati street railway system and thus added to the traffic congestion in the business district. With the opening of the new terminal in October, 1921, these cars are kept clear of the congested district and avoid all interference with the city cars. A proposed development is to bring the interurban line of the Cincinnati, Lawrenceburg & Aurora Electric Ry. into the new terminal. This will involve a 6½-mile extension including about a mile of elevated line.

FIG. 1. DIXIE TERMINAL BUILDING, CINCINNATI, OHIO, WITH ARCADE ENTRANCE TO STATION

In the layout of the terminal, a sidehill location on ground sloping up from the river facilitates a separation of grades for the line over the Covington bridge, as shown by Fig. 3. Thus there is a difference of 28.64 ft. in elevation in the 400-ft. block between Third and Fourth Sts. At the corner of Walnut and Fourth Sts., is the north section or office building, 142 x 231 ft., with nine stories in front and ten at the rear. Through this building extends a handsome arcade 25 ft. wide and 34 ft. high which is lined with shops and forms the main approach to the terminal station in the south section or annex of the building. This annex is 139 x 183 ft., four stories high, with tracks on the first and second floors. Stairways from the end of the arcade at the first floor or Fourth St. level of the office building lead down to the second floor of the terminal, which has also a side entrance on Walnut St.

Directly opposite the terminal is the Covington suspension bridge which has along each side a car track isolated from the roadway. Formerly these tracks swung into the roadway on the Cincinnati approach and continued down this incline to connect with the street car tracks on Third St. Two short single-track viaducts have now been built by the Covington & Cincinnati Bridge Co. to divert these bridge tracks from the approach roadway and carry them over Third St. into the second floor of the Dixie Terminal (see Fig. 2). The Newport cars cross the Newport or Central bridge about half mile eastward and run on Third St. to the terminal, where they enter the first floor. This arrangement is not objectionable since the street is outside of the congested district. Fig. 4 shows the layout of the two terminal floors.

Structural Features of Office Building—Floor construction in the main building is of the long-span cored or ribbed type, using gypsum floor tile as cores. The panels vary from 18 x 26 ft. to 18 x 40 ft. in column spacing and the floors are designed for a 50-lb. live-load.

Above the third floor the office building is L-shaped with girders spaced 18 ft. 4 in. c. to c. running lengthwise of the short leg and crosswise of the long leg. In the former there are four girder spans of 41, 26 34 and 39 ft., while in the long leg they are about 41 and 26 ft. In order to reduce the dead weight of the structure the ribbed concrete floor with gypsum tile between the ribs was adopted. Since the width of the upper or compression flanges of the concrete girders was reduced towards the end supports in an approximate parabolic curve the tile fillers start nearer and nearer to the stem of the girder, as shown in Fig. 5. The rib in the center of the panel parallel with the main girders is intended as a distributing or bridging rib to take care of the possible overloading of one or several of the cross ribs.

An attic slab just below the roof is suspended from the roof girders by means of hangers incased in concrete, in order to reduce the span and consequently the size of the attic floor beams so that they would project but slightly below the ceiling. This is shown by the cross-section of the longer leg of the building in Fig.

6. In the longer span the inverted type of attic beam was used so as to obtain a flat ceiling. The floor below this part of the attic is to be used for a large assembly or club room and an extra high ceiling was required on this portion. The portion at the right indicates the general ceiling height for the story below.

In the design of this structure one system of four beams across the whole building was adopted, with the columns above and below as part of the structure. The theory of least work was the method employed in determining the moments and shears for various manners of loading and the results were checked by the slope deflection method indicated in Faber & Bowies book. Since long-span girders and comparatively low story heights caused quite a little induced bending in the end columns the stresses in these were considered with great care. In the case of the roof girder where the story height was very low and no column above the roof to assist in taking the bending it was found impracticable to design a column to take care of this condition. This difficulty was met by haunching the girder bearing down to the attic, where a slip joint was provided, as shown in Fig. 6. When the forms were removed the movement at this joint was approximately what had been anticipated of the structure.

Structural Design of Terminal—Three methods of floor construction are employed in the south or station building, which is four stories high and is shown in section in Fig. 7. In general the flat-slab system is used with two-way reinforcement and panels 25 ft. 4 in. x 27 ft. Along the east side, however, the beam and girder system was used since the track layout on the two lower floors made is necessary to eliminate one row of columns. This portion of the building has beams 37 ft. long and bays 25 ft. 4 in. x 37 ft. are divided into three panels by beams spaced about 8½ ft. c. to c. This construction is designed for a live-load of 341 lb. on the track floors and 60 lb. on the two upper floors.

Along the loop of the car track the regular spacing

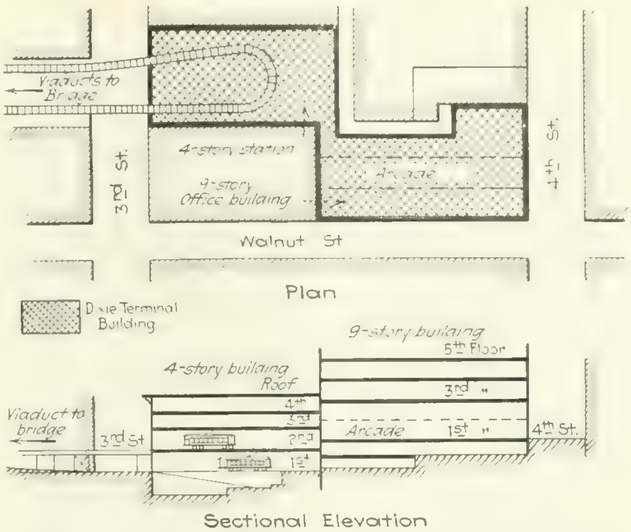


FIG. 3 LAYOUT OF DIXIE TERMINAL AT CINCINNATI

of the columns in the upper floors could not be maintained (Fig. 4). To meet this condition steel columns located to suit the track arrangement carry steel girders in the third floor framing to support columns of the third and fourth floors (see Fig. 7). These steel columns and girders are cased in concrete.

Considerations of headroom and deflection restricted the design of these steel girders. Since the large concentrated load from the supported column caused high shear in the girder a box type of girder was resorted to, with triple webs in some cases. Deflection became an important factor as the third floor was completed before the structural work for the floors above was started. As this work would continue, the bases of these girder-supported columns at the third floor line would settle more than the adjacent columns not supported on girders. This would have the same effect as columns settling unequally and would result in unsightly cracks. To meet this condition the flanges of the girders were

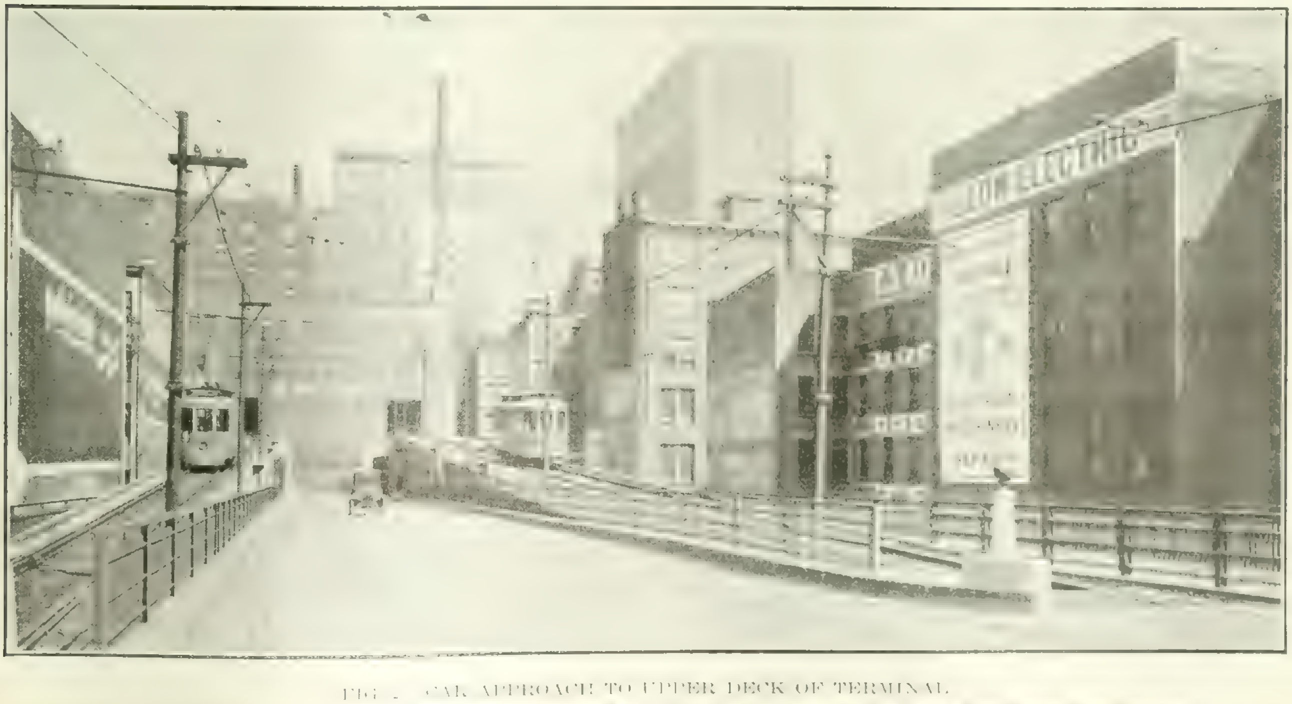


FIG. 2 CAR APPROACH TO UPPER DECK OF TERMINAL

Roadway and old tracks descend from bridge to Third St. New viaducts ascend to pass over street into station

designed with a low extreme fiber stress so that the deflection would be comparatively small.

Track openings in the south wall at the first floor are 28 ft. 8 in. and 17 ft. 6 in. wide, with a height of 16½ ft., those on the second floor are 17½ and 14 ft. wide with a height of 14½ ft. The extra width of one opening is due to the diagonal location of the tracks.

Freight and express matter for tenants of the office building are delivered in the basement of the station building, thus relieving the streets of an obstruction to traffic. This basement is reached from Third St. by a concrete incline 23 ft. with a grade of 17½ per cent, as shown in Fig. 7. It has a double driveway and the doorways are fitted with rolling steel shutters. Motor trucks and wagons deliver goods on a platform from which they are distributed to the elevators or other parts of the building by a small electric truck. In this basement also are the coal bunker and power equipment for the two buildings.

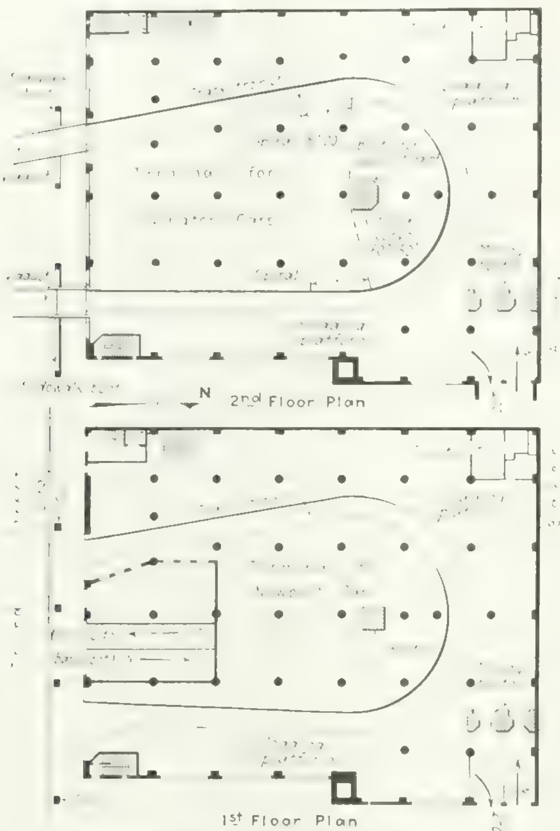


FIG. 4. LOOP TRACKS NECESSITATE UNSYMMETRICAL COLUMN ARRANGEMENT

Viaduct Approaches—A special problem was involved in providing the viaduct connection between the second floor of the terminal and the approach of the Covington bridge. Originally the approach ended at Second St., but as this level was flooded during high stages of the river a viaduct was built to extend the approach to Third St. but retaining an inclined roadway from Second St. This improvement which was completed in 1918, involved raising the grade of the old structure for about 225 ft. and building 737 ft. of steel viaduct. Three-column bents carry a 30-ft. roadway and brackets carry the sidewalks, the total width being 51 ft. except where a 12-ft. offset is required by property lines.

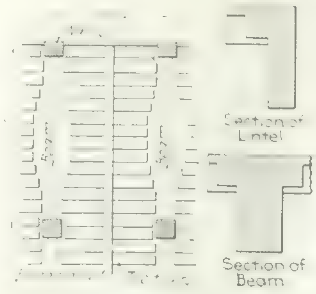


FIG. 5. BEAM AND RIBBED SLAB FLOOR

This bridge approach is not in line with a city street but is faced by a block of buildings on Third St., in which the new terminal station is located (see Fig. 3). Of several plans prepared to carry the bridge cars over this street into the terminal the cheapest was to build two single-track viaducts outside of the approach, but this would have necessitated leading the tracks across the sidewalks, which was objectionable. In the adopted plan, track viaducts on an ascending grade to the north are built outside of the roadway and each carries on the outside a sidewalk on the same descending grade as the roadway. From Second St. the roadway was widened, thus improving the track layout and largely eliminating the effect of the offset at this point. The general arrangement is shown in Fig. 8.

Each single-track viaduct is about 527 ft. long, including 253 ft. of plate, girder construction over streets and three intermediate sections of reinforced-concrete (see Figs. 8 and 9). This combination was adopted partly on account of a slight saving in cost and partly on account of appearance. At Third St. the steelwork is cased in concrete as the city authorities considered that this would improve the appearance (Fig. 8).

Steel Viaduct Construction—Special design was required for the steel portion of the viaduct adjacent to the terminal, the location of columns and girders being governed by the upper and lower track layouts, the lines of the old bridge structure and the street and building lines. The arrangement is shown by Figs. 8 and 10.

In each viaduct there is a bent on the north curb line of Third St. and a 20-ft. tower of two braced bents south of the street line, with a 67-ft. girder span over the street and a short span into the terminal. An unsymmetrical arrangement is required in the west tower, each bent being anchored to a grillage of four 24-in. I-beams cantilevered on footings kept within the property line. The floor beam of the north bent is also cantilevered over the roadway. In the east tower the columns rest

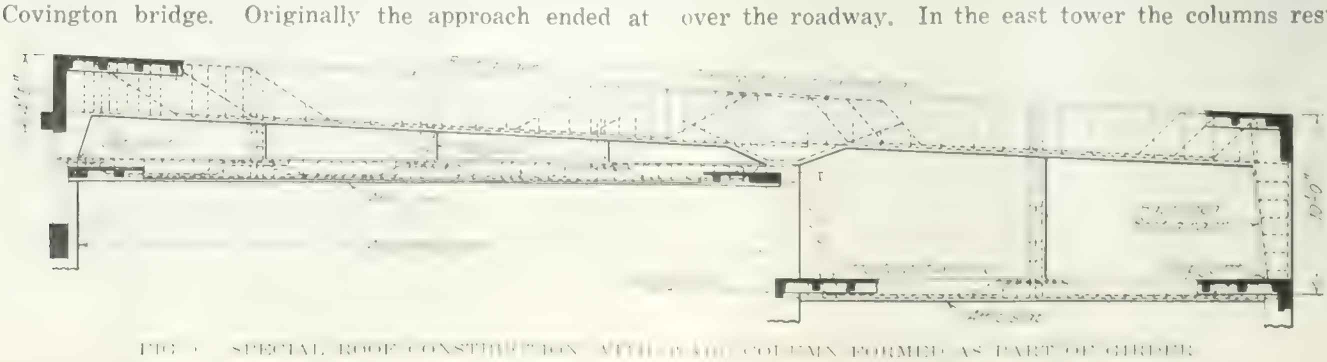


FIG. 6. SPECIAL ROOF CONSTRUCTION WITH [illegible] COLUMN FORMED AS PART OF GIRDER

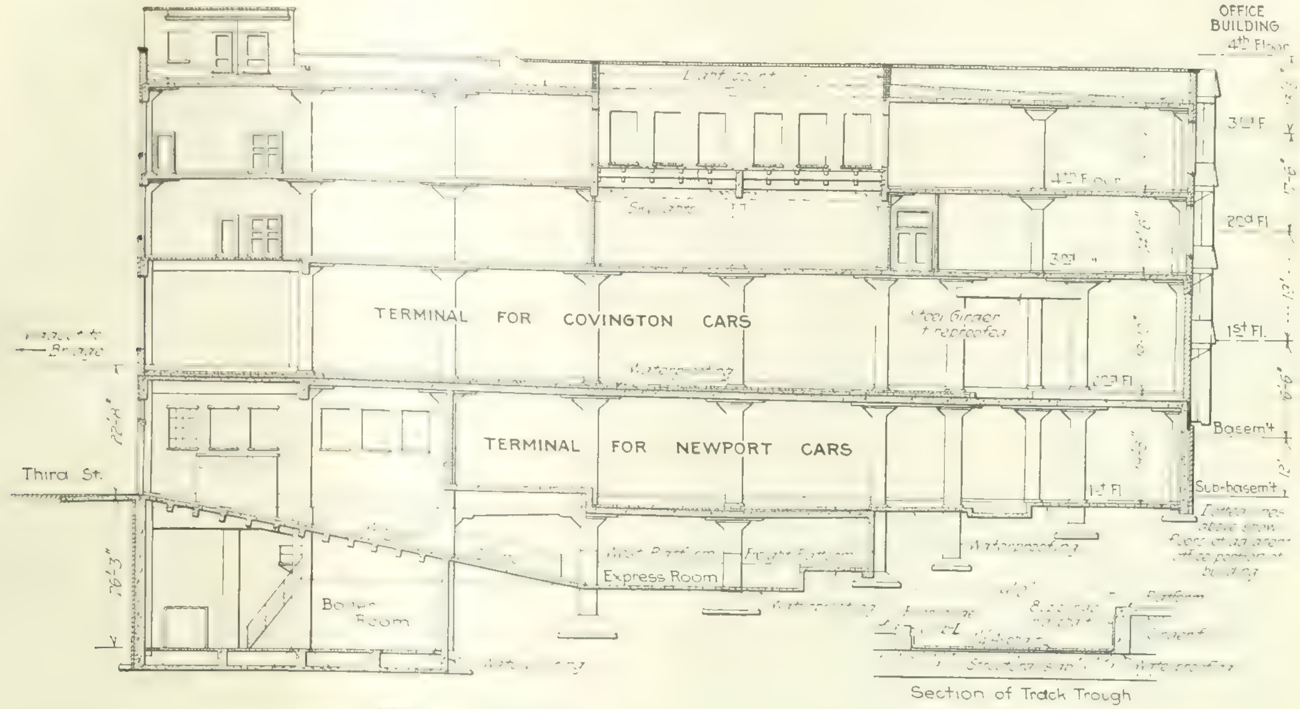


FIG. [illegible] CROSS-SECTION OF TERMINAL BUILDING

directly upon the concrete footings and although the track girders are placed unsymmetrically no overhang or cantilever is required. Both bents of this tower are practically the same, except that one has the doorbeam reinforced by extra stiffeners under the seats for the Third St. girders.

Concrete Viaduct Construction—In the first two concrete sections south of Third St. the west viaduct has two-column bents, as shown in Fig. 11. The columns support a track trough of slab and curved beam construction, and also sidewalk cantilever brackets connected by beams carrying a 4-in. slab 8 ft. wide. As the outer sidewalk line is generally within about 2 in. of the adjacent building the bracket support was adopted to avoid underpinning the foundations of these walls. The two columns rest on piers supported by a single footing. In the last section on the west side, where the grade reaches that of the original structure, the two-column bents support a floor of slab and beam construction with the slab continuous under the track and sidewalk. The columns rest on separate footings. Owing to the proximity of adjacent foundation walls, the floorbeams are cantilevered to partially support the sidewalk, which consists of a 4-in. slab on a cinder concrete fill.

In the east viaduct the bents in the first two concrete sections are of the three-column type supporting the track trough or deck and a sidewalk floor beam (see Fig. 11). The beams are connected by stringers carrying a 4-in. slab 10 ft. 4 in. wide. The two columns supporting the track trough rest on piers built on a single footing, but the outer column rests on a separate footing. The last section of the east viaduct is of the two-column slab and beam type as on the west side, except that the floorbeams are not cantilevered. In all the concrete sections the bents are about 18 ft. c. to c. and stagger the bents in the old structure.

A 1:2:4 concrete mix was used throughout, except for a richer mix in the casing for the steelwork on Third St. All piers and bottom slabs in footings are reinforced. Bottom slabs supporting two piers are reinforced top and bottom. The piers are connected with the columns by stubs or dowels. Main columns are generally 28 in. square, reinforced with $\frac{3}{4}$-in. square rods and $\frac{5}{16}$-in. square hoops placed 12 in. c. to c. Beams are generally reinforced top and bottom and a liberal use of hooked ends is made. Shearing stresses are generally taken care of by stirrups. In the first two sections in each diversion the sidewalk stringer next to the column is made heavier and liberally reinforced

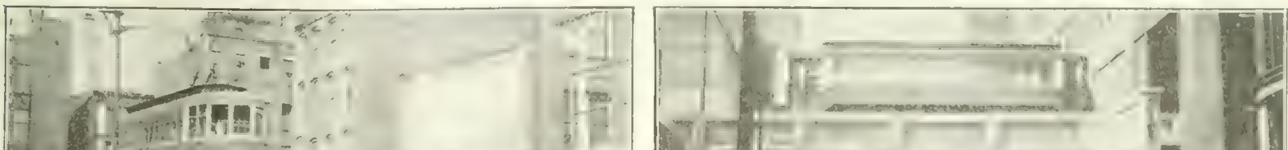


FIG. [illegible] VIADUCT TO BRIDGE APPROACH
Left: Steel and concrete spans with concrete deck. Right: Two single-track concrete-cased steel spans over Third St.

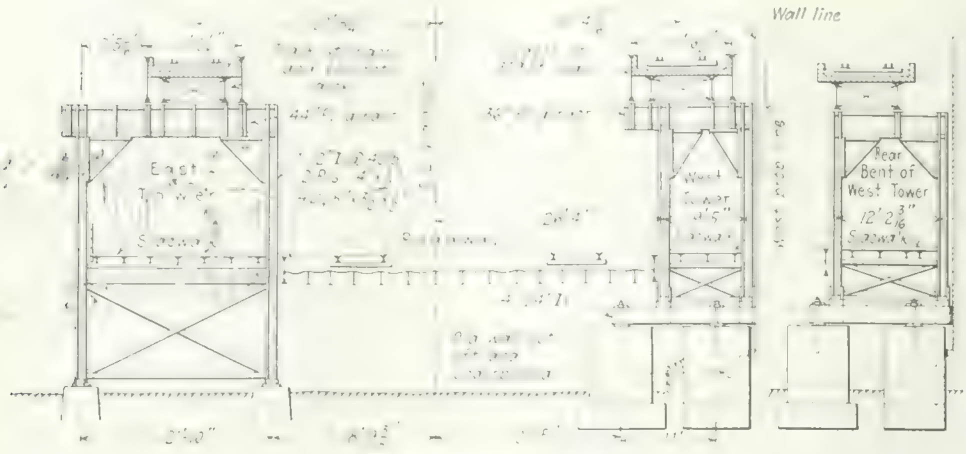


FIG. 10—CROSS-SECTIONS OF STEEL VIADUCT

in accordance with the bridge specifications of the Ohio State Highway Department.

Deck and Track Construction—All the tracks are on the Cincinnati gage of 5 ft. 2½ in. The terminal loops have a radius of 45 ft. 6¾ in. on the center line, with spirals of the Lorain type to connect the circular curve with the tangents. These terminal loops are shown in Fig. 4. A reinforced-concrete track trough supported by the longitudinal girders of the viaduct is 9 ft. 8 in. wide inside and 17 in deep, with 8-in. curb walls and 12-in. slab, except that on the steel sections the slab is 9 in. thick. No waterproofing was used, reliance being placed on securing a good quality of concrete with a sidewalk finish. The trough is drained by 4-in. pipes placed about 35 ft. apart.

In the building the platform or floor outside of the track is level with the top of rail, but on the inside of the loop the floor is 12 in. lower (see Fig. 7). The finished concrete floors are raised above the structural slab by a cinder fill. On the curves the track trough is widened to give the necessary car clearance.

Track construction consists of 100-lb. T-rails on ties 8 x 6 in., 8 ft. long, on 6 in. of stone ballast along the viaduct, but gravel ballast with a large proportion of sand is used on the loops in the station. On the upper loop and the Third St. spans both rails have bolted T-rail guards, but on the remaining portions of the viaducts the guards are 100-lb. T-rails spiked to the ties. At the foot of the grade from the terminal the new tracks have switch connections with the old tracks on the bridge approach. These latter tracks have 7-in. girder rails on wood ties embedded in the concrete base of the granite roadway paving.

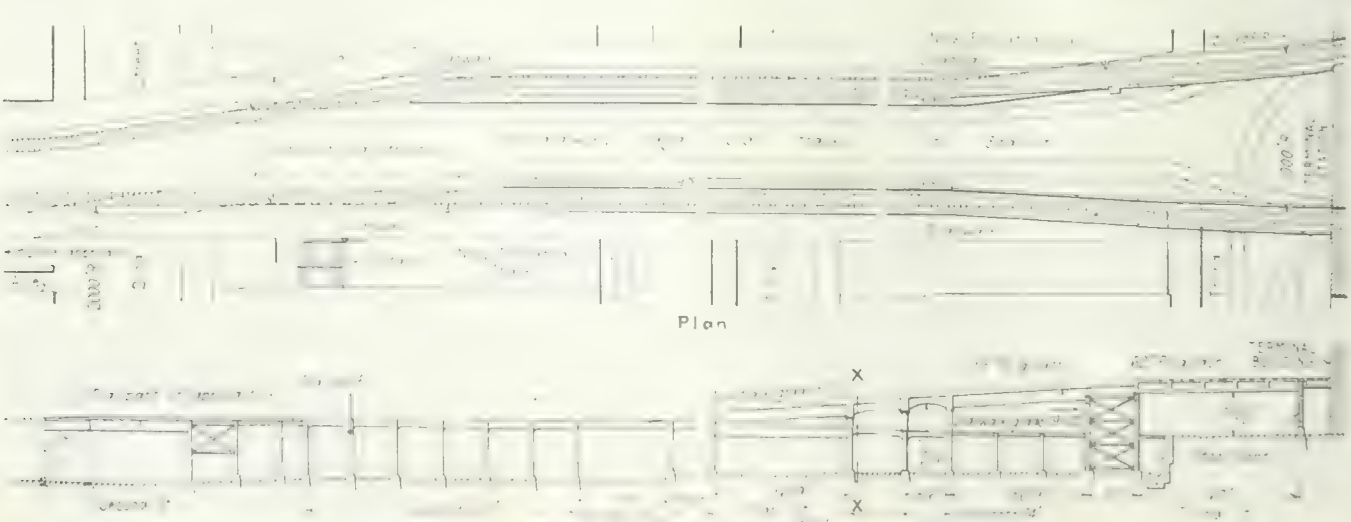
On the lower loop the track construction is similar to that on the upper deck. Special trackwork of the heavy girder type in Third St. in front of the terminal connects the loop with the new double-track line in this street to the Newport bridge. Connections are made

with steel well anchored to the extreme columns to take care of temperature and braking stresses.

The last concrete section in each viaduct is at the grade of the old steel structure and is built against the steel curb girders of the latter. These girders were reinforced by new girders riveted under them and their tops were cut off to allow of the floor connection. South of the new concrete sections the old steel structure was widened by a triangular section on each side (see Fig. 9). On the east side this necessitated the removal of a 42-ft. curb girder over Second St. and its replacement by a new girder of less depth. During this change the old steel framing was supported by a 60-ft. girder on cribbing. This girder was eventually placed at the curb line of the widened roadway.

Viaduct Loading.—Live-loads were used in the calculations as follows: On sidewalks, 100 lb. per square foot; on diversion viaducts, three 50-ton electric cars; on roadway, three 50-ton cars on each track and a 24-ton road roller or 100 lb. per square foot. Stresses arising from centrifugal forces, temperature, braking and wind were also taken into account.

Rectangular frames of steel and concrete were treated as elastic structures with rigid joints. Soil pressures from vertical loads are generally about 3,500 lb. per square foot and the footings of the concrete portions are arranged to secure a practically uniform loading under dead load. The steel superstructure is



VIADUCT FOR CARS TO COVINGTON BRIDGE

also with the old tracks on the bridge approach, so that in an emergency the Covington cars may be diverted to the lower-deck loop.

Engineers and Contractors—The buildings and terminal layout were designed for the Dixie Terminal Co. by Barber & Woodward, architects, Cincinnati, with Theodore Green, Buffalo, N. Y., as structural engineer. Harry C. Reely was superintendent in charge for the architects. Walter G. Franz, Cincinnati, planned the mechanical equipment. The contract for the station building was let to the H. Harig Co., of Cincinnati, and for the office building the Ohio Building & Construction Co.

The diversion viaducts were designed for the Covington & Cincinnati Bridge Co. by Clifford N. Miller, consulting engineer, Cincinnati, who had designed the previous alteration to the bridge approach and who

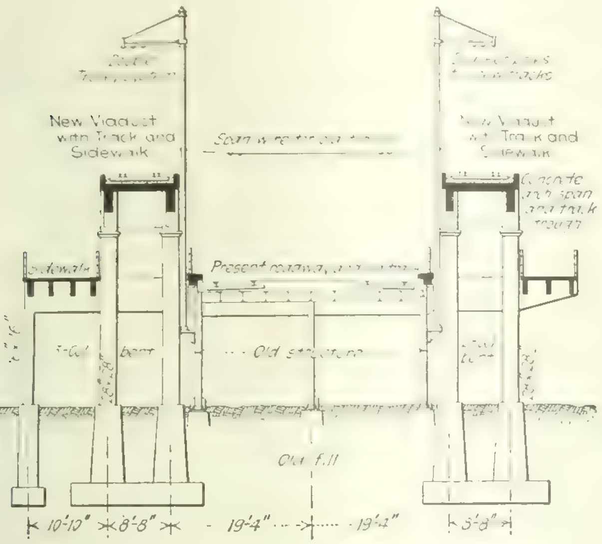


FIG. 11. CROSS-SECTIONS OF CONCRETE VIADUCT

supervised the execution of the work. Steelwork was fabricated and erected by the American Bridge Co. All concrete work was done by the Ferro Concrete Construction Co., Cincinnati.

The first car entered the terminal on Oct. 27, 1921. The daily traffic includes 786 Covington cars and 638 Newport cars. In March, 1922, the total number of passengers carried out of both terminals averaged 31,605 daily. There is no method of registering the number of people carried into the terminal but it is assumed to be about the same as the outbound passengers, making a total of approximately 63,210 passengers daily. These figures are given by W. H. Harton, general manager of the South Covington & Cincinnati Street Railway Co.

Power Plant Under Construction at Quito, Ecuador

Installation of a new power plant has been begun by the Quito Electric Light & Power Co., the operation of which is to commence in November. The plant is located in the Chillo valley and will develop 3,000 horsepower. Equipment is being purchased in the United States. The falls which the company is utilizing are capable of developing a total of 6,000 horsepower. It has been suggested that the government might find it advisable to use this electric power to operate the Quito-Ibarra R.R., as the supply will be sufficient for this purpose.—*Commerce Reports.*

Commerce Department Reports American Ties Used on Chinese Railways

Abstract of report by Frank Rhea, U. S. Trade Commissioner at Peking.

THERE are both present and future possibilities for American railway ties in China. Although steel and concrete are used, the demand is mostly for wooden ties. Concrete ties are quite satisfactory on a well-ballasted railroad like the Canton- Kowloon, which runs through a territory not subject to freezing, and therefore has no heaving of track in the winter to cause breakage, but such ties are entirely too expensive to compete with imported wooden ties. On the Canton-Samshui Ry., a Belgian steel tie has been used which, although expensive, has been reasonably satisfactory, especially as this railway has light traffic and wheel loads. The meter-gage Yunnan Ry., is all laid with steel ties. The Shantung Ry., was originally laid with steel tie of German design, but many of these were removed during the Japanese administration and replaced with wooden ties.

American Timber Used—Northwestern American and Canadian timber is used and is reported to give better results than either the Japanese or Manchurian timbers. In South China, however, the Australian, Indian, or Philippine hardwoods are said to give better service. This is because the wood resists white ants, which are very destructive to ties in that section. Humidity also affects the ties in that territory. Most of North China has light rainfall and most of this during the summertime. This condition probably does not affect the life of railway ties, although in such territory as the western end of the Peking-Suiyuan Ry., extending into the Mongolian territory, it is thought to increase the life rather than shorten it.

Size and Treatment—The usual dimensions for railway ties are 8 ft. x 9 x 6 in. Bridge ties, as a rule, are 10 ft. x 9 x 8 in. There are very few creosoted ties in use in China. The Chinese Government railways, such as Peking-Hankow Ry., Tientsin-Pukow Ry., and others treat their ties in their own creosote plants. Treated ties will probably be used in the future as they become better known.

Tenders are usually called for by the railways concerned and terms of payment arranged by the railway. Payment is probably the most difficult factor at present, as the Chinese railways will give the business to whomsoever will give them the longest credit almost regardless of price. Americans may deal directly with the several railway purchasing departments but much of this business is handled through commission houses. American species are included in official and semiofficial invitations for tenders.

Handling Ethics Cases in Iowa

Following a recommendation of the ethics committee of the Iowa Engineering Society, special committees, usually of local members, are appointed to investigate breaches of the code. In recommending the abolition of a standing committee on ethics the report indicates that engineering organizations with one or two exceptions do not have such a standing committee. The committee also found that members in a position to know something of a case in question are reluctant to furnish the facts and put them in writing. Four cases were reported, but without the co-operation of members so that evidence could be produced necessary to prefer formal charges, the committee could not function. In compliance with the above suggested procedure, one special committee has already been authorized by the executive committee. For work somewhat along the line of ethics is a special committee appointed by the executive committee to investigate cases where bids are received for the position of county engineer when the sole consideration is one of salary.

Engineering Schools Fall Short of Modern Needs

Narrow Training Fails to Meet Cultural and Economic Demands—Suggests Longer Course for Engineering Degree

BY JOHN H. DUNLAP

[illegible]

Since the preparation of the following paper (presented to the Society for the Promotion of Engineering Education, Urbana, Ill., June 21, 1922) Professor Dunlap has been elected to be Secretary of the American Society of Civil Engineers. Special interest attaches, therefore, to his views as to the problems of the profession and the ability of the engineering schools to prepare men to cope with them—EDITOR.

IN view of the enlarged service that our profession is now asked to render, a heavier responsibility than ever before now rests upon the institutions entrusted with the task of preparing the engineer for his life work. Engineering colleges, sensing this responsibility, should determine to maintain their leadership of a generation ago, to the end that ours may be the best prepared of all the professions. But, due in large measure to our failure to understand the imperative needs of a new day, we have allowed our engineering colleges to lose their former leadership. At our annual meeting at Ann Arbor two years ago I called your attention to the following disheartening statistics. (See *Proceedings S. P. E. E.*, Vol. 28, 1921, pp. 128-136.) In the school year of 1898-99 only 14 per cent of the medical schools required for admission more than a one-year high school course, as compared with 33 per cent of the law schools, and 80 per cent of the engineering schools. Moreover, 91 per cent of the medical schools had a four-year course, with an average of 28 months in attendance, as compared with 98 per cent of the engineering schools, with an average of 35 months in attendence. The law school course was much briefer than that of either of the others. Accordingly, twenty years ago, the requirements for admission to engineering schools, as well as the length of course, greatly exceeded those of law and medical schools.

The same test applied now shows results decidedly unfavorable to the engineering schools. The medical schools, twenty years ago at the bottom, are now at the top; while the engineering schools, twenty years ago at the top, are now at the bottom, with the law schools in a middle position. The leading dental colleges began to require in 1921 one year of liberal arts college credit for entrance to the four-year dental course. The graduation requirements of the leading schools of theology now consist of a four-year liberal arts course plus a three-year theological course. Accordingly, engineering colleges requiring four years of study in addition to a four-year high school course are now fifth on the list of professional colleges. Indeed it is very doubtful whether they should be classed as professional colleges at all. You will recall that at the annual meeting at New Haven last year, Prof. W. H. Burr declared the present curricula in our engineering colleges to be behind the times.

Specifications for the Engineer—To write specifications for the engineer is not easy. In *Engineering Education* for May, 1922, pp. 403-406, Prof. Frank H. Neff suggests the following list of desirable qualities: kindliness, modesty, energy, patience, perseverance, honesty, a trained mind, thoroughness, accuracy, capacity for details, and breadth of judgment. This list, however, fits equally well any educated man.

In an editorial in *Engineering News*, May 11, 1893, p. 445, "The Ideal Engineering School," Arthur M. Wellington set forth a list of six acquirements to be expected of an engineering student upon graduation: 1. A good common school or high school education; 2. Ability to look oneself in the face and not be ashamed; 3. Practical gumption, physical vigor, mental calmness and keenness; 4. Ability to appear always at one's best; 5. A book knowledge of engineering; 6. Some practical knowledge of engineering. Four of these six acquirements apply equally well to anyone, while only the last two apply peculiarly to the engineer.

In 1918, Charles R. Mann reported in Bulletin No. 11, Carnegie Foundation for the Advancement of Teaching, "A Study of Engineering Education" that he sent to the 30,000 members of the four founder engineering societies a list of six groups of qualities headed by character, judgment, efficiency, understanding of men, knowledge, and technique. He requested that the list be returned with these six qualities numbered in the order of their importance in determining engineering success. In the seven thousand replies which were received, the character group was voted almost unanimously a place at the head of the list while technique was at the bottom of the list. While we all agree as to the importance of character, we all know that without a mastery of technique, an engineer is a failure. Such a discussion is fruitless. Furthermore, to tell an engineering college that character is important without indicating the educational process by which the college may develop character, is not of great assistance.

Ten Essentials—In that which follows an attempt is made to specify the sources from which character springs, in so far as the engineering college is concerned. I believe that no one of the accomplishments to be specified can be omitted from the preparation of the engineer without failure resulting. The first five specifications are general, and represent acquirements that every educated man should have. The last five are more technical, and represent the additional acquirements peculiarly necessary for the engineer.

1. Every educated man shall know his environment. To know one's environment in this era requires at least an understanding of the principal facts of history, biology, geology, and astronomy; mathematics, physics and chemistry; sociology, political science and economics. It would be impossible for everyone to cover the details of these subjects as they are now presented in most of our curricula. Readjustment of our present water-tight compartment system of departmental organization would have to be made.

2. Every educated man shall know himself. Self, as here used, has the broad meaning which includes not only the individual ego, but also those things and people that act and react upon the individual. For a man to know himself, he must know those great storehouses of human thought and aspiration, literature, music and art. He must know the principal facts of philosophy and of psychology. The task today of knowing self is far more difficult than in the days when to "know thyself" became the ideal of the young Greek. And yet many of our graduates do not attain even the standard of the Greek, to say nothing of that early Hebrew discovery in psychology: "The fear of the Lord, that is wisdom; and to depart from evil is understanding." Illustrations of the failure of modern education in these respects are all too easy to find. For example, I have had an experience with a graduate student which has made me very thoughtful concerning a system of education which permits a man to become a graduate student, who is still a child so far as his knowledge of himself and of his environment is concerned.

3. Every educated man shall think well.

4. Every educated man shall write well.

5. Every educated man shall speak well. It would seem that these last three specifications were so axiomatic that our educational process would insist upon them. If one really wishes to know, however, how little attention is paid to these accomplishments in our engineering courses, he should serve as secretary of a good-sized engineering society. Such an experience would lead inevitably to the conclusion that a pitiably small percentage of engineers can think well, write well, or speak well.

6. Every engineer shall know the sources of scientific information. He should be at home in libraries, and be able to determine what has been written upon any subject in which he may be interested. In this connection I invite

your attention to an article in *Engineering Education* for May, 1922, pp. 407-420, by E. H. McClelland, technology librarian, Carnegie Library of Pittsburgh, entitled "Instruction of Students in the Use of Technical Literature; an Unexploited Phase of Engineering Education." Your attention is invited also to the excellent course of this character at the University of Illinois for the students in chemical engineering.

7. Every engineer shall be skilled in using the method of applied science to solve engineering problems. He must, of course, first master the fundamental principles of applied science so far as they are tools of the engineer. Right here the line is most sharply drawn between the engineer and the physicist, between the applied scientist and the scientist. The physicist needs only to know the fundamental principles of science, while the engineer must not only know them, but also know how to apply them.

8. Every engineer shall be thoroughly trained in costs and values. One definition of an engineer is that he can do for one dollar what anyone can for two. In almost all engineering work the final control of design and construction is cost. Despite the controlling importance of costs and values, very little of scientific worth concerning them is to be found in our textbooks, or magazines. Even *Engineering News-Record*, for example, still reports bids received in such a way as to be of little use to the engineer. Take this case in the issue of June 8. "Maple Heights, Ohio—For 14,735 ft. 4-10 in. mains in Dunham, Rockside, Kohout, Raymond and Royal Sts., from J. H. Dace, 1452 West 98th St., Cleveland, $40,816; W. McDowell & Son, 10319 Miles Ave., Cleveland, $45,514." From such a notice no knowledge whatever can be gained as to the price per foot for different diameters of main, or as to the depths and the conditions under which the pipe was to be laid. A few days ago I was talking about engineering education with the head of the leading firm of structural engineers in Iowa. His comments on the lack of attention to costs in our engineering colleges were emphatic, to say the least.

9. Every engineer shall prove himself to be an economic asset in his work, and shall understand the commercial and ethical aspects of professional practice. Throughout his entire college course he should be taught to look upon himself as one who by his peculiar skill can save his employer much useless expenditure, whether his employer be a private individual, or a group of individuals like a county board of supervisors, a city council, or the public in general. Many of the counties in Iowa are so little convinced that an engineer is an economic asset to them, that they do not hesitate to advertise for bids for engineering services, and to accept the lowest bid. Only a few weeks ago such a case occurred in one of the counties. The secretary of the Iowa Engineering Society, learning at the last minute what was planned, sent the county auditor a letter which arrived at the moment the bids were being opened. Therefore, the letter was opened and read along with the bids. Part of it read as follows: "Your county engineer is a vital factor in the conduct of the affairs of your county, and upon him depends a great deal how much money is saved to your county in carrying out the road program. It is considered unethical among the best class of engineers to submit bids on the basis of salary, and for this reason your county, more than likely, will not get the best engineering services. The best engineer you can get should save your county more than his salary in any year. If he cannot, he has very little excuse for existing. With these facts in mind you will see that it is to your interest to employ your engineer on the basis of his fitness for the position." Strange to say, the board of supervisors was so impressed by this letter that they rejected all bids and re-employed their former county engineer. This situation would never have developed if this county engineer had been taught, in his college days, to look upon himself as an economic asset to his employer, and if he had been taught the necessity of proving it to his employer from time to time. Anyone who does not enjoy cost data, whether applied to construction work or to his own job, probably is out of place in the engineering profession.

10. Every engineer shall be taught throughout his college course that one of his chief functions is to serve his community. Recently I asked Dr. Edward T. Devine, the sociologist, in what direction he considered the greatest hope of our municipalities to lie. He answered at once, in substance, in the application to community affairs of the abilities of technically trained men. In spite, however, of the manifest opportunities for service in our communities, composed as they are today principally of engineering units, our engineers do not occupy their rightful positions of leadership. At a dinner some time ago, I asked a woman who was a leader in the community affairs of her town, a small county-seat of less than four thousand population whether she was acquainted with the county engineer. Imagine my surprise to learn that she had not yet heard of him. As a sequel to this story, it should be added that a few weeks ago this county changed county engineers. Of course part of the trouble is that the training of the engineer is so narrow that he feels himself uncomfortable and embarresed when he attempts to help in public affairs. If the major part of the above specifications could be carried out, the engineer would find himself, as the years of practical experience came to him, the best prepared man in his community, and as a natural result, would assume leadership. While this has an important bearing on the relative standing of engineering as compared with other professions, it is even more important from the viewpoint of the community, and its need of men skilled in the method of applied science.

Specifications Not Met—The first five specifications, which are really essential to every man who calls himself educated, are for the most part ignored in our present engineering courses. Of the last five, which are intended to apply particularly to engineers, only one now receives careful attention; namely, the seventh, that every engineer shall be skilled in the knowledge and application of the fundamental principles of science. The other nine specifications may be met after graduation, and some engineers have found time to do this, but for the most part, the young graduate finds himself so busy for the first ten years furthering his knowledge of technique that he has little time for other study. Except for the successful few, therefore, some substantial progress in these ten objectives must be attained before graduation.

The Time Required—To cover the ground outlined, the course probably must be lengthened to five, and eventually to six years, although much time can be saved by certain modifications of the existing four-year course. So long ago as 1871, General Sylvanus Thayer, known as the father of the United States Military Academy, concluded that a six-year course was necessary and founded the Thayer School of Civil Engineering at Dartmouth. He stipulated that, after a college course of four years in Dartmouth College, a two-year advanced course in civil engineering should be given in the Thayer School. For twenty-two years this plan was followed, until in 1893 a five-year program was adopted, three years of which are given in Dartmouth and two in the Thayer School. Unfortunate experiments in lengthened curricula have been made at other institutions. At present the five-year course at the Thayer School and the six-year course at Columbia are the principal exceptions to the four-year plan. The recent conference at Chicago of the fourteen deans of Middle-West colleges leads us to hope that better days are dawning for engineering education.

But it would probably be unwise to require all the students who begin an engineering course to take the entire five or six years. A better plan would be a two-stage method, similar to that by which engineering is now taught in France and Italy. To quote from the report of the Committee on Technical Education of the Mining and Metallurgical Society of America; Bulletin No. 150, Vol. 14, Sept. 30, 1921, p. 175: "In France and Italy engineering is taught in two stages. The more advanced stage which aims to turn out actual engineers of training, ability, and power, is open only to those who have proved their right to enter it by conspicuous ability and fitness

in the first stage. And the first stage, though preparatory to the second, is so designed that the majority whose college career ends with it are not turned loose as two-spot engineers, yet ill-fitted by training and because of pride to do anything else. Instead, they are equipped to step into positions of intermediate responsibility, where they do high-grade work with entire self respect."

This suggests that the first four years of an engineering course be planned to fit men with no particular engineering ability to assume the subordinate positions in industry. The regular college degree of B. S. might be given at the conclusion of the four-year period. Then those who have shown themselves fit for advanced technical work in engineering should be encouraged to enter the fifth, or the fifth and sixth years of the complete course, from which they might be graduated with the professional degree of C. E.

The Challenge—We should not be alarmed at the suggestion to increase the length of course, in order to prepare the engineer more adequately. During the early history of the Rensselaer Polytechnic Institute, one year was sufficient. We have, therefore, already added three years to the course, and should expect to add more as science expands. The engineer has been making over the world until we are now in the midst of a mechanical age. Notwithstanding this, we have allowed the preparation of our engineers to lag behind the preparation for the other professions, and have actually lost the position of leadership occupied twenty years ago. Dean Mortimer E. Cooley, past-president of this society, recently expressed it in this way: "The engineer a generation ago was better prepared to do the work of his generation than is the engineer of today prepared to do the work of this generation."

We should insist that the engineer be the most carefully prepared man of our generation. He should know his environment and know himself; he should think well, write well, and speak well; he should be familiar with the sources of scientific information; he should know the fundamental principles of his calling and their application to the work of his profession; he should understand the controlling importance of costs and values and become an economic asset wherever he goes; and he should lead in every type of service that goes to upbuild not only his community, but his nation, and the world. Even as science and industry today are international, so should be the thinking of the engineer.

Let us as teachers do all in our power to prepare him to perform worthily his important part in the evolution of civilization.

Motor Vehicle Loads in Massachusetts

During the past two years, and particularly in 1921, the Department of Public Works of Massachusetts has employed an investigator to ascertain what loads were being carried over the highways and to prosecute the law-breakers as he found them. The extent to which the state law limiting gross weights to 14 tons and weights per inch width of tire to 800 lb. has been ignored is remarkable, according to Arthur W. Dean, chief engineer, division of highways, in a recent address before the Boston Society of Civil Engineers. Trucks having a rated capacity of 5 tons and weighing approximately 5 tons were carrying loads weighing from 10 to 15 tons, so that the total load of truck and vehicle was approximately from 15 to 20 tons. With the worn-out tires on many of the trucks the load per inch width of tire was approximately from 1,000 to 1,500 lb. Statistics under preparation by the department show that this overloading is not confined to isolated cases, but is very frequent, and must be considered not only in connection with road surfaces and foundations but in connection with the designing of bridges.

Earth-Filled Cofferdam With Concrete Core Wall

Assembled On Trestle and Lowered by Chain Falls —Sheeting Cut to Contour of Bottom —Dry Dam Secured

UNUSUAL cofferdam construction in an inconvenient location was successfully accomplished in repairing an undermined, submerged wall-footing for the picker house of the Nashua Manufacturing Co., Nashua, N. H. The view, Fig. 1, shows the wall and cofferdam location. Scour produced by a swirl caused by the tailrace discharge meeting the opposite current of the river was the cause of the footing trouble. To disclose this trouble and to make repairs, the footing had to be laid dry and a cofferdam was designed as shown by Figs. 2 and 3.

Preliminary to the construction proper of the cofferdam, a stockpile of loam was assembled on the bank

FIG. 1. COFFERDAM LOCATION DIFFICULT OF ACCESS

in anticipation of frost and also so that the material would be at hand in quantity for quick use. A platform was also built in the stream, as indicated by the illustrations, and on it was assembled the cofferdam materials. From the platform, runways on trestle were built parallel to and on the two sides of the cofferdam wall location.

As indicated by Fig. 3 the dam varied in height from 6 to 12 ft. depending upon the depth of water. The width was 6 ft. from the outside to the inside sheathing, and was divided longitudinally into an outer section 12 in. wide and an inner section 5 ft. wide. The object of this division was to provide a place to pour a 12-in. section of concrete 2 ft. high for the whole length of the dam, about 70 ft. It was thought that this concrete might render it more difficult for the water to pass under the dam. This contingency was anticipated on account of the very uneven nature of the river bottom which was completely covered with boulders of various sizes. On top of this concrete, earth fill was to be placed, while the 5-ft. compartment was to be filled with puddled earth above the water line.

Upon completion of the runways the work of erecting the cofferdam proper was begun. At 8-ft. intervals,

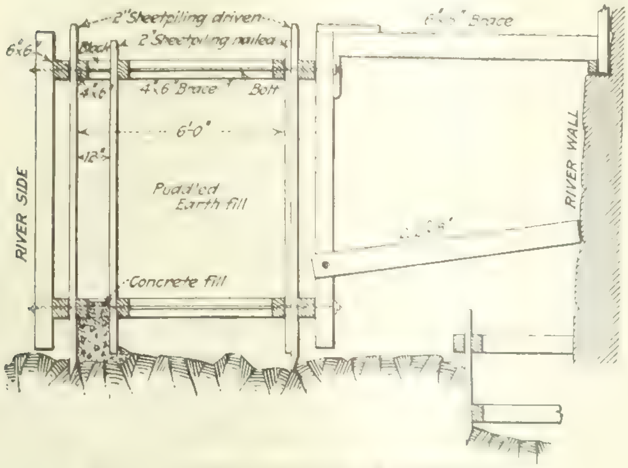


FIG. 2—CROSS-SECTION OF COFFERDAM

8 x 8-in. timbers were placed crosswise from one platform to the other. These were to serve as temporary beams to hold up the cofferdam during erection and were to be removed to allow the dam to be lowered into place.

Very careful soundings were now made over the site of the proposed dam, and profiles of the bottom were plotted. From these profiles it was computed just how many feet above the ultimate position the cofferdam would be built and the relative locations of the top and bottom rangers. It was decided to figure on a 6-ft. drop for the dam. At either end the lower rangers were sloped up so that this 6-ft. drop would not bring them in contact with boulders at any point where the water was shallow.

Before spiking on the sheathing, each piece was pushed down to the bottom and pulled up exactly 6 ft. where it was made fast. The result was that when the sheathing was in place, the bottom ends formed exact contours of the bottom directly under the three rows of sheathing. Consequently, when the dam was lowered, the sheathing conformed to the bottom; the dam maintained a vertical position, and very little driving was necessary before the sheathing started to penetrate, or, where rocks were encountered, refused to go any further.

As soon as the sheathing was in place, the braces and rangers on, and the whole thing assembled and bolted up in accordance with the detail, bents were erected over the dam, about every 10 ft. These bents rested on the platforms on either side. To the cross timbers, which were securely braced, 17 chain falls were attached and the hoisting chains were made fast to the cofferdam.

An even strain was put on the chain falls and the dam raised about 1 in. This permitted the removal of the 8-in. x 8-in. temporary bearers, after which the falls were gradually slacked off and the dam slowly lowered. Care was necessary at this juncture to guard against too much weight coming on one chain fall which might cause it to give way. To make sure that the dam would go down vertically and not be moved out of alignment by the current, 4 x 6-in. guides were put down inside of the rangers, extended to the bottom, and securely braced to the picker house. No weighting was necessary to take the cofferdam to the bottom. When the strain was off the falls, the dam was found resting solidly on the bottom, was standing vertical and in perfect alignment. A few sand bags were placed along the top rangers to guard against any movement and all the sheet piling which was intended to be driven was driven to refusal.

Two feet of concrete were now deposited in the outer 12-in. compartment and the remainder of this section and the 5-ft. section were subsequently filled with well puddled loam. The enclosed water next to the foundation wall was pumped out by means of a 6-in. centrifugal pump driven by an electric motor.

Upon examination, the foundation wall was found to be badly undermined. In the worst place the granite boulders were undermined about 8 ft. This undermining extended the whole length of that part of the building which bordered on the river, approximately 70 ft. A line of sheet piling was driven about 4 ft. outside the face of the old granite foundations. Inside of this at intervals along the walls, short sections were excavated to the required depths and extending from the sheet piling as far and under the wall as the latter had been undermined. Concrete was poured into these sections and carried up to form suitable bearings for the old footing. After this concrete had set up sufficiently to carry a load, the remaining intervals along the wall were similarly treated so as to form a con-

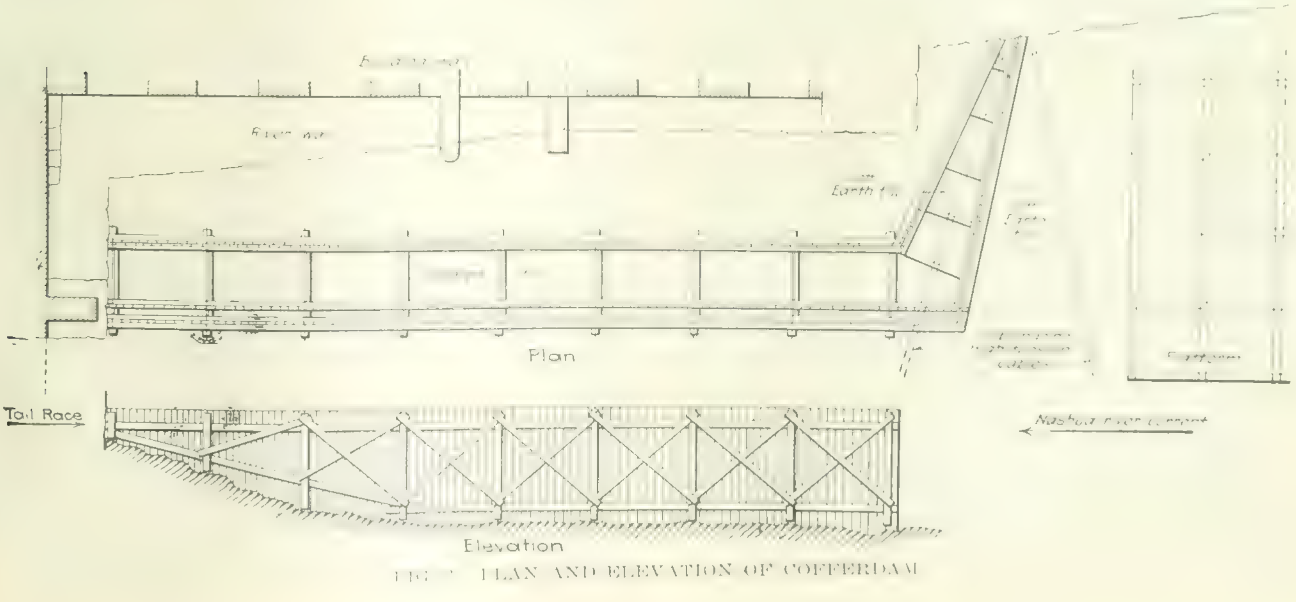


FIG. 3—PLAN AND ELEVATION OF COFFERDAM

tinuous spread footing under the old granite foundations.

Forms were set up and the old stone foundation was faced up on a batter with the concrete wall, the minimum thickness of which at top was about 2 ft. An 8-in. reinforced-concrete slab was carried from the top of this wall over the upper surface of the old projecting foundation and terminated at the brick wall of the picker room. A concrete slab was poured along the bottom of the new concrete facing wall, was carried out to the sheet piling and extended the whole length of that part of the wall which had been repaired. Finally, it was decided to leave the cofferdam in place, as an additional protection to the footing against the abrasion of the rapid curent.

The repair work described was carried on by the Osgood Construction Co., Nashua, N. H., under the supervision of B. J. Craggy, master mechanic for the Nashua Manufacturing Co. Operations were started about Nov. 4, and completed about Dec. 31, 1921.

Generating Station Has Automatic Switching and Control

Dial Telephone Device Gives Head of Water and Gate Opening, Starts and Stops Machines, Warns of Danger, Etc., Over 3-Mile Line

EQUIPMENT for the automatic control of a hydro electric generating station has been developed by engineers of the Westinghouse Electric and Manufacturing Co. and the first installation will be made on the system of the Northeastern Power Co., of Wisconsin. The equipment is included in a contract recently entered into by the electric company to install automatic switching apparatus at the generating station of the Johnson Falls development, about 60 miles north of Green Bay, Wis. The station will consist of two 2,200-kva. waterwheel generators and will be operated over a telephone circuit from the High Falls plant, three miles away.

At the latter station will be installed a dial of the type usually found in automatic telephone systems with a telephone receiver, reversing line key and a loud-speaking receiver for alarm purposes. At the automatic generating station will be installed a 16-volt storage battery together with a group of selectors for performing the various operations and setting up the necessary signals for answers. The connection between these two will consist of a single pair of copper-clad steel wires.

Head Ascertained—If the operator wishes to ascertain the head of water at the generating station he will dial the proper code number and if he has dialed correctly that number will be repeated at the generating station by bell strokes. After the bell signal the operator hears a series of buzzer notes which he counts —the largest number being ten. The total probable variation in the water level is divided into ten divisions, each buzzer tone representing one division. Thus, if the water were at half the normal head the operator would count five buzzer tones and then, by adding the base height of the water to five times the amount of each step, the actual height of the water would be indicated.

Starting Generators—If the amount of water in the forebay is sufficient to operate one machine, the operator clears the line and dials the number required to operate either generator. That number (if the signal is correctly given) will be repeated at the generating station by bell strokes. If the operator in any of these operations signals incorrectly his mistake is revealed by the number of bell strokes given. If, however, the correct number of strokes is counted the line key is left in the closed position for a few seconds and the generator will be started and thrown on the line. If it is desired to stop either machine two other code numbers are provided.

Varying the Load—The automatic control is designed to start the machine and put it on a full-gate opening. If the operator decides that the load cannot be carried by the amount of water available he can reduce the load by dialing the proper number, after which the pilot motor on the governor will be operated for a few seconds. Immediately after the short period during which the governor motor operates to reduce the load, the selector is connected to a code signal device which gives the position of the gate in the waterwheel by means of a series of buzzer tones in the same manner in which the head of water is indicated, each buzzer tone representing one-tenth of the total gate opening. If the load is reduced too much another number for increasing the load on the desired machine is dialed. Another pair of numbers is provided simply to read the gate opening on either of the generators without changing the load.

Alarm Signals—When anything happens in the generating station of an unusual character (if, for instance, the machine shuts down on overload or locks out for any reason) a high-pitched warning tone is put onto the telephone line and sounds to the operator from the loud-speaking receiver. To stop the operation of this signal another number is provided. If, after the warning signal has been given, it is desired to locate the exact seat of the trouble another number will connect in the circuit with a slow-motion selector which will test each piece of apparatus in succession on the two generators. The operator keeps track of the number of operations and is able to recognize the condition of each piece of apparatus by the tone of the signal. A low-pitched buzzer signal will indicate normal operation, while a very shrill, high-pitched tone will indicate trouble. By counting the number of indications, the particular step which gives the abnormal signal can be ascertained and then, by consulting the reference list, the piece of apparatus giving trouble can be identified. Instructions to the maintenance man can therefore be explicitly given.

Hydrated Lime in Concrete

In the report of the discussion by T. B. Shertzer (Lime Association) of the Abrams' tests on hydrated lime in concrete, it was stated (*Engineering News-Record*, July 6, 1922, p. 30) that if the mixtures in the Abrams' tests were adjusted so as to study those of proper water content the average compressive strength of concrete with hydrated lime is 9 lb. per square inch greater than without lime. Mr. Schertzer states that this should be 9.6 lb. per square inch *per per cent of included lime.* This figure, however, is an average. The actual figures show a 14 lb. increase per per cent of lime with 5 per cent inclusion, 11.3 lb. per per cent with 10 per cent inclusion, 6.8 lb. with 20 per cent, 5.1 lb. with 33 per cent and 4.9 with 50 per cent.

Building Reinforced-Concrete Boardwalk at Coney Island

City Putting in 9,500-Ft. Walk and Extending Bathing Beach by 1,700,000-Yd. Sand Fill—Groins and Bulkheads to Prevent Scour—Pleasure-Seeking Crowds Impede Progress

DELIVERY of materials and the actual prosecution of the work has become somewhat of a problem in constructing the reinforced-concrete boardwalk and shore-protection works at Coney Island, N. Y. As the work was started early in the spring it has reached the height of its activity during the busiest part of the season at Coney Island. Consequently, the beach along which the work is being done is swarmed with people on hot days and delivery of materials and prosecution of the work has at times become well-nigh impossible. Also, as the hydraulic fill has not yet been placed the presence of the piles along the bathing beach has become a menace, particularly during heavy seas, which bathers refuse to recognize.

Description of Boardwalk—The boardwalk itself extends from the foot of Ocean Parkway to the entrance of Sea Gate at West 37th Street, the entire length of the city-owned beach, or a distance of 9,500 ft. The walk will be 80 ft. wide or 20 ft. wider than the widest part of the Atlantic City boardwalk. The floor surface will be 13 ft. above normal high tide and will be reached from adjacent streets by double ramps at each intersection. The height of the walk was fixed to give ample clear space under the boardwalk, both longitudinally and laterally. The walk itself is made up of a series of pile bents spaced about 20 ft. apart. Each bent is composed of two groups of four reinforced-concrete piles each group supporting a reinforced-concrete girder. These girders cantilever out beyond the end piles of each group, as shown in the drawings and views, thus leaving a longitudinal expansion joint down the middle of the structure. The piles are 14 in. square and 28 ft. long and are spaced 10 ft. on centers. Each pile will have a penetration in the sand of at least 20 ft. when the sand fill is in place.

The boardwalk itself is designed to carry a live-load of 125 lb. per sq.ft., considered the maximum which could be imposed even with the heaviest pedestrian traffic. A test load was made on one bent early in the construction of the boardwalk. A load approximating 200 lb. per sq.ft. was placed on the bent and the maximum subsidence was less than one inch.

The superstructure of the boardwalk is to be of yellow pine timber. The floor beams will be 4 by 14 in. and spaced 2 ft. apart. They will run longitudinally and are to be creosoted. The flooring will be of dressed Douglas fir and the joints between boards will be but ⅛ in. This will add to the durability of the structure by preventing the splintering of individual boards. The boards will be laid in a diagonal direction to facilitate ease in walking. Provision has also been made for two longitudinal strips each 6 ft. wide of closely-laid planks which can be used for rolling chairs in case they are found to be popular and practicable.

Piles and Girders—Borings made in the vicinity of Coney Island indicate that the sand extends to a great depth, in some places 80 ft. The piles, therefore, are easily jetted into place within an inch or two of exact grade and then lightly tapped by a piledriver hammer set in the swinging leads of the derrick which is usually used to handle the piles. The boardwalk is built in its two longitudinal sections, bents of four piles each being set by one derrick and the other half section being set by the second derrick.

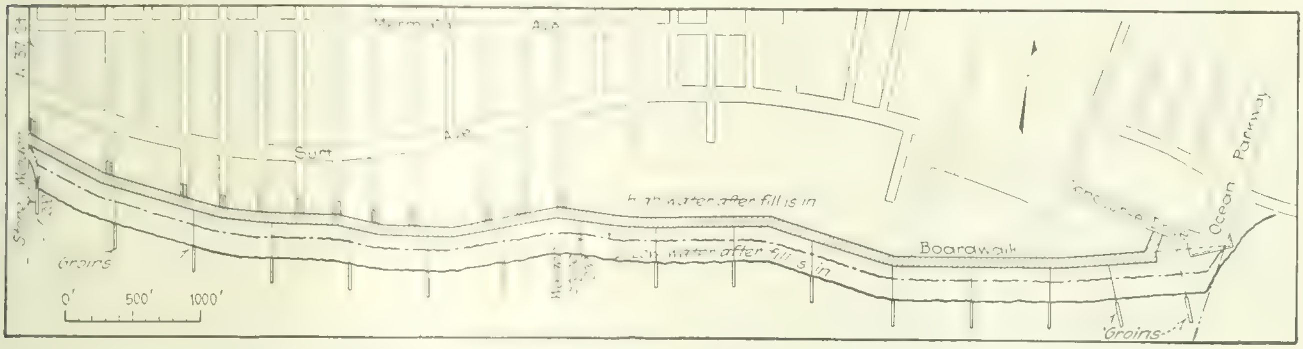


FIG. 1—POSITION OF MUNICIPAL BOARDWALK ALONG CONEY ISLAND BEACH

Inshore side of the boardwalk is the northern boundary of the city-owned property. The line of both high and low water, after the 1,700,000-yd. fill is placed, is shown, indicating how greatly the bathing facilities are to be extended.

Girders are 39 ft. 5½ in. long, 10 in. wide and 22 in. deep. When poured the formwork is supported on temporary timber beams placed on either side of the piles and bolted together on both sides of each pile. Pouring is done in a direction opposite to that of setting the piles, making it possible to pour all girders without transporting materials, equipment or formwork over those poured until the side forms at least have been stripped. Side forms are usually stripped after three or four days, but bottom forms are left in place at least 15 days. Concrete is mixed on shore and transported in buggies on a staging built over the forms.

The concrete piles are pre-cast in the construction company's Flushing, N. Y., yard, being barged to Coney Island Creek and hauled by motor trucks to the site. Inasmuch as it has not always been possible for the city to secure access to the site of the boardwalk at the most convenient locations, it has been necessary to transport single piles by tractor through the sand a maximum distance of 1,500 ft. This condition has slowed up the work to some extent.

Rich Concrete Mix Specified—Insurance against deterioration from sea water is embodied in the specifications for the concrete both in piles and girders. A 1:1½:3 mixture and traprock of an outside size of 1 in., are specified. Reinforcing steel both in piles and girders is

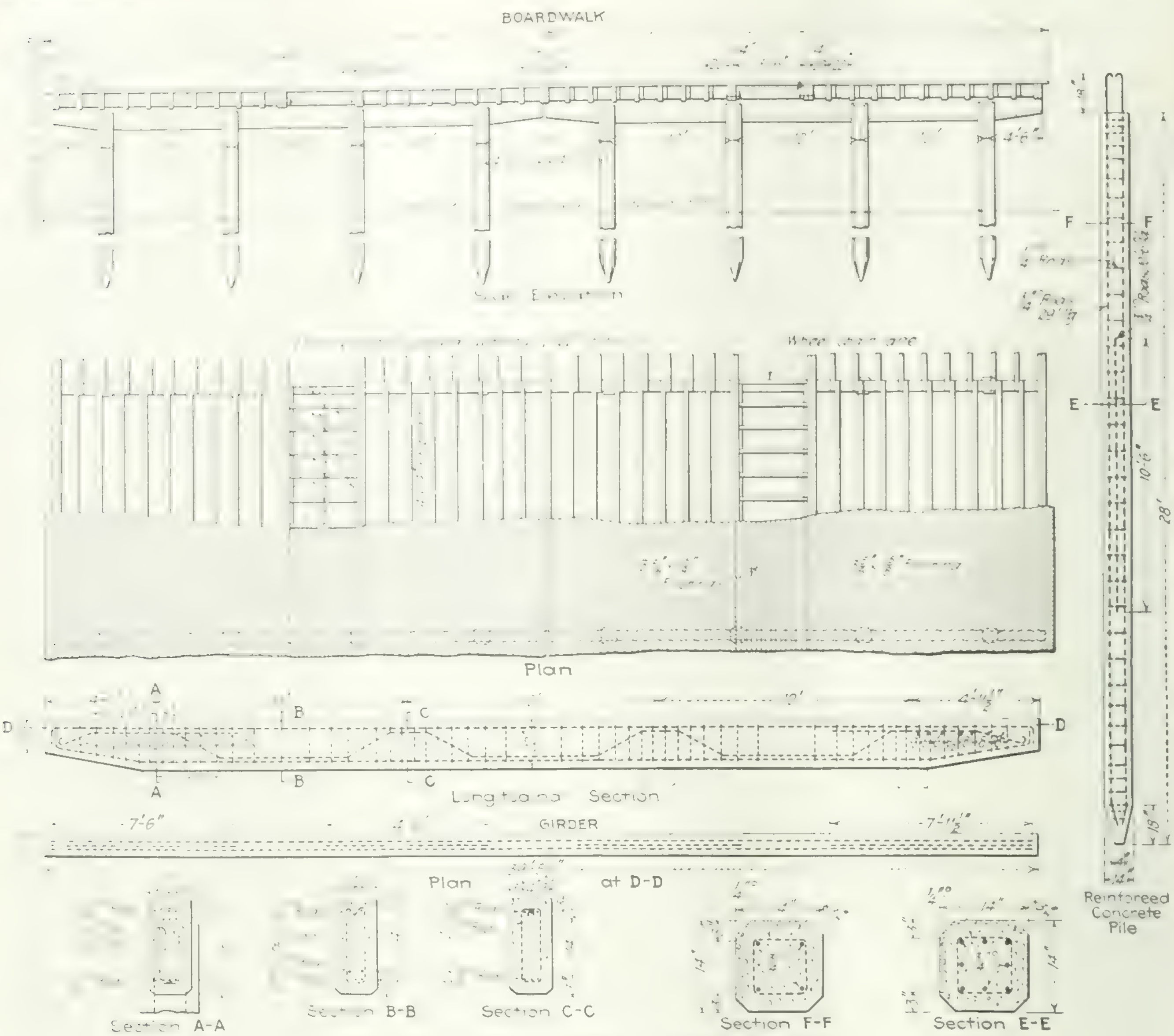


FIG. 3—BOARDWALK, GIRDER AND PILE DETAILS

embedded 3 in. in the concrete. After some of the piles had been placed hairline cracks were discovered on a few. Each pile in place was therefore carefully inspected and the hairline cracks chiseled out to discover if there was a possibility of them extending into the steel. So far there is no indication that the steel is in danger of being exposed either on piles or girders. Wherever there is the slightest indication of the concrete spalling off or cracking, piles and girders will be thoroughly waterproofed. All piles and girders are to have a finish coat of cement.

Shore-Protection Works—The shore-protection works consist of a series of groins extending from approximately the inshore side of the boardwalk out a distance of about 300 ft. These groins are spaced at approximately 600 ft. c. to c. and bear generally in a southeast direction though the position of each is such as to afford the greatest resistance to wave attack, affording at the same time the maximum protection to the existing beach and the additional beach which will be thrown up by the hydraulic fill. Out to the new low-water line these groins are made of timber piles and a double row of lapped sheetpiling with wales bolted to and through the piles. All of the timber used is creosoted. Penetration of the piles in the groins is specified at 17 ft. Sheetpiling must be driven 10 ft. These are minimum depths below the present sand level and are required to prevent possible damage from excessive scour.

The outer ends of the groins extending seaward about 200 ft. are composed of a mass of heavy stones. The upper surface of the rock section is 2 ft. above high tide and has a top width of 10 ft. It is designed to have slopes of 45 deg., making at the extreme outer end, where the water has an average depth of 14 ft. below high water, a base width of 50 ft. Stone varying from 100 lb. up to 7 and 10 tons is used in these rock sections. The smaller stones are being used to fill the voids between the large ones while those of greater weight are intended to surround and cap the interior core, offering the greatest resistance to wave action. Stone is brought mainly from granite quarries in Massachusetts and landed at Gravesend Bay. From there it is transferred to barges which are equipped with calibrated wells for measuring the tonnage. The difference in the draft of the vessel when filled and empty therefore bears a direct relation to the stone tonnage.

In order to protect the shore end of the groins from scour which might occur during heavy storms or excep-

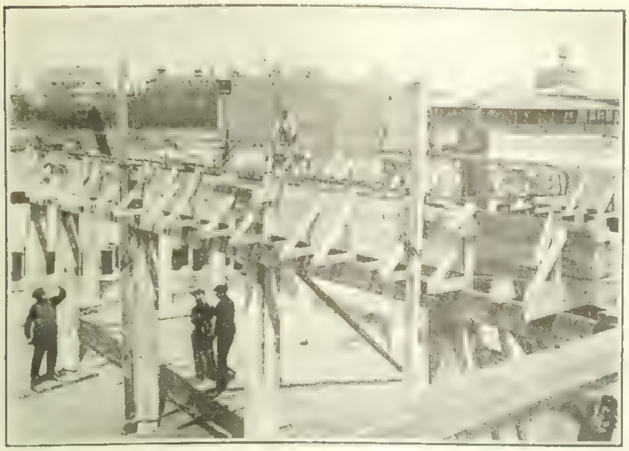


FIG. 2—SETTING A GIRDER REINFORCING CRADLE

tionally high tides, bulkheads of creosoted timber piles and splined sheeting parallel the interior line of the improvement wherever the wave action has demonstrated this to be necessary.

Sheetpiling and wales for the groins are handled by a floatable derrick, floats being made of specially-constructed steel tanks. A patented walking derrick of British design was first used but found impracticable because of the inability to move it at will except in a true forward direction.

Sand Fill—When these shore-protection structures are completed, the contractor is to deposit 1,700,000 cu.yd. of sand fill on the ocean floor between and beyond the exterior rock ends of the groins in such a manner as to produce a new or extended beach approximating in slope the present beach and ocean bed. The effect of this is to advance the high- and low-water mark seaward a distance of about 250 ft., thereby providing a bathing area in front of the boardwalk. Sand for this fill is to be taken from the ocean bed outside the limits of the city-owned property which extends 1,500 ft. out from the approximate present high-water mark. Placing this fill will probably afford the feature of the job. Just what success the contractor will have in placing a hydraulic fill on the shore without any bulkhead protection as yet remains uncertain. As it appears, the job will not be the simple one of depositing sand behind a bulkhead. Beside the possibility of the sand not being retained as placed, the contractor will be exposed, in dredging, to the dangers of an open sea.

FIG. 4—GIRDERS READY FOR FLOOR BEAMS
Piles are darkened by a green marine growth. This part of the boardwalk is near the upper, or Ocean Parkway, end.

Miscellaneous Installations—Along the ocean front on the shore side provision has been made for a galvanized-pipe guard-rail fence and wherever necessary a similar fence will be placed on the north side of the walk. Steps will lead to the beach at intervals and as many as are needed can be added as required. Lamp standards for lighting the walk are to be placed at frequent intervals along the outer side of the walk and at the foot of all streets. In the pending contract no provision is made for shelter houses or resting places.

The Coney Island Boardwalk was planned and designed by Philip P. Farley, consulting engineer of the Borough of Brooklyn. It is being constructed under his special direction through the Bureau of Highways of which J. S. Schmitt is chief engineer. Arthur C. Forbes is the resident engineer and W. H. MacMahon represents the consulting engineer on the work. The Phoenix Construction Co., of New York, has the general contract for the beach improvement. John A. Benham is the general superintendent and P. W. Hughes superintendent on the work.

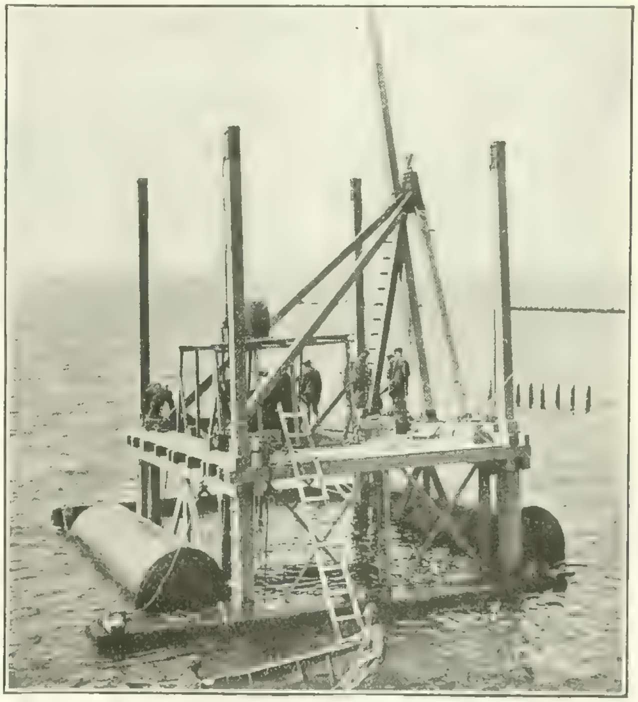


FIG. 5—FLOATABLE DERRICK FOR BUILDING GROINS

Improved Grain Elevators at Dunkirk, France

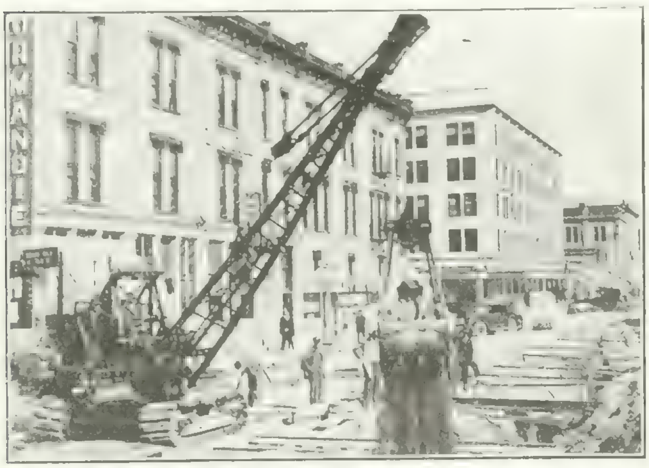
A recent bulletin by the French Chamber of Commerce repots the installation of specially designed grain elevators at Dunkirk and the resulting improvement in unloading facilities at that port. The new elevators are capable of discharging grain from vessels into sacks at the rate of 2,000 tons per day, with a great reduction in wastage from the former methods. During the war Dunkirk was used as a supply base for the Allied armies operating in northern France. Plans are now being made for improvement of the port on a large scale.—*Commerce Reports.*

Notes from the Inter-Mountain Country

By W. W. DeBerard
Western Editor, *Engineering News-Record*

The Southeast Corner of Wyoming

"WHY stop at Cheyenne? What is so interesting there to engineers?" said the chief when I was making up my schedule of a trip to the West. Letters from good friends in the southeast corner of this rapidly developing frontier state with its newly found oil resources and irrigated farm projects indicated to me that there must be quite enough doing from the engineers' viewpoint. Furthermore J. A. Whiting had long ago written me about a half-million dollar sewer job and his experience at the water-works filtration plant and dam from frost on porous concrete. I knew also that there was a large road-building program and had had much correspondence with Z. E. Sevison, state highway engineer, concerning the 2,400 ft. of precast concrete slabs on the Caspar-Salt Creek highway. I knew from previous experience that Cheyenne had no hard street pavements but utilized disintegrated granite which makes an ideal surface. What I did not know was the fact that the Wind River Canyon road was about to be started, opening up a rich territory 100 x 150 miles in extent; nor did I realize that the Lincoln Highway had been relocated over famous Sherman Hill. These projects proved to be entirely sufficient to occupy most fully the short day it was possible to crowd into my schedule.

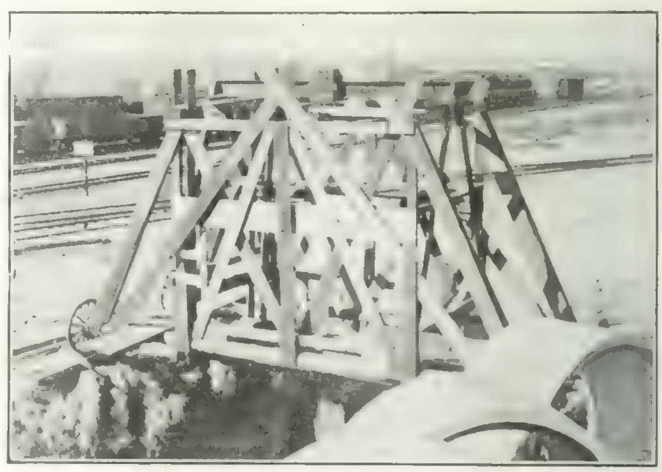


LAYING 54-IN. REINFORCED-CONCRETE SEWER PIPE IN MAIN STREET OF CHEYENNE
Gasoline excavator also lays pipe and is followed closely by gasoline backfiller.

Cheyenne pays tribute to high freight rates and every citizen reminds you of that fact as a reason for the extra tariff you pay for a comparatively small article, to which 10 to 30 per cent additional has been added although the freight could not possibly be more than a few cents per dozen articles. Rents are high due to the freight on lumber and supplies. This reminds me that three years ago on the occasion of a former visit when daylight saving time had recently been inaugurated, two engineers were building a house to sell, utilizing their after-hours time to piece out a meager salary. I was interested in that house and on inquiry found that one of the engineers, now holding down a much more substantial position, was living in it and had been saving rent for the last three years. In common with almost every other western city, Cheyenne has been continuously in need of houses for several years. With the present building boom the supply is soon likely to catch up with the demand. Housing developments had their effect in pushing the sewer work to the construction stage.

Waiting for the conventional calling hour of 9 o'clock to arrive, I concluded to look over the sewer job and make notes by the photograph method. Everywhere in the downtown district it was evident that the contractor had not yet placed all of his numerous 54-in. reinforced-concrete pipe underground. Though not new, the pipe-lowering arrangement interested me greatly and after several attempts I secured a view that seemed worth while to pass on to my friends. But I am including also a view of the main street showing the use of a gas-engine excavator in handling the work so as to keep open the trenches a minimum length of time. The whole job was said to be too large for the local contractor with limited credit and he has delayed the work far beyond the patience of many of the citizens of the town. Furthermore, costs on the easiest sections done first have been fairly near to the bid price. Future unit costs are almost sure to exceed the bid price and prove disastrous to the contractor. In consequence, Cheyenne faces the almost certainty of having to take over the work and finish it by force account or through a new contractor. Low bids too often end this way, to the embarrassment of the contractor and the almost certain unpleasantness to the engineers in charge.

Waterproofing seeping concrete on both the dam and the filtration plant walls has stopped the crumbling on the outside of the concrete effectively proving, according to J. A. Whiting, the contention that the action was not due to alkali but to frost. (See *Engineering News-Record*, p. 947, June 2, 1921).



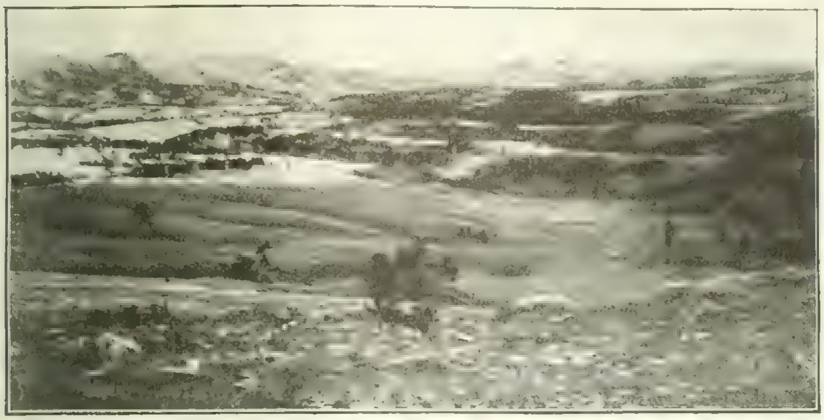
MOUNTED PIPE-LAYING FRAME FOR LARGE SIZES
A hand-operated block and fall lifts pipe off of the supporting skid planks and lowers it into place.

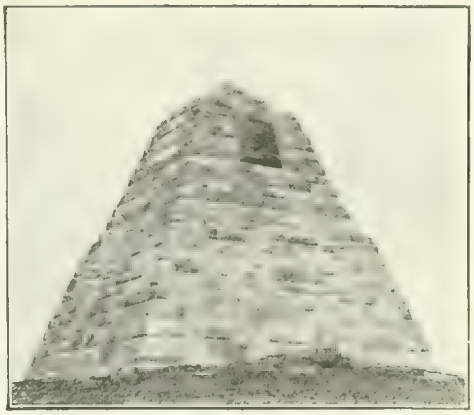
Road Construction—Large expenditures of money for roads in Wyoming have reached the peak for the time being at least. Valuations are low, population is scanty and the mileage is great. As through-route traffic has been insistent on getting a few roads through the state in operating shape, work has been concentrated on these routes and several will be completed this season.

Here, as elsewhere in the mountain country, political maps are occasionally put out with wide broad bands in red showing the unsuspecting tourist where he can drive. These maps occasionally show roads that not even a burro could negotiate. The ulterior motive behind the publication of such maps is two-fold. The politician hopes to enlist support for the local project and the merchant along the route expects to sell supplies. It is a poor practice. Selection of routes causes much wrangling between the Bureau of Public Roads, local influential chambers of commerce and business men who ought to be decidedly ashamed of themselves. The main highways of the country are being built so that the traveling public may reach its destination in the shortest time and most economical way; not to enrich a few grocery stores. State highway officials are alive to this situation and in the majority of cases stand with the federal officials for the best location. This question of locations is one of the uppermost problems in the frontier state road development, because many of them are only now emerging from the trail stage to the road stage, the road surfacing stage being still years ahead.

Precast concrete slab roads have proved their worth in Wyoming in the opinion of the state officials and some of the federal engineers. Dr. Hewes of the San Francisco office, Bureau of Public Roads, and A. B. Fletcher, chief engineer of the State Highway Department of California, were so impressed with the utility of the method for certain isolated locations that the latter who had been over the road the day before my arrival in Cheyenne, may lay some of the slab road in California. However, the slabs proposed will be 3 x 10 ft. By laying six slabs side by side on an 18-ft. road the traffic will straddle the longitudinal joints. Practically all of the numerous kinds of joints on the experimental road have proved satisfactory but the plain joint laid at a slight angle with the transverse line seems best, inasmuch as it permits the slabs to be removed easily and to a certain extent it prevents displacement of the slab. The present experience indicates a probable cost per square yard of somewhere near $3. The use of Haydite, the cellular burned clay aggregate used in ship construction, is being looked into seriously because a reduction in weight from 150 to 100 lb. per cubic foot will be no small item when slabs must be hauled 30 to 40 miles. Later inquiry from the company at Kansas City elicited the information that while no official tests on abrasion of Haydite concrete has been made, nevertheless a few unofficial tests made at the University of Kansas indicate that the reduction due to abrasion in a rattler is comparable with many of the accepted limestone aggregates. Practical consideration is given to this light-weight aggregate since it is likely one of the largest oil companies at Casper will install a plant for its manufacture for its own use. Concrete made from Haydite has been particularly successful as a light cover for oil tanks and for floors in some of the older tanks which have begun to deteriorate.

The Wind River Canyon road interested me not only from the heavy construction standpoint in the box canyon as portrayed in the numerous photographs which C. C. Warrington, deputy state highway engineer, and R. L. Silver, district engineer in charge, enthusiastically exhibited, but because it was one of the few highways in the country which are being built to open up a new country shut in by the mountains. The area is practically inaccessible from the outside because of the difficult grades over the high mountain passes and is cut off absolutely for five or six months of the year by snow blockades. On the 13½ miles in the contract recently let to the Utah Construction Co., 11½ miles must be carved out of the solid rock, making 94 per cent of the excavation rock (284,000 cu.yd.). Incidentally, this road will be the main route to Yellowstone Park. Contractors will be interested to know that the solid rock excavation went at 68½c. per cubic yard, a decidedly low figure under the circumstances.





SHERMAN HILL SCENERY FROM THE LINCOLN HIGHWAY AND THE AMES BROTHERS MONUMENT

Typical of the topography where the engineers sought a route on ridges free from wind-blown snow. The monument to the promoters of the Union Pacific Ry is the only record of the abandoned town site on Sherman Hill.

In the bridge department of the highway department a brief interview with J. S. Seiler, bridge engineer, indicated that novel and economical designs are being worked out in U-shaped abutments and cantilever concrete bridges with inverted T-beams. Altogether one gets the impression that decidedly high grade work is being turned out in Wyoming and that somewhere at the top proper confidence is reposed in the engineering staff, together with the necessary support to put the plans into execution.

Unfortunately F. C. Emerson, state engineer, whose sane views on the utilization of the water storage in Yellowstone Park were given in *Engineering News-Record*, p. 777, May 5, 1921, was out of the city. Mr. Emerson could have told me what Montana citizens thought of the Colorado River controversy, and could have checked up such layman opinions as had been expressed to the effect that

Wyoming would be against the legislation favoring the lower Colorado River developments which many people felt would benefit the states organized to take advantage of it. Wyoming is not so organized nor so situated as to benefit.

Along the New Highway — Confronted with the choice as to whether I should take a 50-mile trip to see a newly constructed concrete sheep-dipping tank which Senator Warren was having installed on his sheep range or to go 60 miles over Sherman Hill, via the Lincoln Highway to Laramie was a problem until I got the invitation-givers to get together and combine the trips so as to take in both of them. Sherman Hill as a station is no more. Buford is now at the summit. The huge monument to Oakes and Oliver Ames of Boston, the financial backers of the Union Pacific, erected near the old town, stands alone a mile or two away from the relocated line and also a mile or so off the line of the Lincoln Highway. So voracious are tourists and others in this vicinity for wood that not a house and scarcely a piece of fire wood remains of the old historic town. So completely has nature restored the landscape to its original state that the monument is practically the only man-made feature left. Several movements have been put on foot to move the monument to Cheyenne but it is not practical because of the distance to the railroad and the immense size of the stones.

J. A. WHITING, JUNIOR AND SENIOR, C. C. WARRINGTON AND R. C. DUTHIE, CONTRACTOR

After filling the slot-like dipping tank with a creosote mixture the sheep are completely immersed and swim through its 105-ft. length.

Unlike the ordinary road locator the highway engineers laying out the Lincoln Highway sought out the ridges, for it must be recalled that in Wyoming wind-blown snow fills depressions to incredible depths, even though the amount of the fall is comparatively light. In consequence practically all of the roads are made in fill. More than half a dozen routes were surveyed over the hill before the present satisfactory location was found. The engineers visited these locations all winter long to locate the route which retained the least snow. Making all of the road in fill has its difficulty for the contractor inasmuch as the wind frequently carries away this fill, especially if it happens to be of fine material, nearly as fast as he can build it up. Thus the costs per cubic yard mount up. In some places there is so little disintegrated material on top of the comparatively solid rock that it is difficult to get the prescribed side ditch required by the Bureau of Public Roads.

The trip to see the sheep dipping tank proved to be a mild adventure for on the way back to the Lincoln Highway the numerous unfenced roads looked so much alike that even the deputy state highway engineer got off the trail 5 to 10 miles. For cross-country cruising one needs more than a sense of direction. A tar-bucket memory as to the formation of prairie-dog villages and sage-brush clumps is a much better guide. There is a limit to the number of miles per gas-tank measure one may drive even a Dodge on so good a road as the disintegrated gravel of Sherman Hill. When the last ounce of gas had been drawn through the carburetor Mr. Warrington comforted me with the remark that statistics indicated that a car passed over this portion of the Lincoln Highway every 22 minutes. Thirty minutes after this observation a young rancher armed to the teeth against road robbers pulled up behind us and cautiously made friends. Ultimately, however, he generously drained a gallon of gasoline from his flivver tank into a milk can top which he poured successfully into our tank through a funnel improvised out of an *Engineering News-Record* envelope.

Just over the top of the hill one passes out of the granite into a distinctly different geological formation producing a sticky mud. Not all of this new road with its continuous grade for 9 miles into Laramie has yet been covered with the Sherman Hill gravel, but it is in good condition.

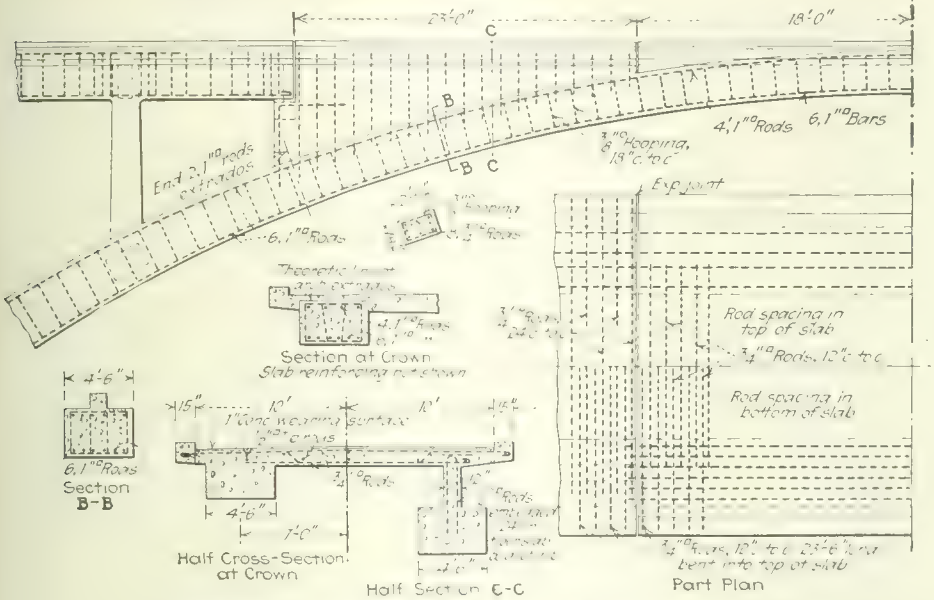
Fortunately, the gas shortage experienced on top of the hill did not prevent our getting into Laramie in time to observe that the main highway entrance paved with disintegrated granite was at least as good as the country road. Too many cities over the country leave a stretch of decidedly poor going near their boundary lines. Illinois has been boasting for a year of two routes of concrete from Chicago to St. Louis, but woe be the driver who in the spring forgot that country concrete is one thing and municipal mud quite another.

It would be interesting to detail the road conference at Laramie held until midnight between the engineer from headquarters and the man on the job. There are thousands of just such informal discussions between chief and assistant taking place over the country continually. Everything is discussed from salary raising to the question of how to handle the influential farmer who would be a contractor and annex some of the good money the state and federal government is spending mostly for his own benefit. Line and grade are not neglected, neither are entirely new routes, nor the maintenance of the old ones within the budget estimates. No one pays for these overtime midnight conferences; no one but the engineer himself. Nevertheless the results show in the efficiency of the year's work. Truly, the West is getting more intense and efficient engineering than it ever got before and the engineers on the job are having the time of their lives. They are living over again the experiences of their railroad brethren of the eighties. They are full of the consciousness of achievement. As I dozed off in the Pullman on the way to Salt Lake I could not help recalling the remark of one of my first chiefs who said that engineers were the happiest individuals in the world because their profession furnished them their pastime.

Concrete Arch Rib and Floor Combined at Crown

In the Cienega Creek Bridge built by the Arizona State Highway Department, the main span is a 146-ft. reinforced-concrete arch in which the floor system for some distance on either side of the crown is made integral with the arch rib, as shown in the accompanying view and detail drawings, with a consequent reduction in depth there and some simplification in construction.

The floor slabs on either side of the crown section have but two supports—the spandrel walls—and just two supporting beams over the open spandrel sections. This gives a somewhat longer span with consequent deepening of slab than is usual for floor slabs of this class but this was more than paid for by the resulting ease of form construction.



DETAILS SHOWING CONJUNCTION OF FLOOR AND RIB

The bridge was designed for the dead-load plus a live-load of two 15-ton trucks, plus 30 per cent impact, or 150 lb. per square foot distributed live-load. Temperature variation of plus or minus 45 deg. F. was taken into account and numerous roadway expansion joints were provided.

The bridge was designed by Merrill Butler, bridge engineer of the department under the direction of Thomas Maddock, state engineer.

Costs of Federal-Aid Highways

Average costs covering 11,017 miles of federal-aid highways, as detailed below, were given by Thomas H. MacDonald in an address delivered before the annual meeting in Washington of the Chamber of Commerce of the United States.

Class 1, including the graded and drained, the sand-clay and gravel types, average cost $11,320 per mile.

Class 2, covering macadam, waterbound and bituminous types, $20,540 per mile.

Class 3, covering the bituminous concrete, portland cement concrete, and brick types, $36,100 per mile.

It does not follow, Mr. MacDonald pointed out, that because the average cost of Class 1 roadway is only one-third that of Class 3 roadways that Class 1 should be built to the exclusion of the other.

The Class 3 roadways, he said, are capable of rendering many times the service that the Class 1 types are able to give.

THE CIENEGA CREEK BRIDGE NEAR TUCSON, ARIZ.

Results of Tests of Bates Experimental Road in Illinois After Fifth Traffic Run Was Completed, July 1, 1922

(■ *indicates complete failure*)

[illegible]	Wearing Course Thickness, In. Brick	Cushion	Base Thickness	Coarse Aggregate	Mix	Traffic Run No. 1 (Rear wheel load, 2,500 lb.) Total trips, 1,000	Traffic Run No. 2 (Rear wheel load, 3,500 lb.) Total trips, 3,200	Traffic Run No. 3 (Rear wheel load, 4,500 lb.) Total trips, 3,000	Traffic Run No. 4 (Rear wheel load, 5,500 lb.) Total trips, 3,000	Traffic Run No. 5 (Rear Wheel load, 6,500 lb.) Total trips, 3,000
Lug and Lugless Brick, Bituminous Filler, Macadam Base.										
1A	3, lug	2 sand	4	Cr. limestone			■ after 1,000 loads			
1B	3, lugless	2 sand	4	Cr. limestone			■ after 1,000 loads			
2	4, lug	2 sand	4	Cr. limestone			■ after 1,000 loads			
3	4 lug	2 sand	4	Cr. limestone			■ after 1,000 loads			
4	4 lugless	1 mastic	8	Cr. limestone			■ after 1,500 loads			
5	3 lugless	2 mastic	8	Cr. limestone			■ after 1,500 loads.			
Asphaltic Concrete, Macadam or Novaculite Base.										
6	2, Topeka		10	Macadam			3 failures	■ 3 Add. failures; has reached max. carrying cap.	5 add. points incip failure; max. carrying cap. reached, third test.	Failed under third test
7	2, Topeka		8	Macadam			■ 6 failures, decisive	8 failures, 9 incip failures; max. carrying cap. exceeded.	2 add. points failure; 5 add. pts incip. failure.	
8	1½, Topeka 1½, binder		5	Macadam			No failures	2 add. points incip failure.	2 add. points incip failure.	7 add pts of failure; max. cap. reached
9	2, Topeka		6	Macadam			6 points incip. failure.	2 add. points incip failure.	■ 11 pts add failure 5 pts add incip failure.	
10	2, Topeka		4	Novaculite		■ after 800 loads	after 3,200 loads.			
11	2, Topeka		4	Macadam		3 failures.				
Asphaltic Concrete, Portland Cement Concrete Base, 6-in. curbs.										
12A	2, Topeka		4	Cr. limestone	1:3:5		Cracks thru curb.	No. add. breaks; curb cracks not serious.	■ 1 corner failure; decisive break.	3 add. corner failures, 2 add cracks, failed fourth test
12B	2, Topeka		5	Cr. limestone	1:3:5		Cracks thru curb.	No. add. breaks; curb cracks not serious.	No add. failures.	No add. failures.
13	1½, Topeka 1½, binder		4	Cr. limestone	1:3:5		Cracks thru curb	1 add. curb crack; previous curb cracks not serious.	1 corner failure; decisive break.	1 add crack in curb and base.
14	2, Topeka		4	Cr limestone	1:2:3½		1 corner break curb cracks.	1 add curb and base crack; previous cracks not serious.	■ 1 add. corner failure; decisive.	1 add. corner failure; failed under fourth test.
15	1½, Topeka 1½, binder		4	Cr. limestone	1:2:3½		No failure, 2 curb cracks.	No add. failures.	■ 1 corner failure; decisive.	1 add. corner failure 2 curb and base cracks; failed fourth test.
16	2, Topeka		5	Cr. limestone	1:3:5		No failure	No add failures.	No failures.	1 corner failure, decisive.
17	2, Topeka		5	Cr. limestone	1:2:3½		No failure	No. add. failures.	No add. failures	No add failures
18	1½, Topeka 1½, binder		5	Cr. limestone	1:2:3½		No failure.	No add. failures.	1 corner failure; decisive break.	No add. failures.
19	2, Topeka		6	Cr. limestone	1:3:5		No failure.	No add. failures; 1 curb crack.	No. add. failures.	No add failures
20	2, Topeka		6	Cr. limestone	1:2:3½		No failure.	No add. failures	No failures.	No add. failures.
21	2, Topeka		7	Cr. limestone	1:2:3½		No failure.	No add failures	1 corner failure; not decisive.	1 add. corner failure; not decisive
22	1½, Topeka 1½, binder		8	Cr. limestone	1:2:3½		No failure.	No add failures	No failures.	No failures
Lug and Lugless Brick, Bituminous Filler, P. C. Conc. Base, 6-in Curbs.										
23A	3 lug	1, sand	6	Cr. limestone	1:2:3½		No failures	No add. failures.	No add failures	No add. failures.
23B	3, lugless	1, sand	6	Cr. limestone	1:2:3½	3 pts partial failure	No failures.	No add. failures.	No add. failures.	No add. failures
24	3, lug	1, sand	5½	Cr. limestone	1:2:3½		No failures	No add failures 1 curb. crack.	No add. failures.	No add. failures.
25	3 lugless	1, mastic	5½	Cr. limestone	1:2:3½		No failures.	No add failures	No add. failures.	No add. failures.
26A	4, lug	1, sand	4	Cr. limestone	1:2:3½		2 curb and base cracks	1 add. corner break; max. cap. reached under second load test	Previous damage not decisive.	1 progressive break
26B	4, lugless	1, sand	4	Cr. limestone	1:2:3½		1 curb and base crack	1 add. curb and base crack.	No add. failures.	1 curb and base crack.
27	3, lug	1, sand	4½	Cr limestone	1:2:3½		■ 2 curb and base cracks.	No add. failures.	1 add. corner failure; cap. reached second test.	Failed second test.
28	3, lugless	1, sand	4½	Cr. limestone	1:2:3½		2 curb and base cracks.	■ 1 corner failure decisive.	1 add. corner failure; cap. reached third test.	Failed third test
29A	3, lug	1, sand	4½	Cr. limestone	1:3:5		■ 2 curb and base cracks	2 add. corner failures; 1 curb. and base crack; limit reached prev. test	1 add. corner failure; considered failed second test.	Failed second test
29B	3, lugless	1, sand	4	Cr. limestone	1:3:5		3 curb and base cracks.	No add. failures.	No add. failures.	2 corner failures decisive.
30	3, lug	1, sand	5½	Cr. limestone	1:2:3½		■ 2 corner failures and 1 break (decisive).	1 add corner failure; 1 curb and base crack; limit reached prev. test	1 add. curb and base crack considered failed second test	3 add. corner failures. Failed second test.
31	3, lugless	[illegible]	3½	Cr. limestone	1:2:3½		1 curb and base crack	No add. failures	No add. failures	Progressive breaking
32A	3, lug	1, sand	3½	Cr. limestone	1:3:5		2 corner failures; 2 curb and base [illegible]	1 curb and base crack; limit reached under second test	No add. failures.	Progressive breaking
32B	3, lugless	1, sand	3½	Cr. limestone	1:3:5		1 corner failure; 1 curb and base crack	No add failures max. cap. not reached.	No add. failures.	1 add. corner failure, decisive.
Lug Brick, Monolithic and semi-Monolithic P. C. Conc. Base.										
33	3, monolithic		2	Cr. limestone	1:2:3	■ [illegible] corner break	3 initial corner fail- [illegible]	Decisive failure under first test		
34A	3, semi-monolithic [illegible]		2	Cr. limestone	1:2:3		■ 3 [illegible]	Considered failed under second test		
34B	3, Conc. Intersection			Not a test section						
35	4, monolithic		2	Cr. limestone	1:2:3	2 [illegible]	■ 1 add. corner failure [illegible] failure	Considered failed under second test		

Traffic Tests of Bates Experimental Road Summarized

Five Runs Completed—Rear Wheel Loads Vary from 2,500 to 6,500—Sixth Run in Progress

RESULTS of tests of the 63 sections of the 2-mile Bates experimental road near Springfield, Ill., are presented herewith in the form of a table covering five traffic runs, the last of which was completed July 1, 1922. As recorded in the news section of *Engineering News-Record* April 20, 1922, p. 667, the first run, completed in April, covered 1,000 trips of motor trucks with a load of 2,500 lb. on each rear wheel and 2,250 lb. on each front wheel. It was followed by four other runs in which the rear-wheel load was increased progressively by 1,000 lb., amounting to 6,500 lb. in the fifth run, as shown in the following summary of traffic conditions:

Traffic Run No.	Rear Wheel Load, Lb.	Front Wheel, Load, Lb.	No. of Trips, Night	No. of Trips, Day	Path of Travel
1	2,500	2,150		1,000	Each edge of pavement
2	3,500	2,150	1,033	2,167	627 day trips on edges. 1,540 and 1,033 night trips 2 ft. 6 in. from north side and on edge of south side.
3	4,500	2,000	1,000	2,000	2 ft. 6 in. from north side and on edge of south side.
4	5,500	1,900	1,000	2,000	Same as for 4,500-lb. load.
5	6,500	1,800	1,000	2,000	Same as for 4,500-lb. load

The length of the Bates road is 10,800 ft. and its width is 18 ft. It consists of 63 sections, most of them 100 or 200 ft. long, surfaced with brick, asphaltic concrete and portland cement concrete of various types. The subgrade is a brown silt loam.

The results thus far indicate that if the line of traffic can be held away from the edges of pavements fewer failures will occur than when the truck wheels pass directly on the edge. It has been noted, also, that

Section	Wearing Course Thickness, In.	Base Course, In.	Coarse Aggregate	Mix	Traffic Run No. 1 (Rear wheel load, 2,500 lb.) Total trips, 1,000	Traffic Run No. 2 (Rear wheel load, 3,500 lb.) Total trips, 3,200	Traffic Run No. 3 (Rear wheel load, 4,500 lb.) Total trips, 3,000	Traffic Run No. 4 (Rear wheel load, 5,500 lb.) Total trips, 3,000	Traffic Run No. 5 (Rear Wheel load, 6,500 lb.) Total trips, 3,000
36	3, monolithic	3	Cr. limestone	1:3:5	3 corner failures.	1 corner crack; not decisive.	■2 corner failures, decisive; max. capacity exceeded.	Progress in failures 5 points.	Failed third test.
37	3, monolithic	3	Cr. limestone	[illegible]	1 corner failure.	No further breaks.	■1 corner failures; approaching limit.	4 add. corner failures; cap. reached third test.	Failed third test.
38	4, monolithic	3	Cr. limestone	1:2:3½		Break in surface only; not decisive.	1 corner failure, decisive; 1 interior surface break.	2 add. [illegible] breaks.	2 add. corner failures
39	4, monolithic	4	Cr. limestone	1:3:5		No failures	4 breaks, not decisive	3 corner failures; decisive	1 add. corner failures
Portland Cement Concrete.									
40	9 (plain)		Cr. limestone	1:2:3½		No failures.	No failures.	No failures.	2 short cracks.
41[1]	8 (plain)		Cr. limestone	1:2:3½		No failures.	No failures.	No failures.	3 [illegible] cracks.
42	8 (plain)		Cr. limestone	1:2:3½		No failures.	No failures.	No failures.	[illegible]
43[1]	7 (plain)		Cr. limestone	1:2:3½		No failures.	No failures.	No failures	No failure.
44	7 (plain)		Cr. limestone	[illegible]		No failures.	No failures.	No failures.	[illegible]
45[1+2]	6 (reinf.)		Cr. limestone	1:2:3½		No failures.	No failures.	No failures.	2 corner failures.
46[1+2]	6 (reinf.)		Cr. limestone	1:2:3½		No failures.	No failures.	No failures.	No failures
47[1+2]	6 (reinf.)		Cr. limestone	[illegible]		No failures.	No failures.	No failures.	1 short crack
48	5 (reinf.) (same as No. 45)		Cr. limestone	1:2:3½		No failures	No failures.	No failures.	No failures.
49	5 (reinf.) (Same as No. 46)		Cr. limestone	1:2:3½		No failures.	No failures	No failures	[illegible]
50	5 (reinf.) (Same as No. 47)		Cr. limestone	1:2:3½		No failures.	No failures.	3 transv. cracks.	1 corner failure; 2 cracks.
51[3]	6 (reinf., wire)		Cr. limestone	1:2:3½		No failures.	No failures.	No failures.	No failures.
52	6 (plain)		Cr. limestone	1:2:3½		No failures.	No failures.	2 small cracks	[illegible] cracks.
53[3]	5 (reinf., wire)		Cr. limestone	1:2:3½		No failures.	No failures.	3 cracks.	1 corner failure; 1 crack.
54	5 (plain)		Cr. limestone	1:2:3½		No failures.	No failures.	■3 corner [illegible] ive failure.	4 add. cracks. [illegible] ed fourth test.
55	5 (plain)		Gravel	1:2:3½		■1 corner failure.	2 corner failures, decisive; capacity reached under second test	1 add. corner fail- [illegible]	
56A	5 (plain) (4% Cal chloride)		Cr. limestone	1:2:3½		No failures.	■1 corner failure	Failed decisively, third test.	
56B	5 (plain) (2½% Cal chloride)		Cr. limestone	1:2:3½		1 corner failure decisive.	Several new cracks, not decisive.	Additional cracks.	■ [illegible] considered failed, fifth test
57	5 (plain) (Cemite cement)		Cr. limestone	1:2:3½		1 corner failure (decisive.)	■1 corner failure, decisive, failed decisively.		
58	{ 4 conc. { 4 stone base		Cr. limestone	[illegible]	2 corner failures.	No failures	1 add. corner failure; not decisive	■2 add. corner failures.	2 add. corner fail- [illegible] fourth test.
59	4 (plain) (Cemite cement)		Cr. limestone	1:2:3½	2 corner failures.	■2 add. corner failures prog. breaking decisive.	3 add. corner failures; considered failed under second test.		
60	4 (Cal. chloride added)		Cr. limestone	1:2:3½		No failures	■2 corner failures considered failed decisively.	5 corner failures	
61A	4 (Hyd. lime added)		Cr. limestone	1:2:3½		■1 corner failure, decisive.	2 corner failures reached limit under second test.	[illegible]	
61B	4 (plain)		Cr. limestone	1:2:3½		No failures.	■2 corner failures decisive; considered decisively failed	1 add. corner failure; 1 crack.	
62[4]	4		Cr. limestone	1:2:3½		1 corner failure.	■2 corner failures decisive; considered failed decisively.	3 corner failures	
63A[4]	7		Gravel	1:2:3½		No failures	No failures	No failures	[illegible]
63B[4]	7		Cr. limestone	[illegible]		No failures	No failures	No failures	No failures

Note 1. Tr. and long. dividing planes [illegible]
Note 2. Bar reinf. ¾ in. placed 2 in. from top and [illegible] in. from edges.
Note 3. Wire mesh, 45 lb. per 100 sq.ft.
Note 4. [illegible]

greater damage to pavements occurs during night traffic when the pavement edges are curled away from the subgrade, than during daytime traffic.

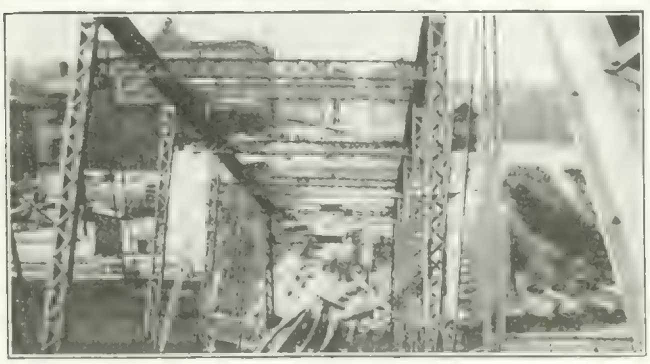
Following the fifth run the load now being applied is 8,000 lb. on each rear wheel and 1,930 lb. on each front wheel. As this load is the legal limit for the State of Illinois it is intended to make 10,000 applications so that a thorough test can be given all remaining sections of the road.

The tests are being conducted by the Illinois State Division of Highways, Clifford Older, chief engineer.

Bridge Abutment Crumbles, Wrecking Span

By C. S. Stewart
Milwaukee, Wis.

AFTER standing for 30 to 40 years, the north abutment of the Humboldt St. bridge across the Milwaukee River in Milwaukee collapsed recently. We are accustomed to expect that such masonry structures will remain forever without attention unless wrecked by flood, storm, or accident, but this abutment, after successfully withstanding many seasons of ice and flood without showing signs of weakness, quietly crumbled dropping the end of the bridge truss into the river.



ABUTMENT FAILURE NOT DUE TO HIGH WATER
Upper view, looking downstream; at right is the abutment whose face wall crumbled.
Lower view, floor stringers of fallen span forced upward while trusses went down when the bearing masonry failed.

Cracks were first seen to appear late in April, about two weeks before the collapse, and the bridge was immediately closed. Neither at the time of the failure nor during the preceding spring months was the water in the river unusually high. It is possible that the failure may have been caused by a bulging of the wall due to freezing, to scouring during some past high water, to uneven settling, or to a combination of all of these conditions.

The abutment was of a soft grade of limestone in use in this locality about 40 years ago. The stone shows the effects of weathering. The truss, except for the last panel, appears to have suffered little damage.

Fire Pressure a Function of Fire Rather Than Water Department

THAT the duty of the water-works department should stop with supplying water of sufficient pressure for domestic service and that the provision of pressures for use during fire should be the function of the fire department by means of fire engines is contended by Charles R. Henderson, manager of the Davenport (Ia.) Water Co., in the *Journal* of the American Water Works Association for July. The advent of motor-driven fire apparatus carrying hose, men and tools and small and inexpensive pumps to fires, renders quite unnecessary, Mr. Henderson states, "the dangerous and wasteful practice of increasing pressure on hundreds of miles of water mains, every time there is an alarm of fire." Mr. Henderson cites the bursting of half of the 2-inch lead service pipes in use in one city owing to fire pressure, and the breaking of mains, 12 in., and over in diameter, in other cities, "virtually putting the water department out of business until such mains are shut off," as arguments in support of his contention. He also cites the case of a city of 50,000 population entirely without water for nearly an hour due to the shut down of an engine following a change in the adjustment of valves to effect a change in water pressure.

Mr. Henderson maintains that a pressure of 60 lb. is sufficient for domestic pressure for all but very high buildings and for small fires requiring only one or two lines of hose.

Statistics collected by Mr. Henderson and published in tabular form in the *Journal* show that the water pressures in 143 cities and having a population of more than 50,000 by the census of 1920 ranged for domestic purposes from 20 to 145 lb. per square inch in commercial districts, and from 25 to 125 lb. in residential districts. The average pressure reported was 68 lb. in commercial and 56 lb. in residential districts. Not over 25 per cent of the cities in the list increase pressure at times of fire. Where pressure is increased the range is from 4 to 55 lb. with an average of 24 pounds.

Already the Illinois and the Iowa sections of the American Water Works Association, and the Indiana Sanitary and Water Supply Association have adopted resolutions, Mr. Henderson states, "advocating the discontinuance of raising pressure during fire." Mr. Henderson adds that "it is strange that such a reasonable and apparently necessary reform was not started sooner"

Highway Work in Minnesota During 1921

Minnesota highway work during 1921 benefited 3,393 miles of main routes, while patrol and maintenance service was given on 6,855 miles of the 7,000-mile system of state trunk highways—all exclusive of betterments on the secondary or so-called farmer roads. Paving built last year measured 109 miles, compared with 112 laid in previous years combined; and 765 miles of grading and 497 miles of gravel-surfacing were added to the respective 1,499 and 1,371 mile total listed as graded and gravelled when the state took over the trunk routes for improvement and perpetual upkeep. In addition, state maintenance forces re-shaped 1,137 miles and re-surfaced 885 miles on the trunk system. The Minnesota Highway Department last year planned and supervised projects representing an outlay of $19,321,238.60.

Maximum Flood Discharges in Hawaii

By J. B. Lippincott
Consulting Engineer, Los Angeles, Cal.

IN JANUARY, 1921, the Island of Oahu, Hawaii, was visited by heavy storms which resulted in excessive flood flows in all of the streams. The flood undermined and damaged the spillway of the Waiawa reservoir of the Waiawa Water Co., Ltd., which delivers irrigation water to sugar plantations on the western side of the island. The dam creating the reservoir is located on the Kaukonahua stream which heads in the Koolau mountains at El. 2,700 ft. above sea level. Water backs up two forks of the stream, which join immediately above the dam, 4 and 6 miles respectively. In connection with an investigation of the damaged spillway and preparation of plans and estimates for its reconstruction the writer made studies of the flood flows during this storm on most of the streams on the Island of Oahu.

The Water Resources Branch of the U. S. Geological Survey has maintained gaging stations on various streams on the Island of Oahu and on the other islands of the Hawaiian group, so that records are now available on some of the streams for the last seven years. The engineers in charge of this department were exceedingly helpful and courteous in placing at the writer's disposal all of these records. From the information available it is found that the storm of Jan. 16, 1921, was of much greater violence than that of any previously recorded on the Island of Oahu. James E. Stewart, district engineer of the Geological Survey, has furnished the data for the accompanying table, with the exception of the measurements made at the Waiawa dam and on the south fork of the Kaukonahua, which latter were furnished by Mr. Lairson of the Constructing Quartermaster's Department of the U. S. Army.

The shape of a drainage basin has much to do with the volume of runoff per square mile. It is difficult to draw accurate conclusions as to the probable flood volumes at the dam from floods in other basins. A comparison, however, is some indication as to whether this flood at Waiawa was an absolute maximum as compared with other basins similarly situated. A map of the Island of Oahu showing streams herein mentioned is contained in *Water Supply Paper* No. 318, Plate XII.

The runoff per square mile from small drainage areas, other things being equal, is slightly greater than from larger ones. The drainage basin of the Manoa, situated at the southern end of the island and for which flood measurements are recorded in the table, is such as to produce a greater concentration of runoff at its gaging station than the large basin of the Kaukonahua. Consequently, one would not be justified in applying to the Kaukonahua the large runoff per square mile indicated from these smaller fan-shaped basins. The flood discharges for Jan. 16, 1921, are in excess of any actual records in the files of the Geological Survey where the drainage area is known. For a larger drainage area a flood which occurred on Jan. 16, 1920, on the south fork of Wailua stream near Lihue, Kauai, is of interest. The peak discharge of this flood was estimated at 45,000 sec.-ft. or at the rate of 30,000 m.g.d. from 23 sq.miles.

In collaboration with Mr. Stewart the author has estimated from the hydrographs of the Geological Survey that there was a sustained flow for a period of 11 hours of 2,881 sec.-ft. from the 17½ sq. miles of the Kaukonahua drainage basin on Jan. 16, 1921. It has also been estimated that the maximum aggregate flood waves from the 4½ sq. miles at the head of the Kaukonahua amounted to 7,220 sec.-ft. or a rate of 4,640 m.g.d. The following details on this flood are of interest:

FLOOD DISCHARGES OF HAWAIIAN STREAMS

Stream	Place	Date	M.G.D.	Sec.-Ft.	Authority	Area Sq.Miles	Sec.-Ft. per Sq.Mile	Remarks
East Branch, Manoa	Honolulu	Jan. 16, 1921	2,000	3,090	Stewart	1.1	2,810	Maximum
West Branch, Manoa	Honolulu	Jan. 16, 1921	2,100	3,250	Stewart	1.0	3,250	Maximum
Nuuanu	Reservoir 4, Honolulu	Jan. 16, 1921	1,100	1,700	Stewart	1.5	1,132	Below reservoir
Kaneohe	Oahu, No. side of Pali	Jan. 16, 1921	7,100	11,000	Austin	5.3	2,070	Circular basin
Nuuanu	Reservoir 4, Honolulu	Feb. 11, 1907	1,500	2,400	Schuyler	1.5	1,600	Rain 6.89 in. in 24 hr No storage then
Wailua	South Fork near Lihue, Kauai	Jan. 16, 1920	29,100	45,000	Stewart	.23	1,955	Rating curve—Basin L 2 width
Kaukonahua	Right Branch, North Fork, Oahu	Jan. 16, 1921	436	671	U. S. G. S.	1.2	559	11 hr. sustained flow
Kaukonahua	Left branch	Jan. 16, 1921	807	1,250	U.S.G.S.	1.5	833	11 hr. sustained flow
Kaukonahua	South Fork	Jan. 16, 1921	618	960	Est. Stewart	10.2	94	11 hr. sustained flow
Kaukonahua	Total for three Forks	Jan. 16, 1921	1,860	2,881	Est. Stewart	17.5	164.7	11 hr. sustained flow
Kaukonahua	Waiawa Waste	Jan. 16, 1921	2,580	*4,000	Wilson and J.B.L.	17.5	228	Max channel $n=0.014$
Nuuanu	U. S. G. S. gage	Jan. 16, 1921	2,150	3,334	J.B.L.	3.5	952	3 reservoirs above
Kaukonahua	Left Branch, North Fork	Jan. 16, 1921	1,815	2,820	U.S.G.S.	1.5	1,880	Maximum
Kaukonahua	Right Branch, North Fork	Jan. 16, 1921	937	1,450	U.S.G.S.	1.2	1,210	Maximum
Kaukonahua	South Fork	Jan. 16, 1921	1,900	2,950	Harrison	1.8	1,640	Maximum
Kaukonahua	Upper Dams Sum	Jan. 16, 1921	4,660	7,220	J. B. L.	4.5	1,605	Maximum
Kaukonahua	Waiawa	Dec. 24, 1920	887	1,368	J. B. L.	17.5		Volumetric rise
Kaukonahua	Waiawa	Mar. 23, 1920	860	1,325	J. B. L.	17.5		Volumetric rise
Kaukonahua	Waiawa	Feb. 10, 1908	1,320	2,040	J. B. L.	17.5		
Kaukonahua	Waiawa	Jan. 16, 1921	3,860	**6,000	J. B. L.	17.5	343	

* Exclusive of 2,000 ± sec.-ft. stored in reservoir during 12-hr. rise.
** Inclusive of 2,000 ± sec.-ft. stored in reservoir during 12-hr. rise.

	Sq. Miles	Sec.-Ft.	Sec.-Ft. per Sq. Mile
E. Branch of Manoa	1.1	3,090	2,810
W. Branch of Manoa	1.0	3,250	3,250
Total	2.1	6,340	3,060
KAUKONAHUA:			
Right branch, north fork	1.2	1,450	1,210
Left branch, north fork	1.5	2,820	1,880
South fork	1.8	2,950	1,640
Total	4.5	7,220	1,605

Statements by old residents indicate that the flood in Manoa valley on Jan. 16, 1921, was larger than any in the last 40 or 50 years. It is uncertain however, how close the crest of this flood was to the absolute maximum. The rainfall at certain points in the Koolau mountains during the night of Jan. 15 and 16 exceeded 12 in., for one 12-in. gauge overflowed. Probably the rainfall did not exceed 20 in., however, for otherwise the amount of water in the monthly precipitation cans would have been greater. At Honomu (El. 1,200 ft.), Island of Hawaii, there was a rainfall of 31.95 in. Feb. 20, and 11.84 in. Feb. 21, 1918. At Hana, Island of Maui, there was 28.2 in. April 27, 1915, and it is said that 24 in. of this amount fell within three or four hours. These two records would indicate that greater floods than that of Jan. 16, 1921, may be expected in the islands.

Car Icing Station for the Belt Railway of Chicago

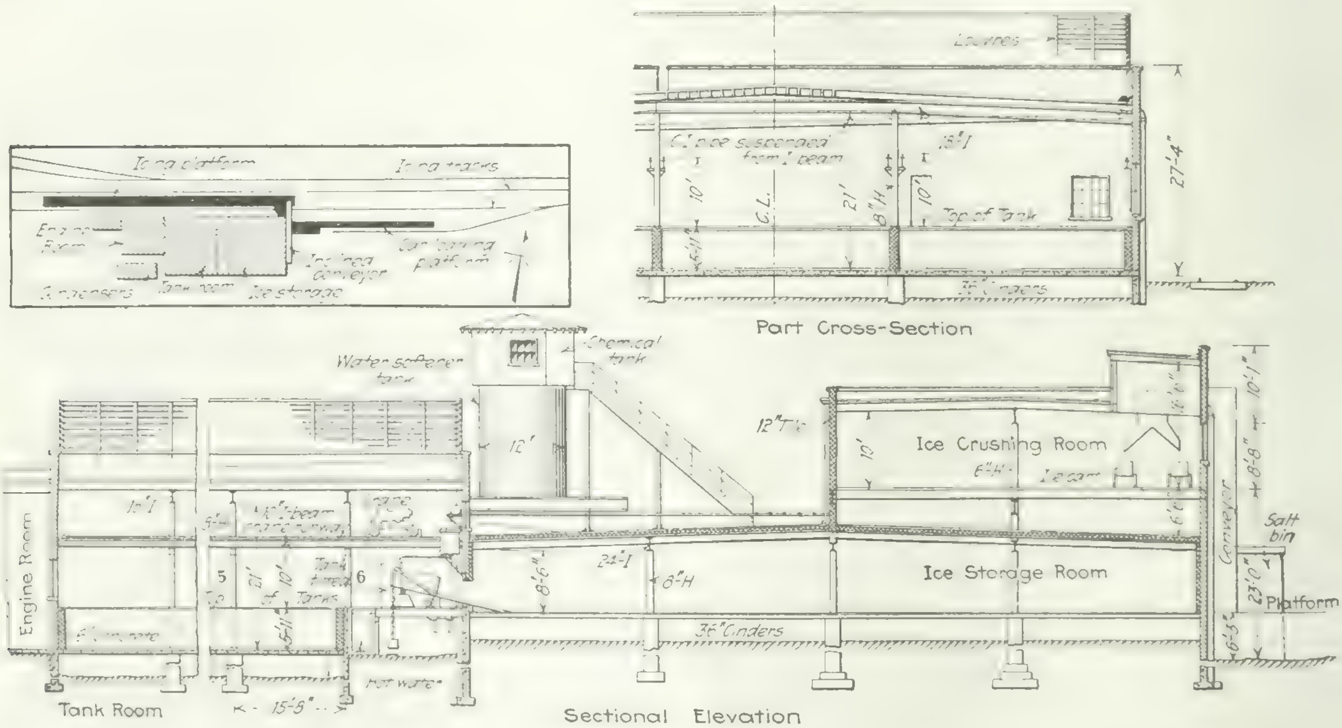
Refrigerator Cars at Transfer Yard Supplied With Cake or Crushed Ice—Conveyors, Carts and Portable Chutes

FOR the icing of through refrigerator cars in transfer between trunk lines the Belt Railway Company of Chicago has established at its great freight yard at Clearing, Ill., an icing plant designed to produce an average of 300 tons of cake ice per day, or sufficient to supply approximately 300 cars daily. This plant, which has been laid out to provide for future expansion, includes equipment for handling also crushed ice and salt. Cake ice in 400-lb. blocks is used in cars carrying fruit, vegetables and certain other perishable products. Crushed ice mixed with salt is used in cars carrying meat products.

Icing stations on trunk lines are arranged frequently for serving solid trains of refrigerator cars. At the Clearing yard, however, cars coming in from various trunk lines are classified and sorted for forwarding over other lines. Under these operating conditions, refrigerator cars collected in the eastbound and westbound receiving and classification yards are taken to the icing plant and thence to the departure yards to be made up in trains for the various roads. The plant comprises an ice manufacturing plant with storage room, an elevated platform between two tracks for delivering ice to the cars through the roof hatches, and a stub track with platform for loading box cars with ice in bulk for shipment. From this latter platform ice may be delivered also to wagons for local distribution. The general layout is shown in Fig. 1.

Ice Manufacturing Plant—A steel-frame building with brick walls and plank roof covered with tar and gravel contains the engine and compressor room 75 x 65 ft., tank or ice-making room 110 x 97½ ft. and ice storage room 100 x 97½ ft., as shown in Fig. 2. The tank room has three bays 32½ ft. wide and the greater part of its length is occupied by the tanks in which the cans of water are placed to be frozen into 400-lb. blocks by the brine system. Each bay has a 2-ton overhead electric crane to handle the cans.

In the delivery end of each bay there is a tank of hot water into which the crane dips the can in order to release the ice block. When the can is lifted out the crane carries it forward a little distance until the lower end engages a stop and the further movement of the crane tips the can over, discharging the ice into an inclined chute leading to the storage room floor. When the empty can is restored to its vertical position it stands under a pipe by which it is filled with water. The crane then carries it back and lowers it into the tank for freezing. Water for ice making is obtained from the Chicago city mains but is treated in a water-softening plant.



FIGS. 1-2 CAR ICING STATION AND ICE MAKING, STORING AND CRUSHING PLANT; BELT RAILWAY OF CHICAGO

A 12-in. cork lining for the brick walls of the tank room is carried up to the tops of the tanks. In the storage room, the walls have a 6-in. cork lining and the ⅞-in. plank roof is covered with 6 in. of cork board over which is placed the composition roofing. The floor of the tank room has a 6-in. concrete slab on 3 ft. of cinders, and that of the storage room has 2-in. oak plank on 4 x 4-in. sleepers spaced 12 in. apart in a 3-ft. cinder fill.

A vestibule or air lock with double doors forms the main entrance to the storage room, the average temperature in which is about 26 deg. F. Men in this room stack the ice cakes or deliver them to the conveyors. The storage capacity is 2,000 tons. Openings for the

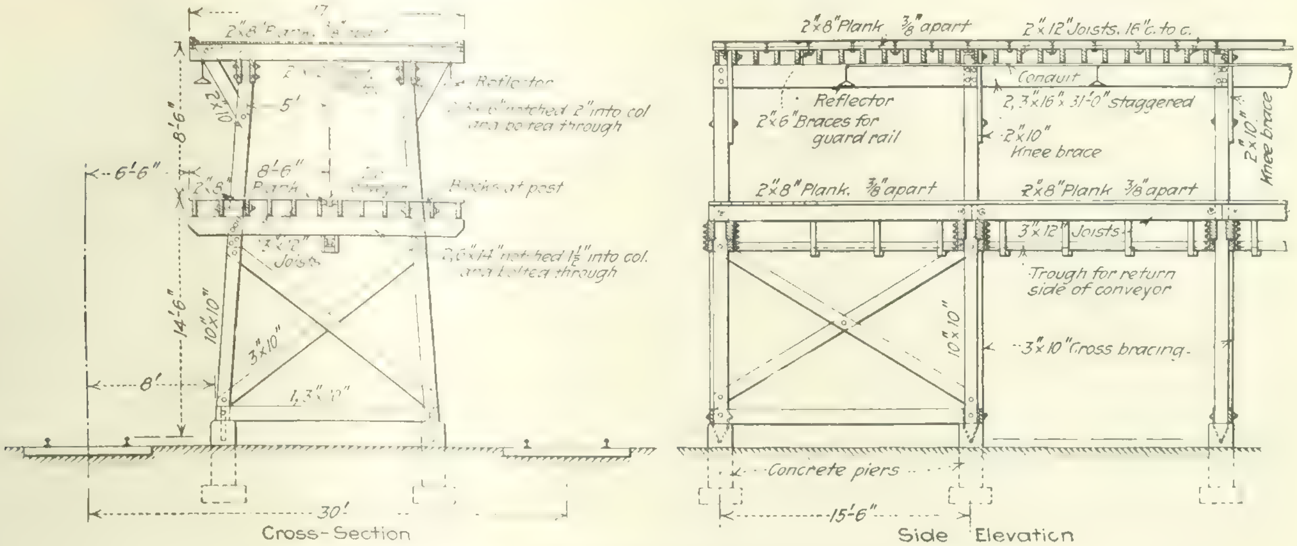


FIG. 3 DOUBLE-DECK PLATFORM FOR ICING REFRIGERATOR CARS

ice conveyors are fitted with vertical swinging doors which are raised by the ice cakes as the conveyors carry them through the opening. Above this room is an upper floor 66 x 51-ft. for the ice crushing plant, with an air space of about 6 ft. between the storage room roof and the upper floor.

Icing Platforms—For delivering ice to the cars there is a double-deck platform located between two tracks spaced 30 ft. c. to c. It is 400 ft. long to accommodate 10 cars on each track, but the layout will permit of increasing the length to 1,000 ft. for 25 cars on each track. The lower deck is a little above the level of the car roofs and on this the ice cakes delivered by a conveyor are handled by tongs, being slid over skids to the car hatches. On the upper deck crushed ice is handled in wheeled carts or tubs. The ice shipping platform along the stub track is at the level of the car floors. It is 11 ft. wide and 253 ft. long, accommodating six cars.

The double-deck icing platform is a frame trestle on concrete pedestals and has spans of 15½ ft. with decks 17 ft. wide, as shown in Fig. 3. The posts are notched for twin transverse caps at the lower deck and for twin longitudinal stringers at the upper deck. The two decks have longitudinal and transverse joists respectively, with 2 x 8-in. floor planking. Every fourth span has longitudinal diagonal bracing to form a tower. Curbs or wheel guards on the upper deck are of special construction to carry portable spouts for the crushed ice. The curb is a 3 x 4-in. timber bolted through the floor and covered by a steel strap fastened with screws. On the inner face is spiked a 2 x 2-in. angle with horizontal leg outstanding to form a shelf or rib.

Ice Conveyors—In the floor of the storage room are two motor-driven conveyors, each consisting of a single chain running on a maple plank in a shallow trough formed by two oak stringers on which the ice cakes slide. The flights are spaced 10 ft. apart and at a chain speed of 120 ft. per minute each conveyor can deliver twelve cakes per minute. One conveyor extends through a doorway and along the floor of the platform for shipping ice in cars. The other delivers the ice blocks by a curved chute to the lower end of an inclined conveyor at right angles to the first one and extending across the outside of the building.

This inclined elevator has a slope of about 1 on 3 for a length of 65 ft. and then a horizontal stretch of 25 ft. across the track to the upper deck of the icing platform. Changes of grade are made by vertical curves of about 22-ft. radius. From the upper end of the incline the cakes make a right-angle turn by means of a horizontal curved chute which delivers them to a descending incline leading to the lower deck. Both the ascending and descending conveyors are of the same type and inclination and are driven by the same motor.

A third chain conveyor of the same type and running

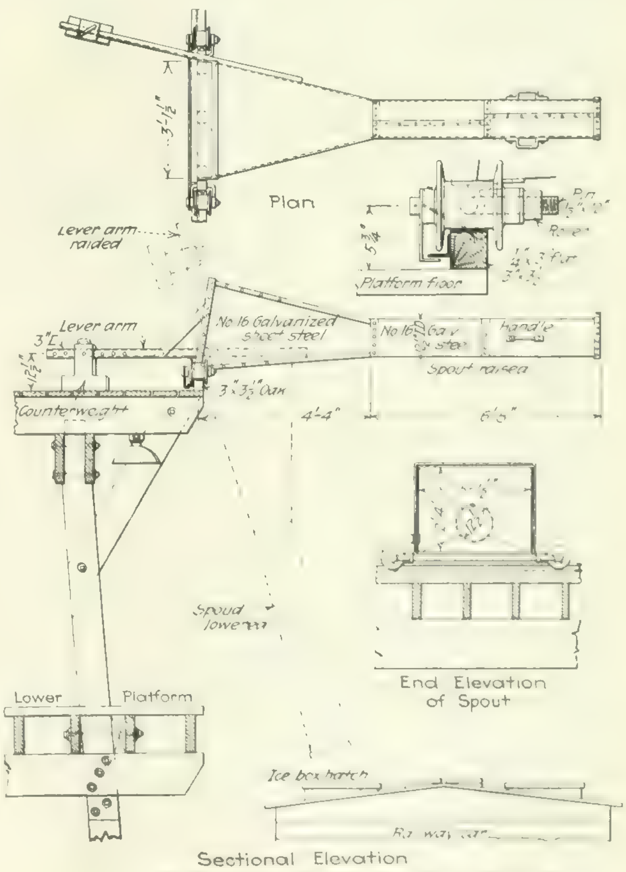


FIG. 4. PORTABLE SPOUT FOR DELIVERING CRUSHED ICE TO CARS

at the same speed but driven by a separate motor, extends along the lower deck of the icing platform. From this the men pull the cakes with tongs and slide them over skids to the roofs of the cars. At some icing stations the descent to the platform is made by inclined or spiral chutes, but for this plant the gravity movement of the cakes was considered likely to result in some loss by breakage. With the descending or retarding conveyor the blocks are lowered steadily and uniformly and cannot run away.

Handling Crushed Ice and Salt—From the head of the inclined conveyor, ice cakes may be diverted through a chute and delivered to a toothed-cylinder crusher on the second floor. Another inclined conveyor receives the crushed ice and carries it up to a bin of 4 cu.yd. capacity. This conveyor consists of maple flights 8 x 24-in., 3 ft. apart, carried by roller chains riding on the sides of a trough. At a speed of 100 ft. per minute it can handle 50 tons per hour, while the crusher capacity is 40 tons per hour. From the bin the crushed ice is discharged into steel wheeled carts or tubs of 900-lb. capacity by means of spouts fitted with radial counterbalanced hand-operated gates.

Traveling spouts, Fig. 4, deliver the crushed ice to the car hatches, the carts dumping into these spouts. Each spout is a 12½-in. galvanized pipe with a hopper top, and its upper end is hinged to a frame so that the spout can be swung in a vertical plane at right angles to the platform. A counterweighted arm is attached to the hopper. The frame is mounted on two grooved rollers which ride on the curb described above.

Coarse salt delivered in cars is elevated to a wooden storage bin by a vertical conveyor consisting of buckets attached to an endless belt. To resist the corrosive action of the salt the buckets are of malleable iron treated by the sherardising process. Spouts and gates similar to those on the crushed ice bin deliver the salt to wheeled carts which convey it to salt boxes placed on each side of the platform at every third bent. From these boxes the salt is shoveled into the car bunkers.

This car icing station was designed and built under the direction of F. E. Morrow, chief engineer of the Belt Railway of Chicago. The ice manufacturing plant was constructed and will be operated by the Railways Ice Co., Chicago. The buildings were designed by S. Scott Joy, architect. Ice making machinery was supplied by the Vilter Mfg. Co., Milwaukee, Wis., and the conveyor equipment, including portable spouts, by the Gifford-Wood Co., Hudson, N. Y.

Flood Emergency Met by Federal-Aid Road

A federal-aid road has just been completed in Arkansas which, according to the U. S. Bureau of Public Roads, has already saved millions of dollars to the community in which it is built. Recently during high water in the Mississippi word came to Helena, Ark., that the levee at Old Town, 17 miles away, was about to break. The situation was critical. A few hours' delay and thousands of acres of rich farming land would be flooded and possibly many lives lost. Helena was the only source of aid and many men with tools and material were needed. Every available motor vehicle was pressed into service and over 600 men, properly equipped for the work, were in a short time speeding over the new road to save the levee. They arrived in the nick of time and by almost superhuman effort dammed the rising waters.

Excess Dose, Thickeners and Carbonation at Water Treatment Plant

EXCESS treatment with lime, soda ash and alum combined, Dorr thickeners, sedimentation, carbonation and rapid filtration are to be practiced at the new 6-m.g.d. water softening and filtration plant at Newark, Ohio, contract for which has recently been let. The plant was designed by Charles P. Hoover, chemist-in-charge of water purification, Columbus, Ohio, assisted by Arthur R. Holbrook. The excess-chemical treatment is an extension of the excess-lime method of water disinfection described in Chapter V of Dr. (now Sir) Alexander Houston's "Studies in Water Supply," published in 1913, discussed by Charles P. Hoover and Russell D. Scott under the title "The Use of Lime in Water Purification" in *Engineering News* of Sept. 17, 1914, p. 586.

The excess treatment is obtained by overdosing a portion of the supply and subsequently mixing it with a larger and undosed part of the supply. Over-treatment gives the effect of mass action, resulting in the formation of large flocs and crystalline precipitates which are less soluble than colloidal precipitates formed when the treatment is not so complete and in consequence the water is not so soft.

At Newark 25 per cent of the water to be treated will be dosed with the lime, soda ash and alum in a tank having a 5-min. detention period during which the water will be vigorously agitated. This 25-per cent portion will then be commingled with the 75-per cent portion in a baffled mixing tank through which the water will pass with a carrying velocity of 0.4 ft. per second, the detention period being 60 minutes. The entire volume of water will be passed from the mixing tank to concentrating tanks equipped with Dorr thickeners where the water will remain for a nominal period of 22 min. The sludge gathered by the thickeners will be removed continuously so as to lessen the noticeable pollution of its discharge into the small stream that receives it. The extraction of as much as possible of the precipitate or sludge in the thickeners before the water passes to the settling basins will lessen the accumulation of sludge at the entrance end of the basins and thus make the basins utilizable to their full capacity all the time.

After a period of detention of eight hours in the settling basins the water will pass to a carbonation gallery located between the basins and the filters. This gallery will be a rectangular covered concrete tank, 15 by 20 ft. in plan by 6 ft. deep, provided with a false bottom of filtros plates. The CO_2 (produced by burning coke) combined with compressed air at the rate of 8 to 10 per cent of CO_2 to 92 to 90 per cent of air, will be forced through the filtros plates and absorbed by the water. Carbonation is for the purpose of preventing after-deposits of lime by making any residual colloidal lime soluble.

It is proposed to make some experiments on the efficiency of returning some of the sludge from the thickener to the large mixing tanks where the over-dosed water is mixed with that to which chemicals have not been added, or to the smaller dosing and agitating tank. These experiments will be in the nature of a continuation of some carried out at Grand Rapids, Mich., by W. A. Sperry.

Quicklime will be used instead of hydrated lime.

It will be unloaded from the cars by a power shovel, elevated to bins and applied to the water by gravity through weighing and chemical-feed regulators. While a plant to handle quicklime costs more than one for hydrated lime, the designers hold that the savings in operation effected in a plant of this size justifies the additional first cost, estimated at 10 per cent. Quicklime available at Newark, Ohio, averages 90 per cent water soluble CaO while the hydrate averages 65 per cent. The average current price for hydrated lime paid by Ohio water-works plants is 0.65c. per pound while quicklime costs the Columbus plant 0.55c. On the basis of the CaO content, hydrated lime having the equivalent amount of CaO in 1 lb. of quicklime costs 0.91 cents.

Delaware River Sewage Treatment Zones Fixed by Facing States

A JOINT uniform policy as to the required degree of treatment of sewage discharged into the Delaware River along that portion of the stream that divides New Jersey and Pennsylvania has been agreed upon by the departments of health of the two states after conferences between the engineers of the two departments. Under this agreement the river is divided into three sections or zones and the general treatment of sewage in each zone prescribed. In the upper zone a clarified and oxidized effluent is required; in the middle zone, removal of settleable matters by efficient sedimentation, with further treatment to safeguard public water supplies where needed; in the lower or tidal zone, sedimentation and deep submerged outlets are required, with further treatment if needed; to protect public water supplies.

The agreement is attested by Edwin Martin, commissioner of health of Pennsylvania, and by J. C. Price, director of health of New Jersey, as having been adopted by the respective departments on July 7 and 13. C. A. Emerson, Jr., is chief engineer and W. L. Stevenson is assistant chief engineer of the Engineering Division of the Pennsylvania Department of Health, and H. P. Croft is chief of the Bureau of Engineering of the New Jersey Department of Health.

The agreement in full is as follows:

1. Sewage discharged into the Delaware River from the northern limits of the states of Pennsylvania and New Jersey to a line above the City of Easton and the Town of Phillipsburg shall be treated to such an extent as to produce a clarified and oxidized effluent; and also, that so far as legally possible, the State Department of Health will prevent the discharge of untreated industrial wastes into this portion of the river.

2. Sewage discharged into the Delaware River from a line above the City of Easton and the Town of Phillipsburg to a line above the Borough of Morrisville and the City of Trenton shall be treated to such an extent as to effect the removal of settleable matter by means of efficient sedimentation; provided, however, that in cases where such settled sewage may be discharged into this portion of the river that it may prejudicially affect a water supply, the effluent shall be further treated to adequately safeguard the purified water supply obtained from the river; and further provided, that when plans for sewage treatment works are approved, where the sedimentation of sewage is the only treatment required under this policy, the approval shall be subject to the condition that means for the further purification of the tank effluent shall be installed when deemed necessary by the State Department of Health; and also, that so far as legally possible, the State Department of Health will restrict the discharge of untreated industrial wastes which might be a menace to public health or create a nuisance to either sight or smell.

3. Sewage discharged into the tidal portion of the Delaware River, from and including Morrisville and Trenton and to and including Philadelphia and Camden, shall be treated by means of sedimentation and the effluent discharged through submerged outlets into deep water in the Delaware River; provided, however, that in cases where such settled sewage is or would be discharged into the said tidal portion of the Delaware River at such a distance above or below a water-works intake that it may prejudicially affect such water supply, the effluent shall be further treated to adequately safeguard the purified water supply obtained from the river; and further provided, that when plans for sewage treatment works are approved, where sedimentation of sewage is the only treatment required under this policy, the approval shall be subject to the condition that means for the further purification of the tank effluent shall be installed when deemed necessary by the State Department of Health.

3-A. From data now available it is considered that the discharge of only settled sewage into the aforesaid tidal portion of the Delaware River within two miles of a water-works intake of an efficient filtration plant may prejudicially affect such water supply.

4. In case the said point of sewage discharge is from one State and the said water-works intake is in the other State, so that the sewage effluent while discharged within the aforesaid two miles would have to cross the river to reach the water intake, then before a decision is reached by the State Department of Health having jurisdiction over the discharge of sewage, the case shall be taken up with the other State Department of Health for a careful determination of the probability of the discharge of only settled sewage prejudicially affecting the water supply.

India Needs Special Pumps for Irrigation

The Indian correspondent of *The Engineer*, London, reports a considerable problem in providing suitable pumps driven by oil, gas, or steam engines for irrigation purposes. Although many plants are operating successfully in capacities ranging from 6,000 gal. per hour upwards, the design of suitable power pumping plants which can compete with animal power in handling small quantities presents considerable difficulty. Owing to the small available capital, first cost must be very low, while, because of the lack of knowledge of machinery on the part of cultivators, simplicity and reliability of both pump and engine are essential. The following points have been emphasized. The standard kerosene oil engine has done very well, but kerosene has become so expensive that cheaper fuel is sought. Liquid fuel, though advanced in price, does well in larger oil engines but it is doubtful if it is as yet satisfactory in engines of 2, 3, or 4 brake horsepower. Suction gas engines working with charcoal may be the solution for small plants. Blow lamps for starting give much trouble under rough use and something stronger than the usual pattern is needed. Small lubricating pipes and glass lubricators soon give out. Moving parts should be incased to protect them from dust and magnetos should be in waterproof cases. Ordinary types of reciprocating pumps are not satisfactory, as there are too many small parts. Glands, cup-leathers and leather-face are rarely treated properly by unskilled natives. Strength, simplicity and cheapness are essential.

Concrete Road Reinforced with Job-Assembled Mats

Shop Cut and Bent Bars and Ties Received in Bundles and Assembled on the Job Into Rigid Reinforcing Mats

REINFORCING mats assembled on the job from shop fabricated members have been adopted for a special 20-ft. concrete road in New Castle County, Delaware. A section of the roadway and pavement is shown by Fig. 1 The slab is separated at the middle by a construction joint, but transverse joints are made only at the end of a day's run, or where for some other reason a stop is required in the continuity of the slab. As indicated by Fig. 2, dowels are employed at these transverse joints. No metal whatever spans the longitudinal joint.

Each side slab is reinforced by mats 11½ ft. long and 9 ft. 8 in. wide with members arranged as shown by Fig. 2. Each mat weighs 85 lb., or about 0.81 lb. per square foot. Materials and construction are specified as follows:

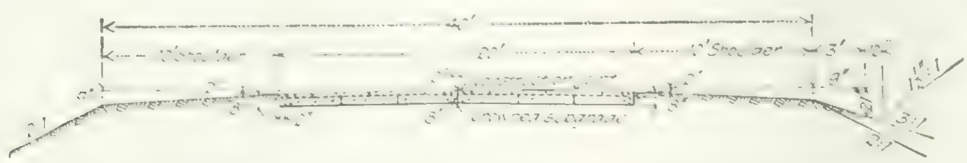


FIG. 1. TRANSVERSE SECTION OF MAT-REINFORCED-CONCRETE PAVEMENT

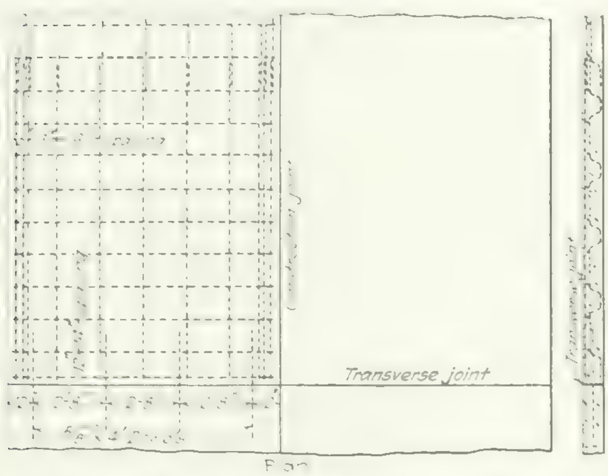


FIG. 2. DETAILS OF REINFORCING MATS

Accuracy of bending is essential, therefore, only machine bent bars will be acceptable where bent bars are required. Hooks on the hook bars and bends on the trussed bars must be true and lie in the same plane.

All steel must be wired securely in bundles, each type by itself, in order to prevent damage in transit and facilitate its selection for construction.

This steel is then to be fabricated into units in an assembly frame, or by any other method meeting the approval of the engineer.

The units are to be tied together, at the points indicated on the plan, in the assembly frame by the use of bar ties. The ties must be made of spring steel wire, and have a powerful spring grip which will yield to permit the rotation of the bar, but will not loose their grip or permit either bar to slip under ordinary usage. Soft tying wire will not be permitted.

Reinforcing units shall be placed directly on the subgrade, lapping the longitudinal bars with those of the preceding section, and securely tied together as shown on the plan.

Concreting when commenced must be carried on continuously until the section is completed.

Where a transverse joint is made in the road at the end of a unit of reinforcement, an additional transverse reinforcing bar shall be tied to the longitudinal bars, one inch from the end of the unit.

A variation of ½ in. over or under the specified length of bar will be permitted.

This road section was designed by the engineering department of the Delaware State Highway Department.

Water-Works and Filtration Plant for Dairen, Manchuria

THE first rapid-sand filter plant in the Far East has recently been put in operation at Dairen, Manchuria, the Japanese name for Dalny. It was designed by the Pittsburgh Filter & Engineering Co., but erected by Dr. Kuratsuka without supervision or assistance other than the drawings, after he had made an extensive inspection trip to the United States and European cities. He describes the Dairen system and the filters in a recent article in *The Light of Manchuria*, from which the following notes are taken:

The city has grown from 18,872 in 1906 to 186,645 in 1920. The per capita consumption is based on 34 gal. daily for whites and Japanese and 7.5 gal. daily for Chinese.

The principal source of supply is the 1,300-m.g. Wangchiatien reservoir, 11½ miles northwest of the city and 7 miles from the Shahokou filter plant and pumping station. The dam is a gravity-section rubble-concrete arch structure 707 ft. long and 96 ft. high, abutting at both ends on solid rock. The width at the top is 11.5 ft. and at the bottom 67.4 ft. Because of the great variation in temperature, 30 deg. C. to 15 deg. below zero C., contraction joints were placed at intervals of 90 ft. The contact surfaces have a thin coat of asphalt and two copper strips are inserted across each joint along the longitudinal axis of the dam to cut off leakage. For 40.5 ft. down from the top, granite blocks 1.2 ft. square and 2.5 ft. thick are placed in the upstream face to provide against the freezing action of the water.

At Shahokou the Russians had sunk in the Malan River bed eight wells 20 ft. deep and 20 ft. in diameter. Only four were found in serviceable conditon by the Japanese. A blind dam 1,680 ft. long and 8 to 30 ft. deep had been constructed across the gravel river bed to intercept and raise the underground flow so that it would fill the wells.

On the way to the settling basin ahead of the filters water from all sources is aerated nine times. The principal aerator consists of 20-in. iron pipes, 39.5 ft. in height, standing erect in a well of elliptical shape, 42 ft. in major diameter and 12 ft. in minor diameter, built at the entrance to the settling reservoir, with a depth of 24 ft. The upper 17½ ft. of these two pipes stand out of the water. Three circular shaped thin flat blocks, made of reinforced concrete and ranging in diameter from 4 ft. to 6 ft., are fitted to the pipes at an interval of 5 ft. The uppermost block has ⅜-in. holes spaced 1 in. apart so as to break the water falling on the blocks from the mouth of the standpipes into many fine streams. In the minor aerating devices two thin perforated iron plates 4½ to 6 ft. in diameter are fitted to 10-in. pipes with the tops of the pipes 6 ft. above the water surface.

Originally there was built a slow-sand filter for the water collected in the wells. The rapid filters are mainly for the surface supply but the latter may be sent to the slow sand filters. A 5-m.g. plain settling basin was originally provided but one-third of it has been converted into a coagula-

tion basin of 6-hours detention period at the 3.6-m.g.d. nominal capacity of the filter plant. Four filter tanks 18 x 20 ft. in plan and 5½ ft. deep have 1,140 strainers with perforations aggregating 1/360 of the filter area. About 7 in. above the wash-water strainers is an air-grid system consisting of ⅜-in. brass pipes spaced 6 in. c. to c., with $\frac{1}{16}$-in. perforations on the under side 6 in. apart. The gravel support is 21 in. thick and the 0.35 to 0.50-m.m. sand is 30 in. thick.

Bacterial results per cubic centimeter of samples taken in March when the water was not muddy are reported as follows [presumably 20 deg. C. counts on agar.—EDITOR]: Plain sedimentation reservoir, 22; rapid filter effluent, 2; slow sand filter effluent, 4; service reservoir, 6. The low counts are attributed to the prolonged settling in the storage reservoir. Despite these results sterilizing appliances for the use of hypochlorite of lime have been installed for emergency use.

At present extensions are being made on a five-year program to cost $2,340,000 and be completed in 1924. They include a 3,840-m.g. storage reservoir on the Lungwangtang River, 18 miles west of Dairen, formed by a rubble-concrete dam, 121 ft. high and 1,048 ft. long, 14 ft. wide on top and 92 ft. at the bottom. For pumping power to lift the water over the divide that separates the new supply from the Malan River valley the electric station at Port Arthur is to be enlarged and a transmission line 10 miles long built. With the new supply completed a capacity of 6 m.g.d. will be available.

Activated-Sludge Experiments at Moscow, Russia

With an Appeal by Prof. C.-E.A. Winslow for Printed Material to Help Relieve the Intellectual Famine in Russia

BY S. STROGANOFF

Director, Laboratories of the Division of Sewerage of the City of Moscow, Russia

[*The appended letter and memorandum which has just been received by me seems worth printing in full as the first glimpse for five years of the progress of sanitary engineering in Russia. In accordance with Monsieur Stroganoff's pathetic appeal for relief of the "intellectual famine" from which the scientific men of Russia suffer, I beg that engineers and biologists having reports or reprints of articles dealing with recent studies of sewage disposal or stream pollution will forward them to me so I may make up a package to send to Monsieur Stroganoff.—C.-E. A. Winslow, Professor of Public Health, Yale School of Medicine, New Haven, Conn.*]

OUR visit to the sewage farms of Moscow with Mr. Whipple in the autumn of 1917 was for us the last manifestation of that scientific solidarity which knows no national or political limitations. Since then I have many times attempted to write to you but the letters always came back to me without crossing the frontier. During these four to five last years we have seen no journals and no scientific works. All my attempts to procure foreign literature through official channels have been in vain. Therefore there remains for me only this last attempt at re-establishing personal relations and your kindness in sending by Mr. Whipple your works on water bacteriology and sewage disposal gave me the hope that my effort will not be fruitless.

The principal investigations with which the bio-chemical laboratory of the division of sewerage of the city of Moscow was occupied under my direction between 1913 and 1919 were as follows:

1. Investigations on activated sludge and the process of aëration which have been conducted in the laboratory and in the experiment station which you visited. [A résumé of these investigations is printed further on.]

2. Biological investigations (1913-15) on the rivers Volga, Oka and Moscow with their tributaries in connection with the plan for obtaining drinking water for the city of Moscow in a quantity of 400,000 cubic meters.

3. Experiments on the purification of sewage through ponding (combined with fish culture) and on the self-purification of sewage without fish culture. Some of these last-named investigations are described in the annual report of the Commission on Sewage Purification.

At present we are studying the fermentation of sludge and are continuing our investigations on activated-sludge treatment. As to the latter I have no doubt of the success of this procedure in America but all my information stops with *Engineering News-Record* of 1917—and I beg you to pardon me if I hope to receive from you some information in regard to this problem.

I venture to draw your attention particularly to the formula $n \div \sqrt{v} =$ constant, which you will find in my report. Is it applicable to the aëration tanks of your country? You will note that this formula brings us back to the ideas of Col. Waring.

I should be greatly interested to hear of the results of the investigations by Professor Phelps on the self-purification of streams and on the conditions covering the discharge of sewage into such bodies of water.

America is bringing most generous aid to my suffering fatherland. Perhaps I may find across the ocean a friendly hand stretched out to assuage our intellectual famine and to give us the strength to continue our scientific work. S. STROGANOFF.

RÉSUMÉ OF STUDIES ON THE PURIFICATION OF SEWAGE BY THE ACTIVATED-SLUDGE METHOD (MOSCOW, 1915-1919).

The experiments on the purification of sewage by aeration in the presence of activated sludge have been made by the department of sewers of the city of Moscow in 1915-1919, at the sewage farms under the direction of S. Stroganoff, chief of the bio-chemical laboratory. A detailed study conducted in the biological laboratory by Mlle. N. Basiakine was followed by technical investigations by M. T. Povartrine, engineer, at an experiment station which permitted the treatment of 7,000 cu.m. a day in the "aero tanks." The results of these studies may be summarized in the following paragraphs:

I. The purification of sewage by aeration in the presence of activated sludge is the logical technical development of the biological method.

II. The studies of this procedure conducted under different conditions in England and the United States as well as at Moscow for the sewage of that city in 1915 and 1919 permit us to draw a fairly definite conclusion in regard to the specific properties of the method. (1) Existence of two consecutive phases; (a) coagulation of colloids and (b) nitrification. (2) A close relation between the rapidity of purification n (= the quantity of nitrogen oxidized in one hour in milligrams per liter) and the amount of air employed per volume of sewage per hour v. That is, $n \div \sqrt{v} =$ constant. This constant = 2.58 in our experiments (50 per cent volume of sludge, at a temperature of 15-20 deg. C. (3) Definite limits for the amount of

sludge necessary for the normal progress of purification. (4) Possibility of treatment by the activated-sludge method in winter (— 25 deg. C.) on condition that the temperature of the sewage does not fall below 7 deg. C., the influence of the cold air being insignificant.

III. The two types of apparatus—aero tanks and aero filters—are distinguished from other methods of purification: (1) by the absence of offensive odors which permits their construction in the immediate vicinity of inhabited districts with consequent economy in outfall sewers; (2) by convenience in operation, since the process of purification depends entirely on the operator and permits the modification within the limits of the method of operating the purifying apparatus; (3) by the compact structure both as regards surface and volume since the apparatus (above all that of the aero filter) occupies a very small space (0.1 of that necessary for percolating filter). (4) by the cost of construction and operation, which for the city of Moscow will be inferior to that of other procedures in the case of aero filters as compared with biological beds following preliminary treatment for coagulation with activated sludge.

IV. The problem of treatment of sludge, of which the accumulation for Moscow amounts to 1 per cent by volume of the purified sewage, can be easily solved thanks to the absence of offensive odors, the facility of drying and thanks to its high fertilizing value.

V. All these qualities are in favor of this form of purification as a technical biological process independent of climate, easily operated, readily adapted to local conditions, and yielding an effluent purified to any desired condition. The adoption of this process in Russia under existing conditions meets with difficulties in regard to mechanical equipment (motors, compressors, piping) although the economy in materials and in labor are more favorable than in the case of other methods of purification (irrigation fields of bacteria beds).

For the moment we must continue under very unfavorable conditions the study of the nitrifying organisms (probably a group rather than a single form) that we have been able to isolate from the activated sludge as well as the study of the nitrification of ammoniacal solutions and of concentrated organic liquids (waste from tanneries and abattoirs and night soil).

Demountable Body Motor Trucks in England

To facilitate store-door service in the handling of freight, and to reduce its cost under present conditions of labor and prices, the London & Southwestern Ry., England, has instituted an extensive service of motor trucks having movable or demountable floors. The ordinary motor truck was found to be uneconomical in view of the idle time while being loaded and unloaded. The removable floors are 13 x 6½ ft., each mounted on eight small wheels with ball bearings. For loading and unloading at the freighthouse these floors are placed on wagon frames which are moved by horses. The wagon frames and motor-truck frames have steel runway plates for the wheels of the demountable floors and have also suitable locks for holding these floors in position. In the morning the wagon frames with floors in position are placed at the freighthouse doors and as soon as they are loaded the horses move them to a parking place. A motor truck backs up to a wagon and the demountable floor with its load is rolled onto the truck and secured. When a motor truck returns empty or with an outbound load, its floor is at once transferred to a station wagon and the truck is ready for another trip. According to the *Railway Gazette* (London) the railway company's cartage service serves an area of 120 square miles and the haul averages four miles per ton. The average daily load per truck is about 11 tons, but some trucks have handled 20 tons in six trips. Trucks of 2- and 4-ton capacity are used.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

From the A. S. T. M. President

Sir—I notice on page 32 of the July 6 issue of *Engineering News-Record* that I am made to suggest, in addressing the American Society for Testing Materials, "that such agencies as the Federal Specification Board will be glad to have their work taken over by the society." As this statement is subject to misconstruction I have requested from Mr. Warwick a copy of the stenographic notes of what I actually stated, copy of which is enclosed.

George K. Burgess,
Chief, Division of Metallurgy,
Bureau of Standards.

Washington, July 21

[The essential part of President Burgess' remarks as recorded by the stenographer is:

> This society has a unique and predominant position on the subject of materials. There are three opportunities before us on this question. There is, first the American Engineering Standards Committee; we have a book of standards; very few of those standards have been put up to the American Engineering Standards Committee to be American Standards. I think in the coming year we should do more, very much more, in getting our standards revised and then adopted as American Standards. Second, there is the field of export use of standards, and there again we should concentrate more in making our standards available abroad. And third, the government does the largest business in the country and is the greatest buyer, and there has just been organized the Federal Specifications Board for the purpose of unifying standards and that board is not going to write standards when it can help it; therefore, this society, dealing with materials, has again a particular opportunity in making its standards of engineering and commercially used materials available for the use of the government."

Our report appears to have construed the statement that the specification board "is not going to write standards when it can help it; therefore this society has again a particular opportunity."—Editor.]

The Other Side of the Case

Sir—I wish to thank you for your sane editorial of June 22 headed "Shingles Again Indicted." It is high time that the simple justice was done to shingles of calling for proofs to support the continuous attacks that have been so mysteriously made upon it during the last ten years. When we consider the long service rendered by the shingle and its great merits, we have also to consider whether propaganda of this sort should be permitted to drive out of use a building material of such varied and proven merit as the shingle.

In the first place the shingle is the best insulating roof covering that has ever been known, with the single exception of thatch. It covers the surface with three layers of wood, having good insulating properties. It is, therefore, many times more efficient in this respect than the saturated felt coverings, slate, tile, copper, tin or any other metal roofing. In these days of high cost of fuel this is a very important factor. The householder does not realize that a very large percentage of his furnace heat escapes through the roof. This is proved by the melting of snow on roofs during freezing weather.

The shingle is also the most aesthetic in appearance and capable of most artistic treatment of all the roof coverings. Its durability is such that it is more economical than most other coverings, and unless ordinances and laws prevent its use, would take the place of practically all of the cheaper manufactured substitutes.

No one advocates the use of inflammable building material in crowded cities, but the stories that are spread after every conflagration in which there are any wooden houses should not be accepted without the proof which you call for. This evidence is wholly ex-parte and is usually given by those interested in the propaganda. Statistics are quoted of the same general tenor as those so lightly given by R. S. Moulton in his letter to which you refer. In answer to similar figures, a statement was made before the Chicago Board of Aldermen a few years ago that if there were no frame buildings in Chicago the fire loss would be reduced only 3.84 per cent because all of the rest of the Chicago fire loss took place in wood, stone, steel or concrete buildings.

A number of years ago also, the *Lumber World Review* of Chicago quoted statistics of roof fires and showed that the number depended very largely upon the disposition of the statistician and his method of compiling his statistics. It is evident from the great variation in the figures quoted by Mr. Moulton that the same conditions probably apply in the cities referred to by him.

Fires are not only communicated to frame buildings in the way mentioned in your editorial, but also to other buildings because the collapse of the window panes from heat and the ignition of curtains, shades and other contents of the rooms is a very frequent occurrence.

SAMUEL CABOT, INC.,
March G. Bennett,
Boston, July 14. Gen. Mgr.

Further Check of Formula by Field Test

Sir—The article, "Field Check on Formulas for Earth Pressure," by H. S. Schick in *Engineering News-Record*, June 15, 1922, p. 994, recalls to me an attempt made some ten years ago, to discuss the formulas used for pressure due to surcharge. At that time, the writer attacked the formulas by comparing the results obtained for sloping surcharge with those for uniform surcharge, to show the absurdity of the formula for sloping surcharge. The only reply was from Prof. Cain, resulting in a long private correspondence between the latter and the writer without arriving at any definite conclusion.

The method then proposed for figuring all surcharge, was to include the weight of the wedge inclosed by the "plane of rupture" and apply to this, the factor $\tan^2 \frac{1}{2}$ $(90-\Phi)$ to obtain the horizontal thrust resulting from the retained earth and its surcharge. While it is true that the angle of repose decreases with the increase in the height of fill, (or in fact with the addition of any surcharge), this factor could be cared for by the assumption of certain slopes at various heights of fill, which is actually practiced in the provisions for railway embankments. The writer was pleased therefore to note the article mentioned and to check his method against the figures actually obtained by field measurements, though the conditions are somewhat different.

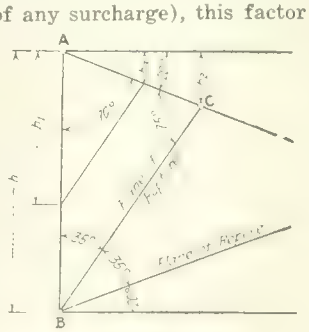


FIG. 1

Analyzing the problem in the article by this method, we have the following conditions: A wall of height h subject to pressure of earth (saturated) weighing $122\frac{1}{2}$ lb. per cubic foot and sloping down from the wall at an angle of 20 deg., surcharged with water to the level of the top of the wall.

We may assume that since the top of the earth slopes off at an angle of 20 deg. with the horizontal, the angle of repose of this saturated material is 20 deg., leaving the complement 70 deg., which divided by 2 gives 35 deg. as the angle made by the plane of rupture with the vertical. It would seem reasonable that at any point, as height h_1, the unit horizontal pressure p_1, would be the weight of the prism of earth plus that of the surcharging water modified by the $\tan^2 \frac{1}{2}$ (90 deg.—20 deg.). But in addition to this, for a depth h_2, from the top to the intersection of the plane of rupture with the top slope, there is the horizontal pressure of the water itself which has to be added to the pressure as figured above.

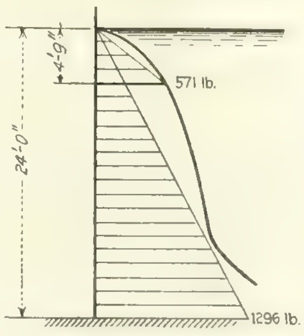


FIG. 2

The solution of the triangle in Fig. 1 results in the following formulas:

$$p_1 = [122.5(h_1 - h_3) + 62.5h_1] \tan^2 35 \text{ deg.}$$

$$h_3 = \frac{h_1 \sin 35 \text{ deg.} \sin 20 \text{ deg.}}{\sin 75 \text{ deg.}}$$

$$p_1 = \left[122.5h_1\left(1 - \frac{\sin 35 \text{ deg.} \sin 20 \text{ deg.}}{\sin 75 \text{ deg.}}\right) + 62.5h_1 \frac{\sin 35 \text{ deg.} \sin 20 \text{ deg.}}{\sin 75 \text{ deg.}}\right] \tan^2 35 \text{ deg.}$$

this results in:

$h_3 = 0.203h_1$

$p_1 = 54.0h_1$

But down to a point at a height h_2 below the top, this pressure must be augmented by the horizontal pressure of the water resulting in formula:

$$P_1 = 54.0h_1 + 62.5h_1 = 116.5h$$

For wall 24 ft. high as per problem, the height:

$h_2 = 0.203 \times 24 = 4.9$ ft.

$P_{4.9} = 116.5 \times 4.9 = 571$ lb. per square foot.

$P_{24} = 54 \times 24 = 1{,}296$ lb. per square foot at the bottom of the wall.

Using the curve in Mr. Schick's Fig. 3 and plotting these lines to the same scale, here reproduced in Fig. 2, we find rather a close agreement between the two, the variation being undoubtedly due to the action of the water horizontally below the line of intersection with the plane of rupture as there would be no abrupt ending of the horizontal water pressure but a gradual diminution and distribution through the earth resulting in a pressure line which would be a curve rather than a straight line.

As to the effect of drain pipes, there is no doubt that under all conditions these cause a reduction of the thrust by reducing the weight and increasing the angle of repose of the material retained. However in the case cited, so long as the water above the fill remained at a constant level there could be no reduction in thrust because the constancy of the water level would indicate a continuous supply of water equal to the drainage.

M. HIRSCHTHAL,
Concrete Engineer,
D. L. & W. R. R.

Hoboken, N. J.
June 21.

"Tainter" not "Taintor"

Sir—Answering your editorial query in the issue of July 27, we can say that Jeremiah Burnham Tainter spelled his name with an "e" and not with an "o." Mr. Tainter was granted several United States patents on sector gates, notably those numbered 344,877-9, all dated July 6, 1886. His home was at Menomonee, Wis. He is not now living.

Fargo Engineering Co.,
By Wm. G. Fargo.

Jackson, Mich.,
Aug. 2, 1922.

NEWS OF THE WEEK

New York, August 10, 1922

Senate Committee Minority Favors Ford Offer

Acceptance of Plan to Operate Muscle Shoals Property Urged on Senate

In a report submitted Aug. 4 to the U. S. Senate, the Senate Committee on Agriculture submitted a minority report urging the acceptance of the offer of Henry Ford to operate the Muscle Shoals property, and strongly condemning the Norris plan, which contemplates government operation. This report follows the majority report, submitted to the Senate more than three weeks ago (see *Engineering News-Record* July 20, p. 120), which recommended the rejection of all bids so far submitted. The minority report was presented by Senator Ladd, Republican, of North Dakota, and signed by one other Northern Republican and by five Southern Democrats.

Financing Proposal Stressed

Stress is laid in the report upon what the minority members believe to be economy in the cost of producing hydro-electric power, according to the Ford plan. It is pointed out that under the method of financing such projects about 80 per cent of the power as delivered at the switchboard is represented by interest on the investment. Such interest charge is to be eliminated, continues the report, by amortizing and returning the investment through a long-time sinking fund. Series of payments are to be provided which, when invested in a sinking fund at as low a rate of 4½ per cent, will return the cost of both dams as well as about $17,000,000 expended on them by the government. This feature, the report states, will allow the capital charge ultimately to be eliminated and power to be sold at approximate maintenance and operation cost, which in large plants runs between $1 and $3 per horsepower per year. The minority members of the committee believe that such a reduction of power cost is ample reason why the offer of Ford should be accepted.

Though the report admits the Ford plan has certain objections, it is stated they cannot be successfully met by government operation.

Other reasons why the Ford offer should be accepted, as stated in the report, included the statement that fertilizer costs would be materially reduced, a reduction not to be expected under present conditions of its manufacture; that the development promised by Ford would induce industrial expansion comparable to that resulting from the development of power at Niagara Falls; and that the utilization of hydro-electric power at Muscle Shoals would give the government an opportunity of seeing what was possible in the avoidance of fuel and transportation difficulties.

The report would contravene the provisions of the Federal Water Power Bill by acceding to 100-year lease.

CHARLES WARREN HUNT HONORED BY NETHERLANDS ENGINEERS

Dr. Charles Warren Hunt, secretary emeritus of the American Society of Civil Engineers, has been elected an honorary member of the Koninklijk Instituut van Ingenieurs of the Netherlands, the highest distinction within the gift of the Institute.

Dr. Hunt retired from active duty in January, 1920, after having served the Am. Soc. C. E. for twenty-eight years, three as assistant secretary and twenty-five as secretary. During the period of his incumbency the society grew in numbers and influence, its membership having increased from 1,800 to 9,400. He plans to attend in person the celebration of the seventy-fifth anniversary of the foundation of the Institute, which will be held at The Hague on September 8 and at which the diploma of his honorary membership will be presented to him.

An invitation to the Am. Soc. C. E. to have a representative attend the anniversary celebration has been accepted and Dr. Hunt will act also as official delegate from the Society.

Ferris Wheel Operator Released

The owner of the Ferris wheel which blew down at Clason Point Park, New York City, during the violent squall on June 11 (*Engineering News-Record*, June 15, 1922, p. 1014) was discharged last week from the charge of homicide which had been laid against him following the failure of the wheel. The magistrate held that there was no evidence of criminal responsibility and that the evidence showed that an extraordinary gale was responsible for the failure. A representative of the city building department testified that the wheel was of strong construction and had been regularly inspected. Six persons were killed in the failure and a dozen or more injured.

Additional Road Bond Issues for North Carolina Possible

Plans for an additional road bond issue of from $10,000,000 to $25,000,000, supplementing the $50,000,000 bond issue authorized a year and a half ago, are being discussed in North Carolina. It is understood that all of the state highway commissioners have not definitely decided whether a new bond issue should be taken up at the coming meeting of the legislature or postponed until two years hence. The taxpayers, it is understood, have sufficient confidence in the state high way commission at the present time to insist upon completion of the state road system. That will mean an additional bond issue.

Clear Road for Detroit Terminal of Pennsylvania R.R.

The dispute that temporarily blocked the Pennsylvania R.R. from entering Detroit has been ended by the abandonment for the present of plans for two additional tracks paralleling the Wabash and Père Marquette roads into the city. Construction of the Pennsylvania's $15,000,000 terminal will begin directly.

The Detroit City Council has passed an ordinance enabling the Pennsylvania-Detroit R.R. Co., an extension of the railroad lines of the Pennsylvania from Toledo to Detroit, to secure adequate facilities, and to use the Fort St. Union Depot located at Third St. and Fort St. West, jointly with other railroad companies. The ordinance also enables the railroad company to secure adequate and convenient freight terminals. The Fort St. Union Depot Co. is authorized to construct new or additional viaducts, to cross certain streets at grade and to close certain streets and alleys.

If permission should be obtained later to construct additional tracks crossing any thoroughfare at grade and the grades should later be separated, the entire construction cost of such grade separation within the limits of the intersections is to be borne by the railroad companies.

Mayor of Seattle Removes City Engineer Dimock

A. H. Dimock, city engineer of Seattle, Wash., for the past eleven years and in the engineering department of the city for more than twenty years, has been removed from office by the recently-elected mayor who announced that the cost of several departments, including engineering, had become excessive, and that changes were necessary in the interests of economy. James DeRuyter Blackwell, who has been practicing privately in Seattle for several years, was appointed to succeed Mr. Dimock. When the mayor announced his plan he gave Mr. Dimock an hour in which to resign, but Mr. Dimock's resignation was not forthcoming so he was removed.

Mr. Blackwell was born in Virginia in 1870. His early engineering experience was in the city engineer's office of Nashua, N. H., and his time was devoted chiefly to street work. For nine years he was assistant engineer in charge of the Boston office of the Boston and Albany R.R., and in that capacity directed extensive grade-separation projects. In 1899 he went to Seattle and became identified with Stone and Webster during the laying out of the Seattle street-railway system. For three years he was chief engineer of the Seattle Electric Co. and in 1903 became superintendent for the Puget Sound Bridge and Dredging Co.

In 1905 he formed a partnership with H. D. Handford and opened an office in Seattle for the practice of general engineering.

Contractors Protest Priority Order of I. C. C.

That the greater part of the construction projects now under way will be forced to shut down for lack of construction materials unless the present coal priority order is modified is the statement made Aug. 7 by the Associated General Contractors of America in a petition of protest to the Interstate Commerce Commission. It is the opinion of the contractors that the action of the Commission is so drastic as to defeat its own purpose to keep industry in operation by practically shutting down the second largest industry in the country employing 11,000,000 people.

The contractors are in favor of priority for coal for the first four classes established by the Commission, including special purposes, government uses, public utilities, medical supplies, and domestic consumption; but contend that building materials are just as important to construction as coal is to other manufacturers, and should have equal place with it after the first four classes are served.

The petition calls attention to the fact that with the reopening of the mines the demand for cars for coal will be not less than 320,444 cars per week, of the maximum 324,000 serviceable cars of these only 291,000 will be suitable for the loading and transportation of coal, leaving only 33,000 open-top cars weekly for all other purposes. Contractors estimate that during August, September, and October (granting the strikes will be settled and the priority order will stand) 50,000 open top-cars will be demanded per week for transportation of sand, stone and gravel, whereas the supply could not be much over 10,000 cars.

Lumbermen Appoint Committee on Standardization Rules

A committee to formulate specific recommendations as to standardization of sizes, grades, inspections and guarantees for submission at the next general standardization conference to be called by Secretary Hoover has been appointed by the National Lumber Manufacturers Association at a meeting recently held in Chicago. This meeting considered the findings of a special committee that met at Madison, Wis. and prepared an outline for the development of grading regulations.

As data were not available with respect to hard-wood grading the Chicago conference considered only the softwoods. The newly-appointed committee, which is empowered to increase its own membership as occasion may require, consists of the following: John W. Blodgett (chairman), president of the National Lumber Manufacturers Association, Grand Rapids, Mich.; John H. Kirby, Houston, Texas; Chas. A. Goodman, Marinette, Wis.; J. E. Lloyd, National Retail Lumber Dealers Association, Philadelphia, Pa.; Dwight Hinckley, American Wholesale Lumbermens Association, Cincinnati, Ohio; two representatives of consumers—one to be selected by the American Railway Association and other by the American Institute of Architects.

Improvement in Engineering Employment Continues

For several months there has been a gradual and steady advance in engineering employment in all sections of the country, with increased activity in many basic industries, according to the employment bureau of the American Association of Engineers. The building industry has been most active, with some irregularities in the manufacturing line, although a gradual improvement in manufacturing and industrial work is evidenced. The coal mining and railroad fields show a slight setback, due to labor difficulties, although technical men are in demand.

Highway and municipal work are progressing with added vigor, and employers in these fields find it difficult to locate experienced men. The demand for architecural and structural draftsmen and designers with building or plant experience has far exceeded the supply in practically all sections of the country. From ten to twenty such positions are received daily at national headquarters and chapter employment offices, but few experienced men are available. Employers are informed of conditions and usually they are required to advertise in the daily newspapers or technical journals for the men desired.

The total number of positions received by the association, including those at national headquarters and by employment representatives, is 402 for May and 433 for June against 351 for June, 1921. Corresponding figures of men placed are 249 for May, 225 for June and 195 for June, 1921. The total number of men registered for employment during June was 1,456. In May 1,443 applied and in June a year ago 1,960 were after jobs. The great majority who are registered for employment desire to improve their conditions or change to other localities. This record in employment work far exceeds any that has been accomplished by the association since its organization. The average monthly salary of all positions during June was $192.

British Railway Electrification Plans Well in Hand

London Correspondence

The British railway companies are forging ahead with their plans for the electrification of their suburban lines. The South-Eastern and Chatham, which serves a greater part of the London suburbs lying south of the Thames, has its plans completed and is ready to begin work. This company will electrify some 220 miles of suburban line at an estimated cost of £6,500,000. The work will occupy about three years and will give employment to 6,000 to 7,000 men. The only difficulty still in the way is to obtain the consent of the electricity commissioners for the erection of a power station.

Electric trains have already started running on the London and North-Western Ry. In 1907 this company obtained parliamentary powers to electrify certain sections of their lines and this work has now been completed. The company will now proceed with electrification under the present scheme. With the introduction of these electric trains there will be twelve trains per hour in each direction on the chief suburban lines.

Priority Order's Effect on Road Work

The following replies to *Engineering News-Record's* query regarding the effect on road work of Interstate Commerce Commission car-priority orders were received too late to be included among those published in last week's issue:

Ohio—To date we have noticed practically no effect of the Interstate Commerce Commission priority order. It is to be expected, of course, that if the priority order is enforced as at present outlined, it will of necessity curtail our construction to the extent that we will not be able to complete our program. We have under construction approximately 900 miles. I do not feel warranted, however, under the unsettled conditions to make any predictions as to the outcome.—*Leon C. Herrick, director, Department of Highways and Public Works.*

Minnesota—Present indications are that the Commerce Commission priority order will not seriously affect Minnesota road constructions. Paving contracts are well advanced and materials are in storage, but it is possible that several important connections may not be completed on account of lack of cement; this is evidently due to the coal situation rather than to priority orders. —*John H. Mullen, state highway engineer.*

North Carolina—Fortunately an extensive material survey during the fall of 1921 and the finding of large quantities and subsequent use of local material on a large part of the 1,600 miles of road now under construction in North Carolina makes it possible for road building to proceed, although at a reduced speed. With a single exception the cement situation is satisfactory but already a large mileage of the asphalt and concrete construction is suspended for lack of crushed stone.

The priority order that went into effect July 26 is beginning to be felt in earnest and the larger proportion of the road construction which is supplied by rail transportation is curtailed and the only hard-surface work now going on unhampered is that on which local aggregates are used. Roughly speaking about one-half of the mileage of hard-surface roads is being supplied by local materials. Approximately 50 per cent of the entire mileage is made up of sand-clay-topsoil gravel or macadam, and with 25 per cent of the concrete and asphalt work being supplied by local materials this leaves about 400 miles of hard surface that is affected by the car situation and priority order. Coal shortage has affected the progress of only one contract up to date.

Although these conditions show the serious situation of about 50 per cent of the hard-surface work being delayed it really means that about 25 per cent of the entire program is affected.

Contractors are at present holding their organizations; putting them in such work as grading and other minor operations so that as soon as the car situation is cleared the contractor will have an organization to place at work immediately to endeavor to overcome the present handicap of the priority order and car situation.—*C. M. Upham, state highway engineer.*

Allocate River and Harbor Funds

Washington Correspondence

During the current fiscal year the Corps of Engineers will expend $5,000,000 on the construction of locks and dams on the Ohio River; $3,000,000 on the Delaware River between Philadelphia and the sea; $2,500,000 for the inland waterway between the Delaware River and Chesapeake Bay; $2,000,000 on the East River, N. Y.; and $2,000,000 on the Southwest Pass of the Mississippi River.

Other projects, to each of which have been allocated more than $500,000 from the river and harbor appropriation are as follows: Mississippi River between the Missouri and Minneapolis, $1,000,000; Detroit River, $1,000,000; Mississippi River between the Ohio and Missouri Rivers, $915,000; Savannah Harbor, $900,000; Columbia and Lower Willamette Rivers below Vancouver, Wash. and Portland, Ore., $850,000; ship channel, Houston, Texas, $750,000; South Pass, Mississippi River, $600,000; St. Marys River, Mich., $557,000; Los Angeles harbor, $500,000; Buffalo harbor, $500,000.

New York State to Have Standard Building Code

Following the failures of the American Theater in Brooklyn and the Knickerbocker Theater in Washington last year, the legislature of the State of New York passed an act creating a committee of 24 to formulate a state standard building code under the direction of the State Industrial Board. Pursuant to this act Commissioner Henry D. Sayer of the board has appointed a committee which will formulate the rules to be presented to the board for approval. The membership of the committee comprises five labor men, one health department man, one policeman, one mayor, five theatrical men, one hotel man, two insurance men, five city building department officials, two architects, and an illuminating engineer.

Spruce Production Railroad on Olympic Peninsula Sold

The sale of the railroad built by the Spruce Production Division of the Aviation Service on the Olympic peninsula in Washington has recently been announced by the War Department. The purchasers, who will operate the road as a common carrier, are given as F. S. Scritsmier, Portland; Fentress Hill, San Francisco, and J. K. Lyon, Los Angeles. The sale price is given as $1,000,000. The properties include 36 miles of standard-gage railroad extending from Disque, the terminus of the Chicago, Milwaukee & St. Paul R. R. to Lake Pleasant; railroad rolling stock, a sawmill, logging and miscellaneous equipment. No timber is included.

The mill is located one mile from Port Angeles on Puget Sound and was designed for a capacity of 400,000 ft. b.m. per eight hour shift. The railroad taps 6,500,000,000 ft. b.m. of timber on an area of about 300 square miles and is capable of extension to tap still larger timber stands. The new owners are reported to be forming a company to operate the railroad and sawmill.

The Engineer in Public Life

GEORGE C. MASON

For five years George C. Mason of the Hurley-Mason Co., designers and builders, Portland, Ore., has served as a member of that city's Civil Service Commission. His other public activities have included the state chairmanship, during the war, of the associate members of the Naval Consulting Board. Mr. Mason was born in New York City in 1871, and was graduated from New York University with the degree of B.S. in 1892, subsequently receiving from that institution the degrees of C.E. and M.S. After a period as assistant professor in civil engineering at New York University and as engineer on surveys in New York State, he assumed charge, for Frank Jay Gould of the erection of the Gould residence in New York. Since 1904 he has been vice-president and chief engineer of the Hurley-Mason Co. and among the structures his firm has built are some of the principal public and private buildings in Portland, such as the Carlton Hotel, North Pacific Dental College, Homeopathic Hospital, and the Board of Trade Building. His company also constructed the army cantonments at Camp Lewis and the Todd Dry Dock and Shipbuilding Co.'s plant at Tacoma.

As a member of the Civil Service Commission of Portland, Mr. Mason has endeavored to impress upon city employees that they have no mortgage on a life job, but that, on the contrary, unless they render service for salary received the appointing authority may remove them, and the civil service board will sustain the removal. "We are," he says, "anxious to protect the employee against removal because of political or religious reasons, but where it is for the good of the service and without personal prejudice, we have invariably sustained any discharge."

A.A.E. to Investigate Vocational Selection for Engineers

The American Association of Engineers is about to undertake an investigation of engineering training and employment. Engineering positions will be analyzed to ascertain the qualifications required and to determine which of them engineers should be expected to obtain in early training and which through practical experience. It is believed that work of this sort will help to fit men into positions in which they can serve most effectively.

The committee which has been appointed to take up the work is assured of the co-operation of Dr. C. R. Mann, who investigated the subject of engineering education for the Carnegie Foundation, and who has had much intimate contact with practical applications of vocational selection.

International Road Congress to Meet in Seville in 1923

Final arrangements have been made for holding the fourth International Road Congress in Seville, Spain, early in May, 1923. An elaborate program has been prepared covering all phases of highway engineering and transport and many Americans either directly or indirectly concerned with these subjects are to contribute to the program.

The first section of the program will concern itself with construction and maintenance. Separate discussions under this general heading will have to do with surfacing roads with concrete in which all the details of materials, plant, proportions, use of expansion joints, advantages and disadvantages of the pavement type, and the results obtained under various circumstances will be thoroughly gone into. Bituminous and asphaltic surfaces will comprise the second question under construction and maintenance and the various methods at present in use will be fully discussed.

The question of laying street-railway rails on the various types of road surfaces will also have special attention and particular discussion will be had of the advantages and disadvantages of various types of roads when laid with rails, the connection between the rail and the surface and the need for lessening noise and vibration.

The second section of the congress will be devoted to traffic and development. Desiderata for improving design and construction of roads in order to meet the tremendous development of motor transport will be the first to be taken up. General traffic regulations including weight and speed, tire widths, lighting, drivers' licenses, the rights of pedestrians and animals, passing and overtaking and other questions will be discussed as well as the problem of handling traffic on congested roads and streets of towns. In this last discussion consideration will be given feasibility of separating slow and fast traffic as a means to solving traffic problems.

Under the general head of construction and maintenance special attention will be given to the progress made in the application of modern mechanical appliances to construction and maintenance of highways. This discussion will include any supplementary information on mechanical equipment introduced since the last congress which was held in London in 1913.

Engineers Sue as Result of Alleged Libel

A. M. Lund and P. B. Hill, engineers of Little Rock, Ark., have entered damage suits against H. L. Remmel, state republican chairman for Arkansas, demanding $50,000 for alleged libelous statements. The suit charges Remmel with falsely stating that Messrs. Lund and Hill wasted the taxpayers' money in connection with the Little Rock-Hot Springs highway construction. The libel is alleged to have been made in an article written by Mr. Remmel and published in the Little Rock *Democrat*. The members of the Arkansas Chapter of the American Association of Engineers are giving the engineers moral support in their suit in the endeavor to end what is characterized as "a too free habit among more or less prominent citizens to attack engineers publicly without cause."

New Canadian Laws Place Severe Limits on Truck Weights

Two new laws have been passed that will affect the use of motor trucks in the province of Quebec. The provincial government has prohibited any truck of over 2½ tons weight to use the provincial highways outside of cities. Although owners of the large trucks are subject to a provincial tax the trucks are not allowed on the roads of the province outside the city streets. Power has been vested in the city to regulate the size of the loads carried by these heavy trucks.

The city of Montreal has enacted a by-law under which 5-ton trucks will be limited to loads of 3 tons if equipped with pneumatic tires; trucks without pneumatic tires are prohibited from transporting loads of over 2½ tons.

There are many firms in the city of Montreal, including large construction companies which own heavy motor trucks. Some of the construction companies are considering the elimination of the trucks of over the 2½ tons capacity. It is claimed that if the law is not repealed, it will not be profitable to use the 5 ton trucks when carrying only half the loads they formerly transported.

The reason for the provincial law and the city law is the same, namely, the fear that the heavy trucks will damage the streets and highways with the heavy loads.

In the province of Quebec the sale of heavy trucks has been injured greatly by the two new laws. Some of the owners of the big trucks have already offered them for sale on the eve of the operation of the two laws. Some of the contracting companies are purchasing draught horses in Prince Edward Island and New Brunswick for use instead of the big trucks in transporting building materials.

To Hold Safety Congress

The annual Safety Congress and exhibition of safety appliances of the National Safety Council will be held at Detroit, Aug. 28 to Sept. 1. As usual, a long program of papers and demonstrations has been planned. Each of the 21 sections of the council will meet separately in two or three sessions and there will be a number of general sessions at which topics of interest to all sections will be discussed. The topics listed for the civil engineering construction section are: An address by Gen. R. C. Marshall, representing the Associated General Contractors; practical safety methods for field superintendents; keeping accident records; safety work on high steel buildings; industrial surgeons, and elimination of waste in construction.

Garbage Collectors' Strike Fails at Detroit

On account of a reduction in wages from $5.50 to $5 a day, garbage collectors and drivers at Detroit, Mich., struck recently. Joseph A. Martin, commissioner of public works, informs *Engineering News-Record* that little difficulty was experienced in replacing the strikers and that there were only a few attacks on the men and those minor. On Aug. 4, strikers were applying for positions but were not being taken back.

State Not Forced to Repair Road Intersections With Town Streets

An opinion by Attorney-General U. S. Lesh, of Indiana, recently given to the State Highway Commission holds that the commission is not required by law to repair and maintain streets in incorporated towns where the streets connect state highways. The commission has discretionary powers in regard to making these improvements, the opinion holds. In some towns and cities of Indiana, streets connecting state highways have been allowed to fall into bad condition by the local officials on the ground that the repair work should be done by the state highway commission.

Record Shipment of Electrical Plant for Chilean Railways

Two trainloads of equipment for the electrification of the Chilean State Rys. have left Pittsburgh, in partial fulfillment of the contract between the Chilean Government and the Westinghouse Electric International Co. for the $7,000,000 worth of apparatus included in the initial installation.

The second shipment, one of the largest single consignments on record of electrical apparatus for railroad electrification, was attended by considerable ceremony and the train was set in motion by radio control. Equipment already shipped includes all the apparatus for the five sub-stations contemplated under the present project.

Zoning and Major Street Plan Work at Columbus, Ohio

Preparation of zoning and major street plans for Columbus, Ohio, has been started by the City Planning Commission. A. H. C. Shaw, who was connected with the work of the Cleveland City Planning Commission for several years, has been employed as engineer of the Columbus Commission and Robert Whitten, city planner, of Cleveland, has been retained as consultant to the commission. Prof. F. H. Eno, of the department of engineering of Ohio State University, is a member of the Columbus City Planning Commission and chairman of its committee on zoning and major street plan.

Industrial Executives to Meet

The seventh annual summer session in industrial organization and administration will be held at the Pennsylvania State College, Aug. 28-Sept. 9. The session will be under the immediate direction of Prof. Edward J. Kunze, assisted by Prof. J. O. Keller and Prof. P. P. Henshall of the department of industrial engineering. The course is designed to meet the needs of manufacturers, superintendents, personnel directors, accountants, production managers, and others.

The purpose of the conference is to assist men in the development of their jobs, to broaden the applicability of scientific methods to industrial management, and to illustrate the most effective methods of modern organizations. The work is divided into discussions on industrial organization, manufacturing methods, employment, industrial relations, factory planning, material and production control, scheduling and dispatching, purchasing, cost accounting, and kindred subjects.

To Award Highway Fellowships at Michigan

Two of the following fellowships will be awarded not later than Sept. 1 and two not later than Nov. 1, by the Board of Regents of the University of Michigan:

The Roy D. Chapin Fellowship in Highway Transport, for the investigation of an approved subject relative to highway transport.

The Roy D. Chapin Fellowship in Highway Engineering, for the investigation of an approved subject relative to hard-surfaced roads and pavements.

Two Detroit Edison Fellowships in Highway Engineering, for the investigation of approved subjects relative to moderate-cost country roads.

Each fellowship pays the sum of $250 with an allowance of $50 for expenses. The holders of these fellowships do not have to pay tuition fees. A fellow must hold a bachelor's degree from a college of recognized standing. An application for a fellowship must include a concise statement of the candidate's educational training and engineering experience, and three references. Requests for information should be sent to Prof. Arthur H. Blanchard, University of Michigan, Ann Arbor, Mich.

Foreign Light-Railway Society Meets in October

The newly-organized International Tramways, Light Railways and Bus Transport Association, with headquarters at Brussels, Belgium, will hold its first annual meeting at Brussels in October. This association is the successor to the old established Tramways and Light Railways Association which was dissolved at the time of the World War by order of the Belgian government because its membership included German companies. The property of the association was also sequestrated since it consisted in part of enemy funds.

Membership in the new association is limited to companies in the allied and neutral countries, and includes also officers of these companies and associate members who are interested in the question of local transportation but are not officially connected with the industry. The president is C. de Burlet, director of the National District Railway Society (Belgium); the secretary is Henri Camp.

Civil Service Examinations

UNITED STATES

For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Vacancies in the Income Tax Unit of the Bureau of Internal Revenue, Treasury Department. Appraisal engineer, $3,000 to $4,000 per year. Receipt of applications to close Aug. 29.

Vacancies in the Lighthouse Service. Architectural and structural steel draftsman, $1,380 and $1,800 per year. Receipt of applications to close Sept. 6.

Vacancies in the Bureau of Public Roads. Highway research specialist: Grade 1, $1,800 to $3,000 per year, or $6 to $10 per day; Grade 2, $3,000 to $4,500 per year, or $10 to $12.50 per day. Receipt of applications to close Sept. 12.

Engineering Societies

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal, Que.; Professional Meeting, Winnipeg, Man., Sept. 5-7.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

The County Engineers' Association of California has elected the following officers: R. R. Arnold, Martinez, president; J. L. McBride, Orange County, vice-president; Lloyd Bowman, Santa Cruz, secretary-treasurer; E. P. Bell, Napa, and Howard F. Coussens, Salinas, directors.

The San Diego (Cal.) Chapter, American Association of Engineers, has elected officers as follows: President, F. S. Callender, naval public works office; vice-president, A. C. Black; secretary, C. B. Ireland; treasurer, R. W. Miller; delegate to state association, N. W. Cummings.

The Illuminating Engineering Society is to hold its 16th annual convention at Swampscott, Mass., Sept. 25-28. Charles L. Edgar, president of the Edison Electric Illuminating Co., Boston, is chairman of the general convention committee.

Personal Notes

SQUIRE E. FITCH, Westfield, N. J., has been appointed county engineer of Chatauqua County, N. Y. He succeeds WILLIAM J. KNAUER, of Jamestown, N. Y., who has resigned.

A. V. RUGGLES, until recently engineer of construction and surveys in the Cleveland water department, in charge of the design and construction of the Baldwin-Fairmount project, involving the expenditure of about $13,000,000, recently was appointed water commissioner for the City of Cleveland. Several years ago Mr. Ruggles was with Hazen & Whipple, consulting engineers, New York City, on various filtration-plant projects. Later he became assistant engineer for the Board of Water Supply of the City of New York. After spending some time on work in connection with the Catskill Aqueduct, New York City, Mr. Ruggles in 1914 became assistant engineer of the Division of Water, Department of Public Utilities, of Cleveland, a position he held until August, 1917. During the war Mr. Ruggles was a captain of engineers and most of his oversea's service was as an assistant to Major John B. Hawley, in charge of water supply and sanitation in Base Section 1, A. E. F.

JAMES A. DAVIS, chief engineer of the Washington State Highway Division for the past nine years, has resigned, to enter the employ of the Carlson Construction Co., of Spokane. GEORGE T. MCCOY, present assistant chief engineer, will succeed Mr. Davis.

R. M. TAYLOR, who has been with the H. W. Kaylor Construction Co., Elkins, W. Va., has joined the engineering staff of the West Virginia State Road Commission as assistant engineer of construction.

WALTER S. PEDERSEN, until recently designer for the Iowa Steel & Iron Works, has been made chief engineer of Geiger and Peters, steel fabricators, Indianapolis, Ind.

J. C. BURGESEN, former assistant engineer with the Union Pacific R. R. Co., has been made project engineer for the Missouri State Highway Department.

WALTER MOORE, JR., has resigned as manager of the Southern California Chapter, Associated General Contractors of America, to accept the sales management of the Union Rock Co., Los Angeles. E. EARL GLASS, engineer for the chapter, is now manager.

M. A. GOULD, assistant engineer with the Illinois Division of Highways for the past few years, has been appointed instructor in the civil engineering department of the University of Idaho. Mr. Gould is a graduate of the University of Illinois and spent two years with the U. S. Signal Corps.

IRWIN S. OSBORN, of Allen & Osborn, consulting engineers, Cleveland, Ohio, has joined the engineering and executive staff of the C. O. Bartlett & Snow Co. of Cleveland. The company named is to add service in the refuse incineration field to what it has already been rendering for many years in garbage reduction.

HORACE P. RAMEY, division engineer, Sanitary District of Chicago, and in the service of the district since his graduation from the University of Michigan 15 years ago, has been made acting chief engineer, during a temporary leave of absence of ALBERT W. DILLING, chief engineer.

W. D. WILSON, of Englewood, N. J., has recently been appointed superintendent of the public works department of Rockville, Conn., succeeding CLAYTON E. SWAIN, resigned.

EZRA C. SHOECRAFT, for the past nine years city engineer of Flint, Mich., has joined the sanitary engineering firm of Hoad, Decker & Drury. City paving and other municipal work will be handled. The name of the new firm will be known as Hoad, Decker, Shoecraft & Drury.

HENRY HOLGATE, of Montreal, Que., has been retained by the Dominion Department of Railways & Canals to report on the hydro-electric power in the Trent Valley District, with a view to settlement of differences between the Ontario Hydro Electric Commission and the Federal Department of Railways and Canals.

C. E. GHYSENS, city engineer of Verdun, Que., has resigned. He is succeeded by H. HADLEY, former city engineer.

EDWARD H. SPIERS, former assistant field engineer with the Interstate Commerce Commission, Bureau of Valuation, is now resident engineer with headquarters at Elkin for the North Carolina State Highway Commission.

CHARLES CLARAHAN, JR., is now junior engineer with the Division of Highways, State of Illinois. He was formerly structural engineer for N. B. Garver, consulting engineer, Little Rock, Ark.

LIEUT.-COMMANDER E. D. STANLEY, Supply Corps, U. S. Navy, attached to the office of the chief co-ordinator, will soon spend some time in Albany, N. Y., in connection with the organization of a centralized purchasing office recently authorized by the New York legislature. Endeavor will be made to co-ordinate the purchase and storage activities of New York State with similar federal activities within the state.

Obituary

A. L. JOHNSON, president of the Corrugated Bar Co., Buffalo, died at his home in that city July 21. An extended obituary will appear in a later issue of this journal.

TIMOTHY SHEA, retired railroad contractor of Knoxville, Tenn., who has made his home in Washington, D. C., for several years, died recently at the age of 73 years. Mr. Shea was one of the most prominent railroad contractors of the south, besides having done much work throughout the southern section of the United States had executed a large number of contracts for the republic Guatemala.

FRANK E. BOGARDUS for seventeen years county engineer and superintendent of highways for Onondaga County, New York, died recently at East Syracuse, aged 56 years. Previous to his becoming superintendent of highways of Onondaga County he had served as superintendent of highways for the town of DeWitt. He was the treasurer of the County Superintendent of Highways Association for a number of years.

A. L. HARRIS, consulting engineer of Los Angeles and Phoenix, Ariz., died recently in the former city, aged 50 years. Outstanding in his professional practice were his associations with reclamation and irrigation projects. For seven years he was an assistant engineer in the U. S. Reclamation Service, spending most of that time in or near the Roosevelt Dam. He was graduated from the University of Michigan in 1896 and after graduation was employed successively by the New York State Barge Canal Survey, the Isthmian Canal Commission, the Pennsylvania & Long Island R. R. companies and private firms in drafting, designing and estimating. Mr. Harris was chief engineer of the Pari-

dise-Verde project and was connected also with the Beardsley and Lotus Valley Project in a consulting capacity. He was a member of the American Society of Civil Engineers.

Business Notes

Monroe L. Patzig has been appointed representative of the Conveyors Corporation of America, Chicago, for the sale of the American trolley carrier in the Des Moines, Iowa, district.

F. L. Howell & Co., drilling contractors, have removed their offices from Scranton to Pittston, Pa.

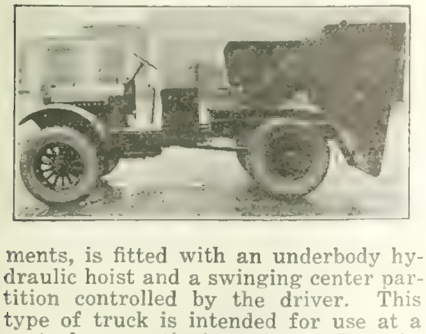
The C. O. Bartlett & Snow Co., of Cleveland, Ohio, announces that hereafter it will build refuse destructors as well as garbage reduction plants and that it has added to its engineering and executive staff Irwin S. Osborn, consulting engineer, who has specialized for years in garbage and refuse disposal. Associated with Mr. Osborn in directing the enlarged service of the company will be Mr. Bighouse, who has long been in charge of the garbage disposal work of the company. Raymond Wells will also continue with the company as consulting chemical engineer.

Equipment and Materials

Truck for Road-Building Service

Designed especially for road-building service, a motor truck with a short wheelbase and equipped with 1 and 2-cu.yd batch bodies has been developed by the Republic Truck Sales Corp., Alma, Mich. To provide manoeuvering ability on subgrades the truck is equipped with pneumatic tires and with a wheelbase of only 110 in. The turning radius is 15½ ft. A special low gear ratio enables the truck to negotiate sand and mud roads. The body is mounted low and is balanced over the rear axle. Approximately 40 per cent of the total load is carried on the front wheels.

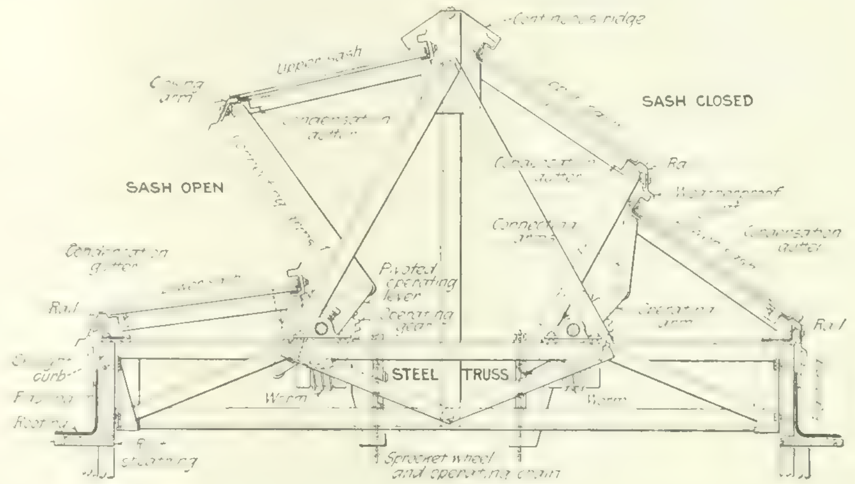
Three body designs, all of 2-cu.yd. capacity, are available. The standard rear discharge type, with two compart-



ments, is fitted with an underbody hydraulic hoist and a swinging center partition controlled by the driver. This type of truck is intended for use at a central proportioning plant. For the wet-mix system the truck body comprises two gravity end-dump hoppers. A third body action provides for mounting two batch boxes of 1-cu.yd. capacity so that contractors may use existing equipment if preferred.

Balanced Ventilating Skylight

Steel-frame skylights having pivoted sash counterbalanced for easy operation and giving an exceptionally large unobstructed area when fully open form a recent development for industrial buildings in which fumes, steam or gases make ample ventilation essential. They are the invention of B. P. Blaski and are being introduced by McKeown Bros., Inc., of Chicago and New York.



From the drawing of the double-pitch skylight it will be seen that each face consists of two panels. The distinctive feature is that these two panels are hinged at top and bottom respectively and are so connected as to balance each other. When closed a weatherproof joint is formed. Interior condensation is collected by gutters on the sash. A rocking lever mounted on the skylight frame carries two connecting arms whose outer ends are pivoted to the two sash panels so that as one panel moves up the other moves down and the panels are thus counterbalanced. On the lever shaft is a worm wheel engaging a worm which is operated by a sprocket wheel and endless chain. In this way the panels can be moved readily to give any desired extent of opening and they will remain in position since they cannot overhaul the worm gear.

These skylights are made in four standard widths of 6 to 12 ft. and of any desired length, with all the sash movable or with alternate sections of fixed and movable sash. They are shipped knocked down ready for erection and simple instructions enable any handy man to install them on existing buildings. For sawtooth roofs a somewhat different construction is used.

Out-of-the-Ordinary Trade Publications

Segment Block Sewers—The American Vitrified Products Co., Akron, Ohio, has issued a hand-book of information on Amco segment block sewers. The material is presented in seven chapters dealing with manufacture, tests, design, construction, estimating and specifications. The blocks, of vitrified clay, are adapted both to circular and egg-shaped sewer sections. There are a number of tables devoted to sewer hydraulics, excavation quantities per linear foot of trench, areas of circles, number of brick required, etc. The data and illustrations are in convenient form for the use of municipal and consulting engineers.

Dragline Cableway Excavators—Sauerman Bros., Chicago, have published an 18-page illustrated pamphlet on handling sand and gravel with dragline cableway excavators which dig, elevate, convey and dump material without the use of intermediate machinery. The scraper buckets are made in six sizes, from ⅜ to 2 cu.yd., and the maximum economical cable span is 800 ft. Photographs and text cover a wide variety of installations of this type.

Lime—The Ohio Hydrate & Supply Co., Woodville, Ohio, presents facts about the origin, manufacture and use of lime in a 16-page illustrated booklet.

Asphalt Macadam—The Texas Co., New York, has revised and reprinted its 12-page booklet entitled "How to Build an Asphalt Macadam Road." Steps in constructing the base and the wearing surface are described and a number of photos illustrate methods of applying the asphaltic binder by hand pouring and pressure distributors.

Pit and Quarry Equipment—The Western Wheeled Scraper Co. shows the adaptability of its equipment to pit and quarry work in a 16-page booklet profusely illustrated with photographs of its scrapers, dump cars, elevating graders, dump wagons and carts, road and railroad plows, jaw crushers and gravel-screening plants. The text deals with operating methods at specific installations.

Riveted Steel Pipe—The Merchant Ship Building Corp., Chester, Pa., describes in an 8-p. illustrated folder the process of manufacture of large-diameter riveted steel pipe. The views, with brief descriptive text, cover the following steps: Pickling, punching, planing, scarphing, rolling, and plant layout for the fabrication of large diameter steel pipe (7¼ to 8½ ft.) for use on the Catskill aqueduct, New York. There are also illustrations of radio and transmission towers and grain elevator equipment.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Production and Material Stocks in Ten Cities

Steel Output Dropped 6 Per Cent, Lumber 12 Per Cent in Month—Cement and Brick Industries Suffer Fuel Shortage

Steel—Production of steel ingots in July totaled 2,487,104 tons, a drop of 6 per cent from the preceding month. The output for June, 2,634,477 tons was the peak of the season. Operations particularly with the Carnegie Steel Co. are proceeding at about 75 per cent of capacity. Transportation and fuel conditions have improved somewhat during the last week. Despite the usual seasonal dullness, demand for car materials, strip steel, sheets and plates continues active. Conditions in the semi-finished market, however, are more unsettled.

Lumber—An average of 369 mills reporting weekly to the National Lumber Manufacturers' Association for the four weeks ending July 22, 1922, show 845,928,489 ft. cut or a weekly average of 211,482,122 ft. as against 240,246,400 ft. during the preceding four weeks. Latest figures show shipments 10 per cent, production 6 per cent and orders 13 per cent below normal.

Cement—Output during June totaled 11,245,000 bbl., an increase of 69,000 bbl. over May, 1922, according to the Geological Survey. Shipments increased 721,000 bbl. leaving a reserve of 10,668,000 bbl. on July 1, 1922, a decrease of 2,225,000 bbl. from the preceding month.

Brick—Latest production figures as of July 1, received from 95 companies reporting to the Common Brick Manufacturers' Association of America, show 106,475,000 brick burned, or increases of 19 per cent in production and 21 per cent in shipments, and 115,333,000 shipped. Orders on the books are far in excess of both burned and green brick on hand as the brick table shows. This condition applies to all the Eastern and Middle Western districts. Stocks are adequate only in the South and Far West. At the outset of the strike brickyards were well stocked with fuel, but recent reports indicate that in many sections manufacturers are at the end of their supplies. Only one plant, in Illinois, is actually closed down for lack of fuel. For the first time in more than a year the brick industry is reporting a shortage of skilled labor.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: cement, Denver, 10,000 bbl.; time required for delivery of carload lots to city job, example: sewer pipe, Atlanta 24 to 36 hr.; and stocks on hand in general terms, example: common brick, New York, shortage.

	San Francisco	Denver	Minneapolis	Detroit	Chicago	New Orleans	Atlanta	Philadelphia	Montreal	New York
Sewer pipe	Well stocked	Del. 24 hr. local plant		Moderate supply	50 per cent below normal normal	Stocks low	Del. in 24 to 36 hr.	Some kinds closed acc't. of strikes.	Plenty	Enough for present demands.
Cement	Heavy stock	10,000 bbl.	Mills refusing large contracts	Warehouse stocks decreasing	Nearby mills, quick deliveries	Enough	20 cars	Plentiful	Ample supplies	Dealers stocks kept up.
Lime	Plenty	Ample supply	Stocks low	Prompt del. from Ohio and Michigan mills			30 to 40 cars	Fair	Del. 24 hr.	Not yet affected by fuel situation.
Common brick	Enough	Small. No delay in del. from yards.	Scarce, filling orders direct from kilns	Enough for immediate needs	Stocks in yards, 100 per cent of capacity.	Sufficient to meet demands	Plenty	Del. from kilns as fast as produced.	Moderate	Shortage
Hollow tile	Fair supply	Sufficient	Stocks dwindling	Stocks light del. take several days.	Factories meeting demand.		Del. 5 to 6 days.	Production affected by strikes.	Del. 24 hr.	No shortage
Lumber	25,000,000 ft.	Large stocks	Fairly good at mills	Normal	Enough	Demand heavy stocks light.	Plenty at present	Stocks depleted in some grades.	Large [illegible]	7 to 8 week from mill
Asphalt	Large stocks	10 cars		Sufficient			Large supplies	Heavy reserves		Refineries near city
Structural steel	[illegible]				Supply not quite up to demand.		2 to 3 cars		Well stocked	Warehouse stocks heavy.

REPORT ON COMMON BRICK FROM 95 YARDS AS OF JULY 1, 1922

Dist. No.	Including states of	No. of firms reporting	Plants closed down	Burned brick on hand	Unburned brick on hand	Orders on books	Price per thousand at brickyard
1.	N. Y., New England	8	0	4,502,000	2,643,000	6,581,000	$8.00 to $18.00
2.	Pa., N. J., Md., D. C., Del.	11	0	12,088,000	[illegible]	35,355,000	12.00 to 18.00
3.	Va., N. C., S. C., Ga., Fla.	7	0	[illegible]	[illegible]	8,013,000	9.00 to 16.00
4.	Mich., Ohio, W. Va.	8	0	4,703,000	4,004,000	21,202,000	12.00 to 13.50
5.	Ill., Ind., Wis.	25	1	[illegible]	[illegible]	[illegible]	10.50 to 14.00
6.	Ky., Tenn., Miss., Ala., Ark., La.	11	0	6,613,000	5,444,000	9,075,000	8.00 to 16.00
7.	N. & S. Dak., Minn., Neb., Ia., Kan., Mo.	9	3	2,917,000	2,801,000	3,429,000	10.00 to 18.00
8.	Okla., Tex., N. M.	7	1	5,183,000	3,136,000	2,499,000	8.00 to 12.00
9.	Wash., Ore., Mont., Wyo., Ida., Utah., Colo	4	0	1,687,000	340,000	339,000	13.50 to 16.00
10.	Calif., Ariz., Nev.	5	0	3,380,000	7,245,000	7,905,000	14.00 to 15.50
		95	5	167,750,000	37,864,000	294,272,000	

San Francisco—Heavy supplies of road oils and cement; dealers' stocks of lime, brick, tile, sewer pipe and reinforcing bars in good shape. Only fair supply, however, of track supplies, expanded metal lath and triangle mesh. Plenty of structural shapes, plates and steel sheets; 25,000,000 ft. of lumber in yards.

Denver—Brick situation improved; supply limited but no delay in deliveries. Plenty of other building materials.

Minneapolis—Dealers' stocks of cement, brick, lime and hollow tile are low, orders being filled direct from cars or kilns in many cases. Mills are refusing to sell cement on large contracts, owing to fuel uncertainties. Lumber stocks fairly good at mills; little buying by dealers owing to uncertain deliveries. Lumber shortage expected soon if present strikes and weather conditions continue.

Detroit—Small quantities of paving stone, wood blocks and hollow tile on hand. Ample supplies of lime, brick and manila rope. Normal stocks of asphalt, sewer pipe and lumber, in yards. One cement mill closed down for lack of coal; others facing shutdown unless situation is relieved within thirty days. Car shortage has had no serious effect upon building materials supplies, as yet.

Chicago—Stocks of common brick in yards about 100 per cent of capacity. Hollow tile demand taking all that factories can produce. Sewer pipe supply about 50 per cent below normal and demand taking entire factory output.

New Orleans—Not enough sewer pipe. No crushed stone on hand. Lumber demand exceeding supply.

Atlanta—Plenty of lumber, brick and asphalt. About twenty carloads of cement, 30 to 40 carloads of lime and 2 to 3 carloads of structural steel on sidings. Deliveries made on sewer pipe in 24 to 36 hr.; hollow tile 5 to 6 days.

Philadelphia—Sewer pipe and hollow tile production curtailed by strikes. Local yards delivering brick from kilns before they are sufficiently cooled. Plentiful stocks of cement, lime, paving stone and wood blocks. Lumber stocks depleted; beginning to affect construction. Big reserves of ashphalt; South and Central West supplied from here.

Montreal—Deliveries made on lime and hollow tile in 24 hr. Cement and brick supplies sufficient to meet the demand. Plenty of sewer pipe and large retail stocks of lumber.

New York—Hudson River brick being shipped into market as fast as possible despite the fact that coal, wood and coke are almost unobtainable, except in limited quantities and at prohibitive prices. No actual shortage of other construction materials.

"July Contracts 34 Per Cent Under Preceding Month"—p. 208, Business Side of Construction, Aug. 3 issue.

Maybe it didn't sound optimistic—but it was the truth.

That was why Engineering News-Record *published it.*

Could have said "July Contracts 13½ Per Cent Heavier than for July, 1921."

That also is true. But construction men are not so keenly interested in a year ago as they are in a comparison of "now" with only a month ago. They want to know the current trend.

So the News-Record *cut to the line—let the chips fall where they might. [The Business Side of Construction tries to do this every week.]*

Bid Prices on Federal Aid Roads Show Wide Ranges

Average accepted bids on Federal Aid road projects, during June, showed rates for common excavation ranging from 16c. in Texas to $1.39 per cu. yd. in New York. Bids on rock excavation reached as high as $3.64 in New England as against 35c. in Texas and 84c. per cu.yd. in Georgia. A wide range of bids on road projects involving the excavation of 8,295,786 cu.yd. of earth, resulted in an average rate of 34c. per cu.yd. for the whole United States. An average rate of $1.41 per cu.yd. is shown for 283,471 cu.yd. of rock excavation, for the entire country.

Prices of gravel, in varying quantities, ranged from 37c. in Iowa and 56c. in Colorado and South Dakota to $3.50 per cu.yd. in Georgia. Rates for sand maintained greater uniformity; the one high average being $2 per cu.yd. in Massachusetts as compared with 66c. in Texas and South Dakota and 26c. per cu.yd. in South Carolina. The highest rate for crushed stone, in place, was in New York, $3.70, with Ohio next, at $3.04; the minimum in Missouri, $1.50. Structural concrete costs were highest in Nevada and Washington.

STATEMENT OF AVERAGE ACCEPTED BID PRICES ON FEDERAL AID PROJECTS DURING JUNE, 1922.
ITEMS AND MATERIALS FURNISHED IN PLACE ON PROJECT.

Geographic Divisions and States	Excavation: Common		Excavation: Unclassified		Excavation: Rock		Materials: Gravel		Materials: Sand Clay		Materials: Crushed Stone		Structural Concrete: Class A		Structural Concrete: Class B	
	Cu.Yds.	Rate	Cu.Yds.	Rate	Cu.Yds.	Rate	Cu.Yds.	Rate	Cu.Yds.	Rate	Cu.Yds.	Rate	Cu.Yds.	Rate	Cu.Yds.	Rate
Totals for all States	8,295,786	0.34	1,983,391	0.65	283,471	1.41	785,318	1.48	92,016	0.46	142,609	2.34	39,560	19.60	24,061	17.60
New England	225,461	1.14	24,687	1.33	16,553	3.64	120,668	2.01	.560	2.00			1,931	21.50	3,181	26.40
Maine	54,614	1.22			2,530	6.10	40,747	2.48					205	30.80	354	26.00
New Hampshire	33,398	1.02	9,692	1.41	746		2,778	2.16					845	19.40	621	18.00
Vermont	47,224	1.01			1,687		19,743	3.07					391	19.00	854	17.20
Massachusetts	90,225	1.21	14,995	1.27	11,590		57,400	1.31	560	2.00			490	23.10	1,352	36.00
Rhode Island																
Connecticut																
Middle Atlantic	351,400	1.39	213,262	1.03	8,030	2.12	1,250	2.24			349	3.70	1,890	9.85	986	19.50
New York	351,400	1.39	116,100	0.97	8,030	2.12	1,250	2.24			349	3.70	1,760	*8.60		
New Jersey																
Pennsylvania			97,162	1.08									130	27.30	986	19.50
East North Central	363,644	0.33	280,869	0.51	23,417	0.98	87,061	1.38	13,845	0.74	9,861	2.30	6,516	17.75	1,688	15.40
Ohio	6,271	0.62	280,869	0.51							741	3.04	2,398	18.30	1,216	14.70
Indiana																
Illinois																
Michigan																
Wisconsin	357,373	0.32			23,417	0.98	87,061	1.38	13,845	0.74	9,120	2.25	4,118	17.50	472	17.10
West North Central	4,524,895	0.27	386,708	0.38	31,028	1.73	266,933	0.64	4,486	0.66	12,498	1.50	3,018	19.10	9,953	13.1[illegible]
Minnesota																
Iowa	1,226,560	0.27	107,720	0.51	7		7,738	0.37								
Missouri	605,522	0.36	116,106	0.37	22,176						12,498	1.50	145	26.80	8,602	12.50
North Dakota	351,389	0.26	78,997	0.27	4,280		34,625	1.29					650	19.30	169	20.00
South Dakota	46,170	0.33			100		224,410	0.56	4,486	0.66			4	23.00		
Nebraska	2,296,254	0.25	83,885	0.36	4,465		160	3.00					1,232	19.20	1,182	15.60
Kansas													987	18.60		
South Atlantic	495,743	0.37	76,754	0.51	11,119	1.08	2,106	3.50	6,673	0.31			4,895	20.00	1,741	17.60
Delaware																
Maryland	82,600	0.59											70	21.40		
Virginia			62,990	0.46									127	22.30	71	18.00
West Virginia	54,248	0.58	12,080	0.64									51	18.80	772	16.60
North Carolina	119,000	0.39			7,900	1.17							1,418	23.00	435	18.40
South Carolina	107,259	0.28	580	0.65					31,450	0.26			1,274	19.50	300	20.00
Georgia	132,636	0.21	1,104	1.58	3,219	0.84	2,106	3.50	25,223	0.36			1,955	17.30	163	15.00
Florida																
East South Central	211,728	0.30			7,265	1.03	13,455	2.34			35,971	2.55	2,161	16.30	400	16.40
Kentucky	69,365	0.40			3,165	1.06					35,971	2.55	645	[illegible]	270	17.00
Tennessee																
Alabama	46,717	0.33			4,100	1.00	13,455	2.34					703	17.10	130	15.30
Mississippi	95,646	0.22											813	13.90		
West South Central	1,122,249	0.20	9,059	0.46	14,147	0.97	153,168	1.78	16,452	0.66			12,841	20.20	4,211	21.00
Arkansas	85,360	0.32														
Louisiana																
Oklahoma	374,005	0.24			13,747	0.99	6,081	2.82					[illegible]	[illegible]	3,851	21.20
Texas	662,884	0.16	9,059	0.46	400	0.35	147,087	1.74	16,452	0.66			7,258	18.90	[illegible]	[illegible]
Mountain	672,266	0.23	390,052	0.67	73,012	1.25	31,727	1.12			39,930	2.50	4,355	21.20	1,901	20.50
Montana	85,223	0.29	10,946	0.41	13,171	1.00	6,731	1.92			1,624	[illegible]	7	24.00	190	20.20
Idaho																
Wyoming	430,000	0.20	287,600	0.79	24,200	0.92	8,600	1.50					2,386	21.00	771	20.80
Colorado	40,909	0.27	3,300	1.25	1,700	3.99	15,992	0.56					770	20.80	151	19.70
New Mexico	95,634	0.29	63,206	0.29	33,941	1.59					38,306	2.48	1,052	21.00	713	20.60
Arizona																
Utah	20,500	0.50					404	1.70					60	15.00	61	[illegible]
Nevada			[illegible]	[illegible]									80	41.00	[illegible]	[illegible]
Pacific	327,400	0.40	602,000	[illegible]	98,900	1.22	108,950	2.56			44,000	2.27	1,953	34.70		
Washington	45,000	0.30			35,000	1.20	20,600	2.04					15	40.00		
Oregon	282,400	0.41			63,900	1.23	53,350	2.37			44,000	2.27	220	32.90		
California			602,000	[illegible]			35,000	3.00					[illegible]	23.70		

*Price of items or materials containing [illegible] cement and bitumen which was not included [illegible]

Coal Shortage Threatens Building Industry

Several Steel Mills Will Close Unless Strike Is Settled Soon—Many Cement Plants Closed Down

The effect of the coal shortage on industrial operations, already noticeable in reports from New York stating that some of the large steel mills will probably have to shut down unless the coal strike is settled within the next few weeks, is also being felt by the cement industry and the difficulty of obtaining coal has caused a number of plants to cease operations for the time being. A statement issued by the Portland Cement Association in Chicago points out that the cement industry is the fourth largest consumer of coal in the country, over seven million tons being consumed at cement mills every year. Many of the mills have been having difficulty in securing coal for some time. With the regular source of supply shut off by the strike the mills have been forced to secure coal from more distant mines, at higher prices and a longer haul. As many of these sources are now cut off the situation has become acute and unless the strike adjusts itself in a few weeks more of the plants will be closed, or operated on part time.

Coming at a time when the country is experiencing one of the greatest building booms in its history, a shortage of cement would have a serious effect on every class of construction operation. As cement enters into practically every building that is erected the cutting off of the cement supply through the coal strike would tie up many of the building projects. A similar effect would be felt by the road construction industry, as cement is used in most of the highway programs.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 3; the next, on September 7.

Steel Products	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$2.83	$3.65	$4.00	$2.68	$2.95	$3.60	$3.10	$3.75	$3.75
Structural rivets, 100 lb.	[illegible]	4.35	5.50	+3.25	−3.52½	+4.80	4.25	3.75	6.50
Reinforcing bars, ¾ in. up, 100 lb.	2.73	3.50	3.50	+2.60	2.85	−3.57½	2.55	3.60	2.90
Steel pipe, black, 2½ to 6 in. lap, discount	[illegible]	61.15%	45%	59½%	61.9-5%	46%	49.1%	53%	30.00
Cast-iron pipe, 6 in. and over, ton	+53.30	48.00	51.50	−45.20	50.50	57.00	51.00	52.50	50.00
Concreting Material:									
Cement without bags, bbl.	2.40@2.50	2.50	2.25	2.05	+2.39	2.85	2.71	2.90	2.78
Gravel, ¾ in., cu.yd.	1.75	1.85	2.25	1.80	1.50	1.75	2.25	+1.25	1.50
Sand, cu.yd.	1.00	1.15	2.25	1.80	1.00	0.75	1.50	+1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+51.00@52.00	+40.00	38.00	47.00	40.00	50.00	31.00	−23.00	+50.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.14½	1.80	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	11.00	11.15	11.00	17@18	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	+.0776	.115	+.0741	.086	.08	....	.11	.09
Hollow partition tile 4x12x12, per block	.1112	+.0776	.115	.0657	....	.08	.108	.11	.08
Linseed oil, raw, 5 bbl. lots, gal.	−.91	−.97	1.07	1.01	1.03	+1.18	1.04	.86	1.04
Common Labor:									
Common labor, union, hour	.60	.35	......	.80	......	.50@.55	56¼	.50@.60	....
Common labor, non-union, hour	.44@.60	.30	.25	.72½	.35@.50	.35@.50	.47½@.50	....	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2 ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags, common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars; other materials delivered.

San Francisco quotes on Heath tile. 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at pit.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.13 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Structural rivets quoted at $3.25, as against $3.10, in Chicago, and at $4.80 as compared with $4.45 per 100 lb., in Denver, one week ago. New Minneapolis price based upon the Chicago quotation of $3.25, plus freight of 27½c., is $3.52½, against $3.53 last week. Reinforcing bars quoted in Chicago warehouses at $2.60 as against $2.58, and in Denver at $3.57½ as compared with $3.67½ last week. Steel shapes and reinforcing bars, $1.80@$1.90 per 100 lb., f.o.b. Pittsburgh, on bulk of current business. Quotations of $1.70, however, are made for large tonnages or contracts with regular customers. New inquiries for small tonnages quoted as high $2 per 100 lb. Mill shipments, New York, quoted at Pittsburgh price plus 34c. freight charges, or $2.04@$2.24 per 100 lb. Mill shipments of reinforcing bars quoted at $2.65 and structural rivets, $2.82½ per 100 lb., f.o.b. Denver.

Despite lull in lumber buying, price advances in some sections continue to equal declines in others. Yellow-pine structural timbers, base sizes, up $1 in Atlanta; fir up $3 in Montreal, down $1 in Denver, and 50c. in Seattle.

Fuel shortage is affecting hollow tile; price advances in Dallas and Atlanta.

Linseed oil down 2c. in New York; 1c. in Atlanta and advanced 2c. per gal. (5 bbl. lots) delivered in wooden barrels, in Denver.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

Volume 89 NEW YORK, AUGUST 17, 1922 Number 7

King for a Day

JOHN MITCHELL at his zenith never reached the heights that John L. Lewis occupies today. He is King—undisputed. He has forced a settlement of the coal strike practically on his own terms: no wage reductions and no arbitration. He has done a bit of "tail twisting" and in doing so has not merely triumphed over the operators but over the public. At a time when all wage scales are coming down, even those of the railroad workers, he successfully holds his wages level. The public wanted and expected cheaper coal. The operators tried to get it for them. But Lewis said, No, and No it is. Thus 750,000 miners have told the 24,000,000 farmers and wage earners in the United States that the miners are superior to the present economic law which has affected these other 24,000,000. Indeed Lewis is King, but is it merely King for a day? Have not the other 24,000,000 a way of speaking and acting?

Almost the Record Dam

WE AMERICANS have become so used to having the largest of every type of structure on this side the ocean that the close approach to a record of the Camarasa dam comes as a surprise. It happens that this Spanish dam falls some twenty feet short of the highest dam in the world—which honor continues to be held by our own Arrowrock—but for head of water Camarasa is fifty or more feet higher than any other dam ever built. Record size is ephemeral, but while it lasts it has its claims to notice. It is not merely for size, however, that this structure is worth describing. Mr. Ranney makes clear, in his interesting article, that the construction methods in this high place in the Pyrenees, under war conditions and far removed from what we are apt to consider the center of modern construction ideas, were as up-to-date as though the dam were being built in these days of peace in reach of an American railroad. Not only as a record of dam construction is the article useful, then; it has its value in the wider view it may give to American engineers of the practice of their profession in a country that has not been thought of as a leader in engineering.

Conserving a National Asset

THE news columns of this issue contain a brief note concerning the work of the engineers at the July training camp for reserve officers held at Camp Dix, N. J. The pity is that so few of the officers have been able to attend these camps. The program of the War Department contemplated the calling of some 2,000 officers in each corps area for a minimum of two weeks' training. Thanks to the niggardly policy of Congress in matters of national defense the allotment was cut to 500. The military policy of the United States rests upon the existence of an organized reserve ready to back up at short notice the tiny regular army and the widely-dispersed National Guard. The framework of that reserve is the body of experienced and trained officers who were returned to civil life after the war and who require but a minimum of contact with army activities to keep their knowledge fresh and their interest alive. To afford them this contact involves but a trifling investment of the national resources that will surely return large dividends in human life and treasure. May Congress next year see this more clearly and give greater weight to the sage and statesmanlike counsel of our foremost soldier.

The Next Best Thing

PENNSYLVANIA will not be fortunate enough to have a practicing engineer for governor next year but she will be sure to get a man with an appreciation of engineering methods and thought. Gifford Pinchot, the Republican nominee, is an Affiliate of the American Society of Civil Engineers and was, as those members of long standing will remember, an energetic speaker at a famous discussion on the effect of forests on rainfall and runoff some thirteen years ago. The Democratic nominee, John A. McSparren, it now appears was educated as a civil engineer, though in recent years he has farmed it so successfully as to become Master of the State Grange. For a state with so many engineering problems Pennsylvania is fortunate in her gubernatorial prospects.

A Pioneer in Reinforced Concrete

THE early history of reinforced concrete revolves around a few men who recognized the possibilities and difficulties of the new material and set to work as specialists to study its peculiarities. In Europe, Coignet, Considère and Hennebique, the great French trio, are remembered with Melan and Wayss and Freytag in the German-speaking countries; all of them worked first some thirty years ago. It was characteristic of these Europeans that each developed his so-called system, a special type of design which he not only prepared but built. There was no independent engineer making a design to be built by a contractor, as is common in other types of construction, but the idea was fostered that there was something mystical and special in reinforced concrete which was not revealed to the common run of engineer. It was natural that this idea should migrate, along with the development of reinforced concrete, to this country, but over here it has not persisted. The designer-builder survives to some small degree, but mainly in the form of the designer-steel man. Of this latter type was A. L. Johnson who died last month. In his later years Mr. Johnson was known best in his capacity as head of a great steel reinforcement company and his earlier history forgotten. Those early days should be remembered by all interested in concrete work today. He was one of group, among whom were Ransome, Kahn and Thacher, who in the first years of this century carried forward the new theories then just being brought to American engineers. That each of

these men should form commercial affiliations was only following the European tradition. It in nowise detracts from the scientific value of their services to the study of reinforced concrete. Mr. Johnson was not an old man but he was already an ancient in a well-established art.

Direct Oxidation Again

THOSE who have been following the adventures of the direct-oxidation or lime-electrolytic method of sewage treatment will do well to consider Mr. Lanphear's data and opinions based on the Easton tests and on his own studies at Worcester, Mass., as given by him elsewhere in this issue. These data and conclusions confirm the consensus of opinion among sanitary engineers that whatever of importance the direct-oxidation process effects can be done equally well and at less capital and operating expense by the use of a heavy dosage of lime in a chemical precipitation plant. The fact is, as Mr. Lanphear points out, that a heavy dose of lime was used in the Easton tests and that too on a sewage that had been passed through bar screens, a grit chamber and fine screens. He might also have mentioned the mechanical agitation of the sewage at Easton by the hundreds of paddles—used, the promoters stated, to keep the electrodes clean but which possibly may have had the same beneficial action as is claimed by those who would substitute paddles for compressed air to agitate sewage in the activated-sludge process. This confirmatory evidence from the chemist and chief operator of what is now the oldest and next to the largest chemical precipitation plant in the country puts a new burden of proof on any one proposing the use of the direct-oxidation process.

Thompson and Tires

TO most engineers who are building and maintaining roads today the fact that June 29 marked the hundredth anniversary of the birth at Stonehaven, Scotland, of Robert W. Thompson carries no particular significance. Yet this man revolutionized highway transport and his influence is manifest on a world-wide scale in practically every detail of highway design and construction. It was Thompson who was the original inventor of the pneumatic tire and the pioneer in the use of solid-rubber tires for road traction. He was a young man, only 23, according to the London *Times*, when he patented the device which he described as "a hollow belt composed of some air and water-tight materials such as caoutchouc or gutta percha and inflating it with air whereby the wheels will, in every part of their revolution, present a cushion of air to the ground or rail or track on which they run." The outer covering or facing was specified as a "series of circular segments of leather . . . protected by flat-headed metal rivets secured by small washers." Thompson was ahead of his time and abandoned the exploitation of the pneumatic tire to engage in other inventions. Later, however, when the steam tractor was being developed for road transport he took out new patents for heavy solid rubber tires in 1867-73. A road steamer, thus equipped, demonstrated exceptional hauling power and a number of these tractors were ordered by the Indian Government, the tires on these machines being 6 ft. in diameter, 15 in. wide and 5 in. thick. From these beginnings in tire equipment for motor vehicles steady progress has been made until today vehicular traffic on the roads is rendering a service in moving people and commodities on a scale undreamed of a generation ago. The trend of design in tire equipment is toward the protection of both road and vehicle from the impact and the general wear and tear incident to heavy haulage. Improvements have been made in solid tires, with the dual tire now common to distribute the weight of heavy trucks. Without such pioneer work as Thompson did, road transport could never have assumed the importance in our economic life that it now occupies.

Arbitrating Contract Clauses

CONTRACTORS have frequently been the victim or object of strikes; there is a certain novelty in their using the strike as a weapon. Apparently this was the only way the contractors in and around Louisville could force the sewer commission of that city to a reform of its contract and specification provisions on new sewer work. As is noted on another page, the strike was effective in a majority of the points at issue for the commission agreed to reword most of the objectionable clauses. The new wording seems so clear and just that the wonder is why it required so radical a move as a contractors' strike to convince the commission of the necessity for reforms.

The main point of contention, however, was only partly settled. The contractors objected to the engineer being made omnipotent in matters of contract and specification interpretation and asked for arbitration provisions. The commission gave way only to the extent of permitting an appeal to itself in disputes affecting compensation. Thus in the tripartite owner, engineer and contractor relation the engineer is shifted from his traditional position as unprejudiced umpire to be a partisan disputant, and the owner becomes the judge in a case involving his own pocketbook.

It can hardly be said that this is a satisfactory solution of this vexing question of engineering authority and possible arbitration. For years the construction contract has been based on the theory that the engineer, obviously the agent of the owner, is at the same time an unbiased umpire between the owner and the contractor in a contract which the engineer has written. This is an anomaly to which contractors have justly objected and which they have tried to correct by insistence on an arbitration clause which would submit all disputes to an outside party.

Two things have acted against the acceptance of such a clause; the difficulty in limiting the issues to be arbitrated and the natural reluctance of the engineer to prejudice his authority.

These two are rather more closely interlocked than at first sight appears. The engineer is the responsible party in any piece of construction. He designs it and he supervises its erection. He is entitled, therefore, to have it put up the way he wants, provided always that in his specifications he can foresee that way sufficiently to cover the general details of how the work is to be done. Language being at best an imperfect expression of thought it is impossible to provide in a specification for all contingencies. The engineer, therefore, must be permitted some leeway in his interpretation of his specifications; he cannot be subjected to the danger of being continually harassed by reference to an arbitrator or of

having his control of the work lessened by threats of such reference.

There should be some middle ground, however, on which all parties can meet. In fact such a compromise has been reached in many contracts. In them the engineer's decision is supreme at the time; the contractor must follow it but he is allowed appeal for compensation to a disinterested arbitrator, sometimes named in the contract itself. The engineer must remain the judge of such things as quality of material and execution, in which the exercise of his technical skill is required. But he has not the omnipotent powers of specification interpretation conferred upon him by such clauses as the one to which the Kentucky contractors objected.

Arbitration clauses, properly written, are desirable additions to a construction contract. Not only will they tend to a fairer relation between contractor and owner but they should lead to better and more precise specifications, for the possibility of outside interpretation will be ever in mind in the writing of the specification. But the contractor who works under such a clause, if he can persuade the owner to insert it, will only delay the more general adoption of arbitration if he uses it merely as a club to hold over the head of the engineer or as a means of delaying the execution of the contract.

A Responsibility of Leadership

IN AN address to the National Lumber Manufacturers' Association, W. A. Durgin, chief of the division of simplified practice of the Department of Commerce, has declared that he deplores "the insidious assumption that the function of government is to originate rather than to discover the best thought, and to impose, rather than to help make effective the best practices."

The elementary principle here laid down for government is thoroughly sound and applies with equal force to successful and fruitful management in almost any field. The efficient executive is not the man who thinks up all the bright ideas and uses his subordinates as mere hands and feet to do his bidding. This is a popular conception, but it is mistaken. It must be remembered that in addition to the material product of industry, the tons or the gallons or the ton-miles, there is a by-product of scarcely less value. This is the supply of trained manhood that is brought up to think and to dare and to do in carrying forward the work of tomorrow. Successful management must produce men as well as materials or service, and the great executive is the man who rises to this responsibility.

The able manager, therefore, is known by the ability of the men with whom he surrounds himself. If he has difficulty in procuring able men to start with, he gets the best he can and sets out to make able men of them. He encourages them to original thinking, he teaches them to appraise fairly their own ideas and to carry them through to practical conclusions. He inspires them with a consciousness of their power, stirs their creative instincts, and instills in them a sense of participation which begets the complementary sense of responsibility. All these are functions of management, and in proportion as men perform these functions they are truly leaders rather than mere "bosses" or taskmasters.

In this day, when engineers are coming more and more to be called into executive positions, we all can afford to ponder this sometimes forgotten aspect of industrial leadership; for our worth as executives will surely be measured by the merit of those that follow us.

Maintenance the First Task of Highway Development

A STATE becomes potentially "active" in road improvement as soon as its people have voted a large bond issue. The public begins at once to "expect to see something done." The more parsimonious the state has previously been in all matters pertaining to good roads, the more exacting will be the demand for fast spending once there is money in pocket.

Astute vendors of commercial types of roads take quick advantage of the public's desire for "results" and often create a buyer on the argument of fast delivery. If the state has a highway commissioner firm enough not to meet the dilemma by buying, he lands on the other horn of newspaper and crossroads-store criticism because of indolence. Indeed the situation is not easy.

A highway department organized for moderate hand-to-mouth expenditure is confronted with a huge problem when fifty or sixty million dollars are chucked into its lap, with orders to hurry up and spend it for improved roads. It is virtually compelled to temporize. It must take time to plan and inaugurate construction. Additional time is required to perform the work. Almost two years must elapse ordinarily before any considerable mileage of newly built road is completed and it is then only an inconsiderable portion of the total state road mileage. Meanwhile all the people are paying and all not immediately served are getting disgruntled or apathetic, if they are not developing a positively reactionary sentiment toward highway development.

All this leads to the question whether the prevailing practice, when a state undertakes wholesale expenditure, of seeking big mileages of construction and postponing maintenance problems, is not an engineering and business error.

Should not maintenance of state system be the primary task?

Even if the old roads of the system are dirt roads and will ultimately all be paved is it not a tactical advantage to put them and keep them in the best condition possible for dirt roads? It manifestly would help to moderate criticism. Moreover, with modern practices of progressive road improvement much of the maintenance work, if it is wisely directed, can be capitalized as permanent grading and widening.

If a rule were to be laid down for state highway departments, with a big bond issue for the first time and a jealous public watching for a demonstration that its generosity had not been amiss, the suggestion would be that this be the rule:

As soon as the main road system is selected begin intensive patrol maintenance on the basis of progressive construction.

Let construction go until it can be adequately planned and carried through. Maintenance is the first task because it immediately reaches every man along every mile of the state system. Let it be patrol maintenance, not merely because this is the most approved practice but so that every man along every mile can see every day the work being done.

The work in North Carolina, described in this journal July 27, is a striking example of the success of this policy.

Building the Highest Dam in Europe

Features of the Camarasa Hydro-Electric Development in Cataluna, Spain—Built at High Speed Under War Conditions—Dam 333 Ft. High With Gravity Section of Sand-Cement Concrete

By Willis Ranney
Consulting Engineer, San Antonio, Tex., Formerly Construction Superintendent Ebro Irrigation & Power Co., Ltd., Camarasa Project, Spain

Europe's highest dam, built in the face of manifold handicaps chief of which was the World War, is located on the swift flowing and snow fed Rio Noguera Pallaresa in the Pyrenees Mountains of northern Spain. With a height above bedrock of 333 ft., the dam creates a most picturesque reservoir and develops a head that generates 88,000 hp. at the Camarasa Project which it serves. The remoteness of the site, the unusual conditions regarding materials and labor and the general method of attack of such a piece of construction under European conditions make the project one which may interest American engineers.

LOOKING DOWN THE RIVER NOGUERA PALLARESA TOWARD THE RIVER SEROS
Dam site in middle foreground laid dry by cutoff at upriver reservoir. Concrete plant under construction on right bank

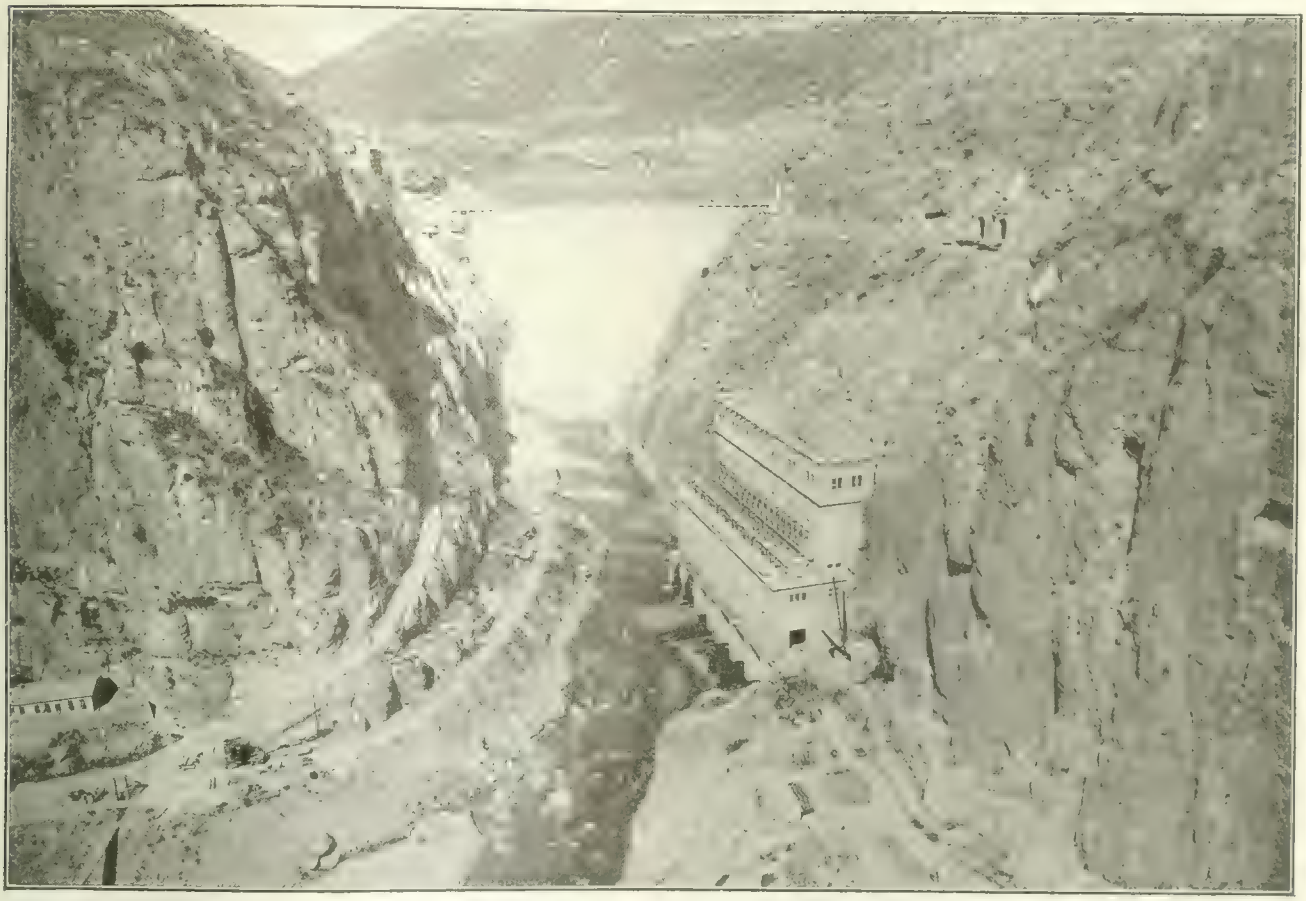
The great industrial activity incident to the war brought about in Spain a tremendous need for water-power, particularly as the war had shut off the supply of steam coal previously brought in by ship to Barcelona, the largest city and second port of Spain. British-Canadian interests already owned the power and public service companies which supplied the bulk of available power to the industrial cities and towns of Cataluna, which state includes northeastern Spain and has Barcelona as its capital. Three existing water-power plants, Pobla and Tremp on the Rio Noguera Pallaresa and Seros on the Rio Segre, were turning out 96,000 hp., distributed by 110,000-volt transmission lines, which was far short of the ever-increasing demand. The splendid power concession at Camarasa on the Noguera Pallaresa, owned by the same group of capitalists, offered through its development an additional 88,000 hp. The emergency was sufficient to permit arrangements with the Allied Governments which assured the vital equipment and supplies. The building of the Camarasa Project was started during the summer of 1917 and completed in three years by overcoming great difficulties in securing materials and equipment, opposition from hostile interests and the very acute labor shortage and unrest during and after the war.

The construction was handled by the Ebro Irrigation & Power Company, Ltd. (Riegos y Fuerza del Ebro, S. A.), with main office in Barcelona and purchasing agencies in London and New York. The bulk of the re-

quired equipment and supplies was imported from the United States, England and Switzerland. Electrical installation is American and the hydraulic turbines Swiss.

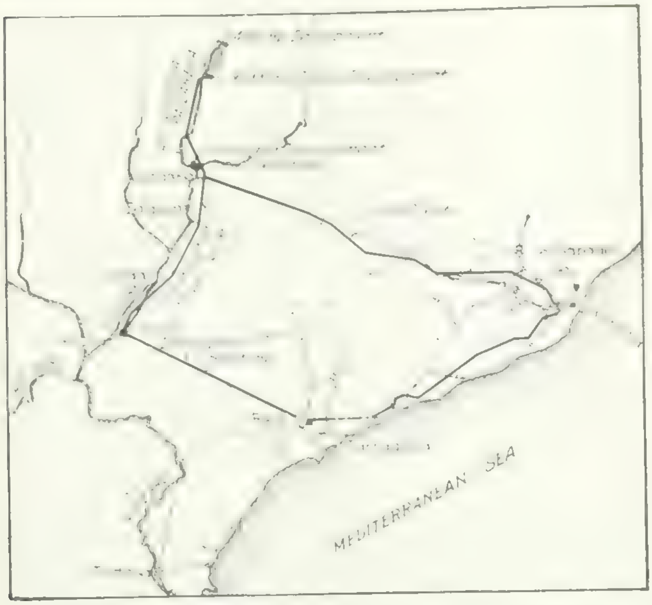
Location—Two rivers, the Noguera Pallaresa and the Segre, in working their way from their snow-fed sources in the high Pyrenees to the plateau country south of the mountains, have cut a series of deep gorges through faulted sections of the massive cretacious rocks. Their confluence or junction occurs about two miles north of the old Spanish town of Camarasa, from which the project takes its name, where the former flows into the latter. A half-mile below the confluence at Dos Rios the Segre debouches into the plateau region leaving the deep gorge and flowing south and southeastward past the towns of Camarasa and Balaguer and the city of Lerida to its junction with the Rio Ebro, which flows into the Mediterranean Sea and is the largest river of Spain. At Lerida, the waters of the Segre are diverted by a dam into a power-canal, 15 miles long, at the lower end of which is the company's Seros power house (56,000 hp.). After passing the turbines the water is returned to the Segre through a tailrace. The Pobla installation, 28 miles above Camarasa on the Pallaresa, develops 4,000 hp. by diversion and that at Tremp, eight miles below Pobla, develops 36,000 hp. by means of a high dam and storage reservoir. With the present four waterpower plants, the waters of the Rio Noguera Pallaresa are harnessed four times in a distance of 64 miles.

It was not feasible to build the Camarasa dam below Dos Rios, thus impounding the waters of both rivers. because the city of Artesa with its rich irrigated valley on the Segre eleven miles upstream would have been submerged by the reservoir. Therefore a dam site was selected on the Noguera Pallaresa, 1,000 ft. from the confluence, at a very narrow part of the deep gorge. The steep topography made it necessary to place the spillway adjacent to the south abutment of the dam and the headworks controlling the flow from reservoir to power house on the opposite side at the north abutment. From here a location was made for a canal and tunnel to take the water to a forebay (really a continuation of tunnel) which was directly above a feasible site for the power house against the north wall of the gorge just above the confluence. The power-drop was secured by five penstocks in tunnels leading from the forebay to turbine-floor.



LOOKING UPSTREAM AT THE COMPLETED CAMARASA DAM
Dam is 333 ft. above lowest part of foundation. Note outlet of large tunnels above power house to be connected thereto by penstocks

Preliminary Work—Foundation rock under test showed excellent structure and all suspicious zones which could be located were sealed by pressure-grouting or concrete prior to filling the reservoir. The rough and precipitous character of the terrain combined with distance from railway and lack of roads and bridges made the layout for transportation, camps and construction plant quite a problem and required a great deal of costly preliminary work. Ten miles south of Dos Rios at the town of Balaguer, the terminus of a narrow-gage branch of the Norte Railway, the company had in storage construction equipment, left from the previously



POWER HOUSES AND TRANSMISSION LINES OF THE EBRO CO. IN SPAIN

The Camarasa Dam [illegible] ft high, the highest in Europe is on the Noguera Pallaresa River about 80 miles northeast of Barcelona.

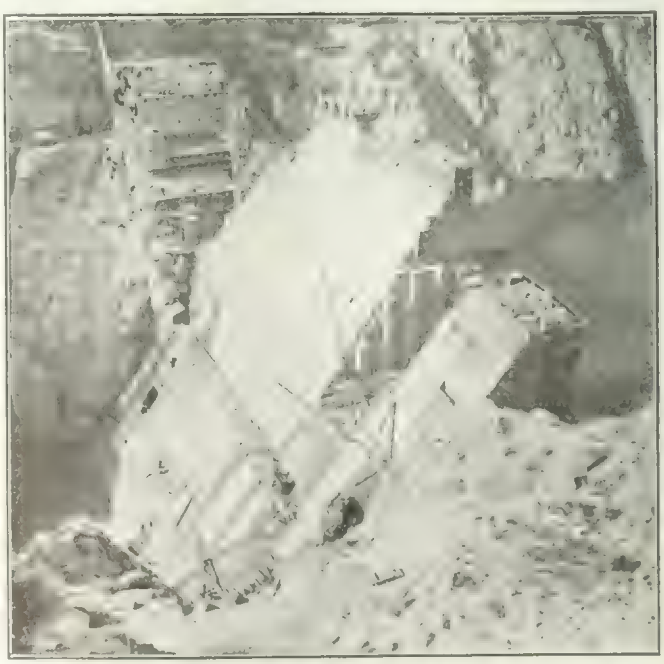
completed projects, which possessed unusual value under war conditions. In addition, there were transport and accounting offices, storehouses and shops. It was therefore necessary to rebuild the very poor road from Balaguer to Camarasa and construct a new road beyond, extending up the gorge to Dos Rios. After passing the main unloading station, under the east terminal of the cableway built across the Segre just below the confluence, this road terminated at the general shops and sawmill. Its completion, together with proper maintenance and the excellent facilities at Balaguer, resulted in the prompt handling and transportation of supplies, materials and equipment by steam-tractor trains, wagons and trucks. The heavy loads were handled by tractor while the biggest single item, cement clinker, was hauled by local teamsters on a per ton contract basis.

Camps—The Spanish workmen with their families totaled some ten thousand persons and the historic town of Camarasa, surmounted by its ruined castle, did not afford sufficient accommodations. In addition, there were no suitable quarters for the members of the construction-engineering staff, foremen and specially skilled men, some of whom had their families with them. To supply the need, four camps completely equipped were quickly built along the road between Camarasa and Dos Rios. All were supplied with pure water, had sewer-systems and incinerators and the general health was safeguarded in every possible way.

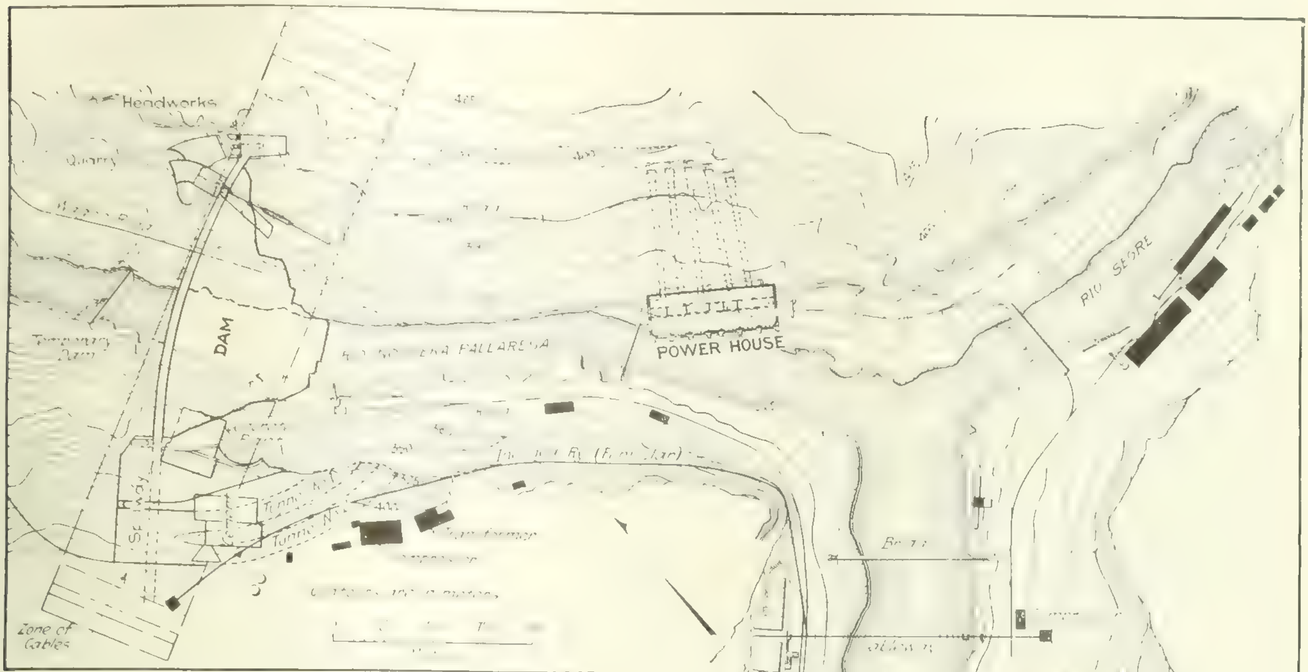
Power for the construction work was obtained by substation connection at the second camp with existing 110,000-volt transmission line from Tremp to Barcelona. The voltage was reduced to 25,000 and taken to Dos Rios over a pole-line built up the gorge where it was further reduced to 440 volts for motors and 220 volts for lighting by two substations on the job, one at river and the other at upper cableway levels.

Organization and Labor—All foreign work, where modern methods are used, requires special organization. The selection of men, composing the construction-engineering staff and the nucleus of foremen and special workmen is all-important. Men with excellent records in their native country back of them are often unable to adapt themselves to changed conditions, handle the available labor or stay for the several years' time required for a big construction job. It takes more than usual enthusiasm, determination and patience along with ability to render the service required. Frequent changes with the consequent shipping in of new men are demoralizing. Good quarters and food, care of health and a reasonable amount of recreation for the men who are "strangers in a strange land" make a splendid investment for any company engaging in work away from home. The stores and transport departments require careful handling. Needs must be anticipated and proper stocks of supplies and spares provided. Deliveries of construction, hydraulic and electrical equipment must be on time and the steady progress towards completion must not be hindered by failure to receive this or by the shortage of that essential thing. The training of native workmen for skilled jobs is worth while and at Camarasa, during the war, was particularly necessary as a large percentage of the men from the United States, England and France, employed on previous work, were not available. It was surprising to see what could be done by carefully selecting and training unskilled Spanish workmen. They quickly learned to operate cableways, derricks, locomotives, etc., skillfully and kept their machinery in running order. Most of the civil engineers were Spanish and did excellent work.

Labor conditions were very unsettled during the entire period of the Camarasa construction. There was always a shortage of men in spite of labor agencies maintained throughout Spain. Agitators, representing the "Sindicato Obrero" which is a radical labor organization with Bolshevik tendencies, and mysterious foreign agents tried every means to incite the company's workmen to strikes, violence and sabotage. This was counteracted by constant vigilance on the part of the company, fair treatment and the presence of civil-guards for whom all wrongdoers in Spain have a wholesome respect. Only one serious strike occurred, but enough loyal and fearless Spanish workmen refused to



CREST BEING PLACED ON HIGHEST POINT OF DAM



LOCATION OF CAMARASSA PROJECT AND ITS CONSTRUCTION PLANT

walk out or be intimidated so that it was possible to preserve the work already completed at the dam site and after six critical weeks the strike was broken. Other spasmodic attempts were frustrated and the leaders forced to leave. There were several accidents, breakdowns and fires which could be classed as sabotage but, all in all, the company was very fortunate.

Construction Plant—The general layout of the construction plant is shown in the plan. The placing of the main units on the south cliff just downstream from the dam was dictated by the location of the height required for gravity handling of materials and the location of the funicular. This incline railway, completed early, was operated by an electric-hoist with 1-in. cable and, starting at the lower level under Segre cableway, climbed up the south side of the Palleresa gorge past the successive levels occupied by crusher-mixer plant, spillway, main quarries and cement plant to the upper cableways, a vertical distance of 380 ft. Gravity was utilized from the delivery of materials to the cement plant at the top to the placing of concrete in the portion of dam below the mixers.

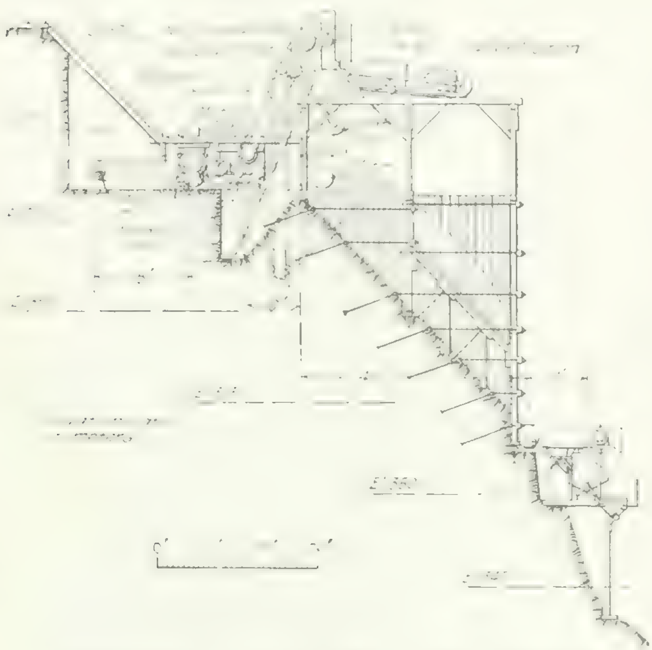
The general shops, which are very complete, were built as soon as the road was finished. Lumber was produced by two sawmills, built along the Segre, which were supplied with logs brought down the rivers in rafts. With the exception of derrick, cableway and heavy plant timbers, which were American longleaf pine, imported at great expense as the Spanish pine was brittle and small sized, all lumber and timbers used for the construction were sawn from native pine logs. A steel bridge was built across the Segre just above the confluence giving access to the power-house site. Difficulty in obtaining structural steel compelled the use of second-hand trusses and crane-girders from the company's storage yards in Barcelona. A system of narrow-gage railway tracks, above flood level, connected the Segre cableway unloading station with the shops and power house and the opposite terminal of this cableway with the funicular and the dam.

Master Cableway—The completion of the funicular was followed by the erection of the master cableway at the dam site. It occupied the topmost position, 500 ft. above the deepest dam foundation, and was put up by means of a temporary 1½-in. cable stretched across the gorge. The 2½-in. main cable had a span of 1,060 ft. between the head and tail towers, which were traveling type, and a ten-ton load was easily handled. The low height of the counterweighted head tower of 54 ft. made possible by an arrangement of guide sheaves, is noteworthy. Six thousand feet of ⅞-in. wire rope were required for button, endless and fall lines and the engines were operated by compressed air. With this cableway and the funicular in operation, the handling to place and assembling of the rest of the plant was greatly facilitated. Two other cableways were put up at funicular-head level on the platforms directly below the upper one with spans of 970 ft. The main plant and dam were within the traveling zone of the cableways, which was 225 ft. up and down stream, and they were kept very busy day and night.

Next below the cableways was the cement plant consisting of raw material bins for portland cement clinker and gypsum, delivered by funicular, and sandstone, brought over by cableway at night, a 5 x 50-ft. revolving direct heat drier with stack, two compeb-mills 5 x 22-ft. with synchronous motors, storage-bins of 4,000 tons capacity for finished product, miscellaneous elevators, conveyors, etc., and a completely equipped laboratory for chemical and physical tests.

Below the cement plant were the main quarries, which included the open-cut spillway excavation and extended upstream. Here much preliminary work was necessary as track-benches had to be cut along the cliffs which were sheer in many places. The output, on account of

seams and pockets filled with clay, was very dirty so that rock for the crushers was hand-picked and then loaded either into skips or directly into the cars. Derricks or locomotive cranes picked up the skips and dumped them into cars of 4-cu.yd. capacity which were hauled in six-car trains to the crusher dump by saddle-tank 18-ton locomotives. Waste material was dumped into the reservoir area at convenient points. Steam shovels were not available as several owned by the company had been sent by them to France for war work. Drilling was done with 3-in. tripod and ⅞-in. rotator drills, supplied with compressed air through a pipe



CROSS-SECTION OF CRUSHING AND CONCRETE MIXING PLANT

system from the compressor stations. Only Spanish explosives, made near Bilboa, were obtainable for the blasting and general excavation. The dynamite was none too good and the blasting powder very uncertain and very expensive, the price being double that of imported high-grade explosives. Complete shop equipment, for machine sharpening of drill steel and general repairs of drills and cars, was provided.

On the opposite or north side, two other quarries were opened up. One, just above the cableway levels where sandstone was found overlying the dolomite, provided rock for the sand-cement. Its output was loaded in dump cars of cubic-yard capacity, pushed down a gravity grade to a platform in front of the cableways, dumped into a bin from which buckets were filled and then taken by one of the cableways across the gorge to the bin at the drier. The other, about 60 ft. above river level, supplied large rocks or plums which were embedded in the concrete of the dam. Skips, filled with one or more plums, were loaded on flat-cars by locomotive crane or derrick and the trains were hauled by locomotives to switch tracks at the dam, located within reach of derrick and cableways which did the placing and returned the empty skips. The biggest plums weighed ten tons and the quarry was operated until flooded by the rising reservoir early in 1920. After that plums were secured from spillway excavation. The output of the quarries was augmented by rock excavation from the dam site and the various tunnels which was sent to the crushers or used as plums whenever possible.

Crushing-Mixing Plant—The main crushing-mixing plant was built on benches cut in solid rock just downstream from dam. It was directly below the cement storage bins with crusher-feed at proper distance below the tracks from main quarry to allow a dumping apron. There is shown a cross-section indicating arrangement of crushing and grinding machinery, elevators and conveyors, screen-house, bins for storage of crushed rock and sand and the concrete mixers below. The rock crushing and sand grinding machinery are grouped to form two duplicate plants thus giving insurance against a complete shutdown. Each unit consisted of large gyratory and disc crushers and hammer-pulverizer with necessary elevators, conveyors and screens. The crushing plant, running two 8-hour shifts per day, handled all the rock gotten out by the quarries in three shifts as the constant shortage of labor was the limiting factor. Crushed rock, 4½ in. retained on ⅜ in. and sand ⅜ in. retained on 100-mesh, were produced from the dolomitic rock. There was no local sand of good quality, which forced the manufacture of fine aggregate. As the screenings from the crushers did not furnish enough, these machines were adjusted to give a surplus of 1-in. rock which was put through the pulverizers. The use of sand-cement for concrete prohibited the presence of rock-flour in the sand so this fine dust was removed before the sand was stored in the bins. Fan-blowers, where suctions were connected to the pulverizers and to screened openings in chutes from revolving-screens to bins, were used successfully. The grading of crushed rock and sand was maintained by adjusting the machines if the mechanical analyses, taken several times daily, showed any decided variation.

The mixing machinery consisted of a battery of five 1-cu.yd. batch mixers located with charging-floor directly below the rock and sand bins. Concrete was dumped into hoppers for distribution to gravity chutes, loading stations for bottom-dump buckets and tower-hoists which supplied gravity chutes for high levels.

In addition to the main plant at the damsite, there was a small crushing plant consisting of jaw-crusher, elevator and screen at the forebay above the power house which crushed rock taken from adjacent tunnel excavation. Adjoining this plant were two mixing plants, each with a 1-cu.yd. batch mixer, one of which supplied concrete for tunnel lining and the other, located on the cliff above the power house, fed concrete to that work by gravity chute. The portland and sand-cement and fine aggregate for these plants were brought over from the main plant by cableway to a track level along which the materials were handled in small cars to destination.

Sand-Cement and Concrete—When the company sold the complete, 350-ton capacity, portland cement plant, used for the Pobla and Tremp Projects, to a Spanish company which installed it near Barcelona, a contract was made covering the portland cement and clinker required for the Camarasa Project. A series of careful laboratory tests proved that a satisfactory sand-cement could be made by grinding clinker and required gypsum with either dolomite or sandstone, secured at Camarasa, so that 90 per cent passed a 200-mesh sieve. While jar-mill tests at laboratory indicated that dolomite could be used, it was found by actual operating tests with compeb-mills that the sandstone was at least a 40 per

cent better grinding medium than the dolomite. It was obtainable from a high level quarry and was therefore used in a mixture, by weight, of 54.3 per cent clinker, 44.4 per cent sandstone and 1.3 per cent gypsum. The maximum output per mill-hour was 4.25 metric tons at proper fineness but the average was 3.75 tons. The average loading for each mill was 14 tons of "concavex" ¾-in. slugs and 4 tons of 2-in. to 5-in. balls. With sandstone having 89 per cent to 92 per cent SiO_2, the analysis of the sand-cement was

SiO_2	[illegible]
Al_2O_3	54.30
FeO	2.00
CaO	33.20
MgO	0.89
SO	1.38
Loss on ignition	2.43
	100%

The Public Works Department at Madrid decided on a compressive strength for concrete 90 days old which corresponded to 2,127 lb. per square inch. This was fixed by royal decree and it took not less than 461 lb. of sand-cement per cubic yard of concrete to secure the strength required. The mix used for the dam was proportioned to give a dense concrete of proper strength.

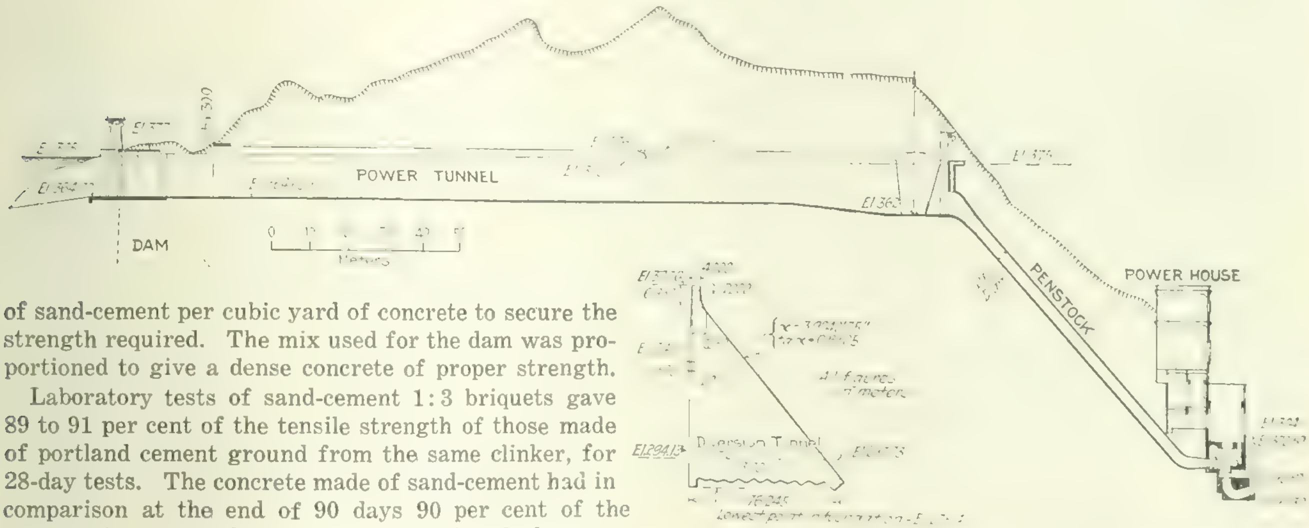
Laboratory tests of sand-cement 1:3 briquets gave 89 to 91 per cent of the tensile strength of those made of portland cement ground from the same clinker, for 28-day tests. The concrete made of sand-cement had in comparison at the end of 90 days 90 per cent of the compressive strength of concrete, made of the same fine and coarse aggregates, containing an equal weight of portland cement. Costing only 60 per cent as much per ton as the straight portland, the great saving effected by using sand-cement is obvious. With the exception of the base of dam below river level and the power house, it was used throughout the work and gave splendid results. The required amount of portland was either shipped in or ground from the clinker on hand.

The sand-cement for the job, after being ground, was stored in the bins long enough to determine the soundness. It was then conveyed in bulk from the released bin to supply pipes at mixers by a system of inclined pipes and screw-conveyors. In transit, it was weighed first at a central station a ton at a time and then weighed at each mixer in a balanced hopper before being dumped into the charging-hopper. This double check insured the use of proper amount. Coarse aggregate was measured in the charging-hoppers by filling up to marks whose volume gave the required weight closely. Fine aggregate was measured by volume of given weight in box-chutes. Experiments were made to determine a practical method of weighing the rock and sand which resulted in a solution by suspending the charging-hopper and adding a balanced sandbox. Mixing by weight gave slightly more uniform tests than volume measurement.

Dam Design and Construction—During the preliminary work, a tunnel (13 ft. square and 525 ft. long) was driven around the dam site at river level on the north side and lined with concrete to be used for diverting the normal flow of the Pallaresa during construction. It was completed in January, 1918, and the river was turned through early in February by means of a diversion dam which also served as the upper cofferdam for the foundation work.

A downstream cofferdam was built just above the tunnel outlet, the foundation area unwatered by pumps and excavation started. This was very difficult and costly as the river bed was full of immense boulders and the deepest bedrock was 83 ft. below the upper cofferdam level. Excavation totaled 11,300 cu.yd. of rock and 49,000 cu.yd. of gravel, boulders and clay. There were several floods which passed over the cofferdam requiring removal of equipment and abandonment of work for short intervals.

The big dam is of gravity section and arched on a radius of 1,000 ft. It is 333 ft. high, bedrock to crest, and contains 285,000 cu.yd. of cyclopean concrete. The width at base is 270 ft. and at crest 13 ft. The crest was widened to 21 ft. to provide a roadway and footwalks and the length on top is 460 ft. which will eventually be used as a river crossing for the projected highway from Camarasa to the French frontier. This road will reach the dam at either end by means of tunnels, short sections of which were driven so that future work would not endanger the spillway or headgate structures.

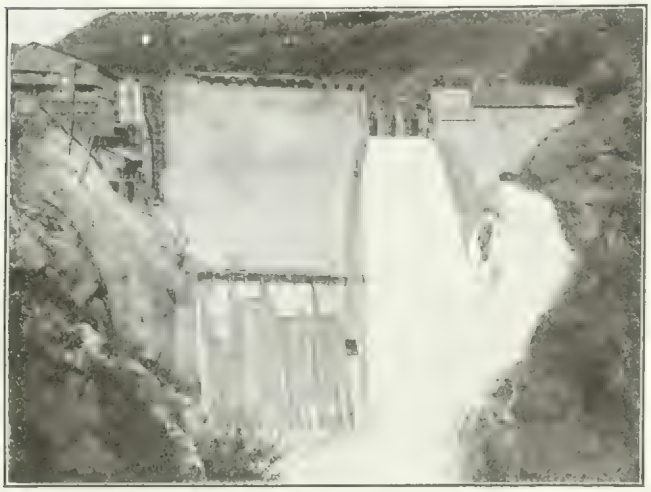


CROSS-SECTION OF UPPER PART OF DAM AND POWER TUNNEL TO POWER HOUSE

To meet the wishes of the government engineers, who wanted regular concrete for the zones of maximum pressure, portland cement concrete was used for the up and downstream toe sections below river level followed by a rich mix and sand-cement concrete.

Gravity chutes, with slopes not steeper than 30 deg. were used for placing the lower concrete direct from the mixers. Then various combinations were employed consisting of tower-hoists with chutes for upper levels, buckets on flat-cars either handled by electric-hoist on incline attached to downstream face or pushed along tracks paralleling mixer-plant to points where derricks or cableways could pick up and, when possible, direct

from mixer hoppers to buckets handled by the cableways. Most of the plums were placed by the cableways which handled the skips dumping rocks into the fresh concrete. They formed about 15 per cent of the cyclopean concrete of the dam and materially reduced its cost. Most of the concrete was placed by the day-shift and the second and third shifts completed the setting of plums, raised forms and cleaned up for the following day's run. Electric flood-lights were used for night work and their mobility made them much better



RESERVOIR DISCHARGING OVER PROVISIONAL SPILLWAY AND THROUGH TEMPORARY GATE

than searchlights. Steel forms, made up in panels reinforced by angles, held in place by channels were used for the up and downstream faces and, with wood fillers, for the cross-bulkheads. The amount of lumber for formwork was kept at a minimum and sawmill-slabs used whenever possible to cut costs.

After the lower concrete had become thoroughly set and seasoned, the diversion tunnel was closed by a reinforced-concrete gate lowered to place by motor-driven mechanism which was immediately removed. As the water rose, some calking was necessary and the tunnel was then filled, through a shaft from plum-track level, with concrete. Grout was forced in by placing pipes at roof level and a tight job secured. The reservoir filled rapidly until the level of the lower of the two small tunnels through the dam was reached. Their inlets were provided with steel flap-gates which had to be closed when the pressure-head above them exceeded 100 ft. The flow through these relief openings delayed the rise until a set of outlet gates and tunnel through dam near north abutment, providing a future lower penstock connection with reservoir, could be rushed to completion. This could have handled the surplus water but for shortage of labor which delayed the completion of spillway and it was therefore necessary to leave a temporary gap through the dam below that level which discharged at intervals. The successful control of the reservoir while it was filling was facilitated by the holding back of the 1920 floods in the Tremp reservoir, 20 miles above.

Expansion-joints, 52.5 ft. apart were provided in the upper 72 ft. of the dam by building this portion in regular alternate sections properly keyed.

Spillway—The spillway was a difficult problem requiring 161,000 cu.yd. of rock excavation. The narrow gorge location for the dam and the steep sides together with the need of space for the main construction plant made it necessary to put the south half of the outlet section in twin tunnels. Its north half is in open cut, taken out after the crusher-mixer plant and cement bins had been dismantled. The open excavation of the gate and intake sections is 141 ft. high on south side adjacent to cableway platforms above. The capacity of 70,000 sec.-ft. is secured through two gate openings, each 88.5 ft. wide, and temporary stoplogs were provided until the automatic drum-dam type reinforced-concrete gates could be installed.

Connecting Works—A logway, composed of a concrete chute in open cut and tunnel, is provided near the north abutment of dam to pass the logs coming down the Pallaresa from the mountain forests north of Pobla.

The flow of reservoir water to the power house is controlled by two headgates adjacent to north end of the dam. The water then flows through a short canal and long tunnel, the downstream end of which forms a forebay to feed the five penstocks. The total distance is 909 ft. on very light grade and both canal and tunnel, a

OVERFLOW THROUGH COMPLETED SPILLWAY DURING AUTUMN FLOOD, 1920

trapezoidal section 44.6 ft. high by 20.8 ft. wide, are lined with concrete. The penstocks are steel, 8.5 ft. in diameter, placed in tunnels with surrounding concrete. There are stopgates at upper ends and big gate-valves at turbine connections. The required excavation amounted to 55,650 cu.yd. and 10,280 cu.yd. of sand-cement concrete were used for linings and gate-structures. The total head developed, with reservoir full to within 6.5 ft. of the crest at the dam, is 270 ft.

Power House—Work on the foundation for the power house required the placing of a crib cofferdam which was built of logs forming three compartments, the outer and inner ones filled with rock and the center with clay puddle. Seepage was stopped with grouting like that employed in the cofferdams and steel sheet-piling was driven along the foundation lines using derricks and air-hammers. Bedrock was reached after much hard work in which pumps played an important part. The foundation concrete with draft-tube and turbine supports was then placed using chutes from a hopper fed by mixer plant on cliff above. Due to cramped location, the excavation was carried back into the cliff and the solid rock, faced with concrete, formed the back walls of the building. The power house is

179 ft. high. Excavation, from above roof level to foundations, totaled 21,900 cu.yd. and 16,800 cu.yd. of portland cement concrete were required. The structure consists of draft-tubes, turbine-room, generator-room with Melan-girder supports for machines and 70-ton traveling-crane, switchboard-room, offices, low-tension room, transformer room with 29-ton crane and the high-tension room which forms the top story. Derricks, chutes and tower-hoists were used for excavating and concreting.

Personnel—The personnel included the consulting engineer, H. F. Parshall, and the president of the company, E. R. Peacock, with headquarters in London, the construction manager, G. W. Caldwell, with offices in Barcelona and Balaguer, the advisory engineer, A. W. K. Billings, the managing director, F. Fraser Lawton, the chief operating engineer, A. C. Hobble, and hydraulic engineer, Walter Diem, at Barcelona. On the work at Camarasa, the writer was construction superintendent with Neal Hanson and John G. Hollman as his assistants.

Brick Used in Paving 34 Per Cent Grade

By A. W. Johns
City Manager, Ambridge, Pa.

THE enthusiasm of land companies and real estate agents of a generation ago in laying out town sites and lots with little consideration for topography has given city engineers days of study and worry in establishing grades that would make the streets of service.

The writer was city engineer of Monessen, Pa., a steel mill town on the Monongahela River about 40 miles from Pittsburgh, for several years. During that time many streets were paved on grades as high as 20 per cent and many tedious hours of study and planning were spent to overcome the difficulties of intersecting grades with cross streets, driveways, etc.

Hillside brick has been used with the greatest success for all paving on grades above 6 per cent. Horse-drawn vehicles make regular use of the streets with grades as high as 15 per cent.

Several of the streets of Monessen have grades that prohibit normal use for commercial and pleasure traffic. In fact some are so steep that it is necessary to provide steps instead of sidewalks for pedestrian traffic. The accompanying photograph of the pavement on the 34 per cent grade of Fourth St. between Schoonmaker Ave. and McKee Ave., shows the hillside brick paving laid in 1907 under the direction of John F. Irwin, then city engineer. There is a stretch of 174 ft. of 34 per cent grade on this street followed by 192 ft. of 28 per cent. While such a grade is obviously too steep to justify its use as a thoroughfare, the street is occasionally used by ambitious automobile salesmen to demonstrate the hill-climbing ability of their cars. It is also used by representatives of fire truck companies to demonstrate their machines to officials of surrounding cities.

The principal reason for paving Fourth St. was to prevent the washing of the street and the consequent damage and expense of cleaning the adjoining streets at the foot of the hill after every rain.

In the construction of the pavement an 8-in. gravel base was used, with a 2-in. bedding course of sand, and 4-in. repressed hillside brick with cement grout filler. At intervals of approximately 40 ft. headers of curb stone 20 in. deep were placed transversely to prevent the washing out of the base course and consequent undermining of the pavement, and to prevent the creeping or slipping of the pavement.

The contractors on this work, Bowman Bros. Co., McKeesport, Pa., built the pavement in about 40-ft. sections beginning at the top of the hill. They first placed the transverse curbing about 40 ft. below the crest and then laid the base, bed, and brick from there to the top. After this section had been grouted another transverse header was placed 40 ft. below the first one and the pavement then completed to meet the first section. As

174 FT. OF STREET WITH 34 PER CENT GRADE

it was impossible to use a roller on this grade, the base course and brick surface were brought to line and grade by hand tamping.

The writer has seen and heard of several streets paved with grades as high as 30 per cent, but to his knowledge this street is the steepest one of which there is general knowledge.

Deferrization of Part of London Water Supply

Removal of iron by aëration and mechanical filtration, using polarite and sand as the filter medium, has been adopted by the Metropolitan Water Board of London, England, for water taken from wells at Waltham Abbey and Rammey Marsh. Twelve Candy filters, 8½ ft. in diameter and about 7 ft. high, two of which are to serve as stand-bys, are expected to treat 2 Imp.m.g.d. According to the London *Engineer*: "A small quantity of compressed air will be injected into the unfiltered water for the oxidization of the iron in solution. The polarite acts as a catalytic agent, transferring the dissolved air to the iron, with which it combines to form an insoluble hydrated oxide of iron. By this means it is hoped to reduce any iron which may be contained in the water to be treated to 0.01 parts per hundred thousand."

Louisville Sewer Specifications Modified for Contractors

Contractors Refuse to Bid on Alleged Unfair Specifications—Commission Agrees to Act as Court of Review

AFTER contractors had refused to bid on two sewer contracts offered by the sewerage commission of Louisville, Ky., on May 23, on the alleged ground that the specifications were unfair to the former, conferences were held between the commission and its engineers on the one hand and representatives of the Kentucky Association of Highway Contractors on the other, which finally led to concessions on practically all of the specification features held by the contractors to be objectionable. After a second advertisement the commission received ten bids. An account of the incident appears in *The Scraper* for June 30. (The publication named is the official organ of the association just mentioned and is published at 523 Court Place, Louisville, Ky.) A condensation of the earlier portion of the account mentioned is given immediately below, followed by a summary of many of the points at issue and the way in which they were settled, the summary being reprinted verbatim from *The Scraper*.

The commission of sewerage of Louisville is a special branch of the government of that city created to make extensions to the sewers built under an earlier commission. The present commission consists of four business men of Louisville, appointed by the mayor of the city, and the mayor himself as member ex officio. J. B. F. Breed is chief engineer to the commission, and Harrison P. Eddy of Metcalf & Eddy, Boston, Mass., is consulting engineer. The Kentucky Association of Highway Contractors was formed in 1921 for the protection and advancement of the business of highway contracting. David R. Lyman is secretary of the association with headquarters at the address given above.

In the official statement in *The Scraper* it is stated that in November, 1921, the association offered its assistance to the commission in the drawing of sewer specifications under which the commission was to receive bids for the first time but that the offer was not accepted. Early in 1922 bids were received and a contract was awarded. Bids were invited for a second letting on May 23, 1922, but none was received. A conference was immediately held at which the contractors submitted to the commission criticism of 22 sections of the contract and specifications for the second letting. On 19 of these suggestions concurrence was secured; on two, "of minor importance" according to *The Scraper*, there was no modification of the original requirements, and on the other suggestion a compromise was effected.

This last point of difference was apparently the most important of the lot, and the one on which the contractors were prepared to make the greatest fight. It concerns the clause in the contract denominating the engineer as the court of last resort in matters of dispute. This clause read as follows:

Engineer to Decide—To prevent disputes and litigation, the engineer shall in all cases determine the amount, quality, acceptability and fitness of the several kinds of work and materials which are to be paid for under this contract; shall determine all questions in relation to said work and the construction thereof, and shall in all cases decide every question of fact which may arise relative to the fulfillment of this contract on the part of the commission and on the part of the contractor. His estimate and decision shall be final and conclusive upon both parties to this contract.

The contractors contended for the substitution of a general arbitration clause covering all matters of dispute. After considerable discussion the commission agreed to modify the clause so that the contractor was granted the right of appeal *to the commission* for adequate compensation for executing the orders and abiding by the interpretation of the engineer. In respect to this modification the contractors' organ says, "We negotiated a compromise sufficiently satisfactory to our members to justify them in feeling their way through at least one contract."

Points at Issue—The review of the points at issue, as given in *The Scraper*, is as follows:

In the original contract the commission did not guarantee the correctness of its borings as shown on the plans. These are now guaranteed.

The contractor was required to negotiate with a railroad company for permission to construct a sewer across its right-of-way and to do the work as directed by the railroad company. The commission now makes all arrangements with the railroad and specifies the methods to be followed in construction.

The engineer of the commission was originally given the final decision in any controversy. This has been modified by providing an appeal to the commission in matters of compensation as above mentioned.

The original contract provided that the engineer should have the right to correct any errors or omissions in the drawings or specifications without reimbursing the contractor for any additional expense thereby incurred. This has been changed so as to provide compensation.

Provision was made in the contract for furnishing additional time to the contractor because of delays caused by the commission but provided no additional compensation if the contractor were damaged. This has been corrected.

The contract placed on the contractor a blanket responsibility to defend the commission in any legal action directed against it even to a defense arising from the exercise of eminent domain. This has been changed so that the contractor is not responsible for any act or omission of the commission.

To cover a one-year maintenance period the contractor was asked to deposit city or United States bonds which, at our suggestion, has been modified so as to give him the option of filing a surety bond.

The original contract required the contractor to take all risk of encountering underground objects. This provision has now been changed so that the contractor will be reimbursed if he encounters an underground structure not shown on the drawings and which necessitates supporting or change of location for a distance of 50 ft. or more.

Much of the solid rock formation in Louisville consists of a very irregular surface thickly covered with rock pyramids or pinnacles with deep and narrow depressions between. The specifications did not clearly state how the quantity of rock in such formation would be calculated. It is now provided that the contractor will not be required to excavate these pockets below a line which is 2 ft. long between rock faces. Earth below this line will be paid for as solid rock.

The specifications originally required the contractor to import earth, sand or gravel for filling around the pipe if such could not be obtained from the excavated material. It was manifestly impossible for the contractor to know until the trench was excavated whether the material would be suitable. This section has been re-written so that the contractor will be paid for material secured from the outside.

In the contract as drawn, the contractor was to be paid

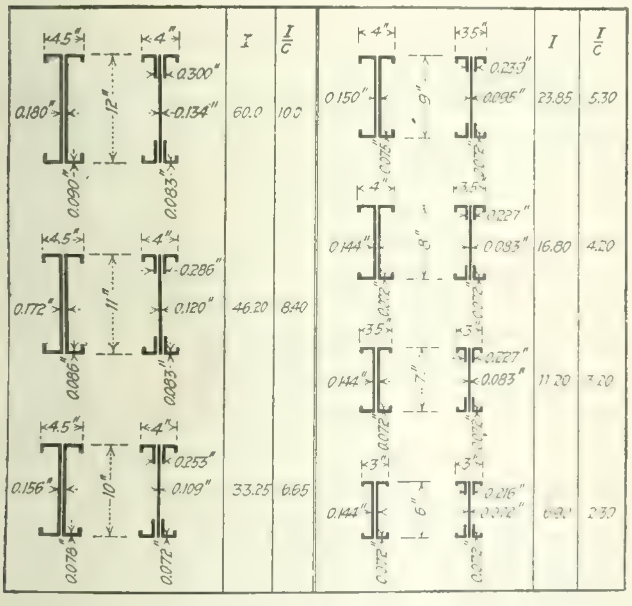
for piles only for the length left in the ground. This has been modified so as to pay him one price for the length in the ground and another price for the portion cut off.

Payment for timber left in place was originally to be based on the "actual" thickness of the lumber. This has been altered so as to pay him on the commercial basis prevailing in the lumber market.

The original plans of the commission for work in rock trench required the contractor to fill back to grade at his expense with concrete. This has been modified so as to permit filling at his expense with broken stone or earth and, if ordered by the commission, with concrete at its expense. It was also agreed to provide a separate classification in rock excavation in very narrow excavations as necessary for under-drain. For replacing waterbound macadam paving the original requirements for 4-in. screenings was changed to 2-in. as it was impracticable to work 4-in. into the coarse stone.

Manufacturers of Pressed Steel Joists Standardize Sections

IN AN effort to simplify the problems of engineers, architects, and others who use pressed steel joists, and who are likely to have occasion to consider the alternative use of the joists of different manufacturers, the three principal producers in this field have co-operated to establish sections of uniform mechanical properties. The result is a standard table of moments of inertia and section moduli, applicable to the shapes of the Berger Mfg. Co., the National Pressed Steel Co. and the Truscon Steel Co. interchangeably.



STANDARDIZED BENDING VALUES OF PRESSED-STEEL JOIST

The standardization does not cover all details of the sections, such as thickness and sectional area, but does cover the bending constants. Two different types of section are manufactured at the present time, a built-up plate-girder section and an I-beam section composed of two channel shapes spot-welded back to back. The principal sizes of both forms of section are shown in the sketch herewith, prepared by M. P. Wright, manager of the Building Materials Division of the Berger Mfg. Co. The shapes represented in this diagram range from 12 in. to 6 in. in depth, but the standards go down to sections of 3-in. depth.

With the standardization of section properties there has also been some increase in thicknesses, the new standard sections being fairly stocky.

The moments of inertia and section moduli are also given on the diagram. These quantities, as above noted, are standard for the three makers. It was found necessary to carry the standardization farther as the important objective was to maintain a fixed bending strength in a joint of given depth. By virtue of the standard bending value the designer using a 10-in. joist, for example, will now be able to count on the same carrying capacity whether the joist is procured from one manufacturer or another. On the other hand manufacturing facilities in the several plants make it more convenient for one plant to form its shapes from a wide strip while another prefers to work up the narrower strips used in the built girder section.

Tables of cross-sectional dimensions and carrying capacities are issued by the several manufacturers applicable to the new standards. The tables of carrying capacities are the same for the different manufacturers, being based on the standard section moduli.

Idle Water Main Converted Into New High-Pressure Feeder

BY LELAND CHIVVIS
Engineer in Charge, Distribution Section, Water Division, St. Louis, Mo.

PITOMETER records taken in St. Louis have shown for some years that the 36-in. low-pressure pump main across Twentieth St. has not been carrying much water at points beyond Cass Ave. For some reason, unknown at present, the greater part of the flow turns east between Hebert and North Market Streets, and by the time the Mill Creek Valley is reached the main in question is carrying a small flow back toward the pumps. This situation was seen to have great possibilities when it became necessary recently to lay out a route for a high pressure main to take the discharge of a new 20-m.g.d. pump away from the Bissell's Point Station. It was made still more attractive by the fact that the existing main leads directly into one of the three high-pressure districts where pressures have been low.

Briefly, the plan proposed is to connect the new pump to the old main and to substitute a new line of 36-in. low-pressure main along a more direct route for that part of the old main which was carrying its full share of the load southward.

The old records showed that several miles of the main were laid with St. Louis Class A pipe, which is only a little heavier than American Water Works Association Class B pipe. As most of our large breaks have occurred on lines of this weight a test was made to ascertain the soundness of the pipe. During two of the coldest months of the winter an extensive "shut" was made, which threw the entire Class A portion of the line on high pressure and incidentally demonstrated the ability of the remainder of the system to carry the winter peak load without its aid. The only trouble due to the increased pressure was a cracked sleeve.

Additional pitometer taps are being put in at selected points in order to trace more exactly the course which the water is now following. These data may modify the design here and there, but it is very probable that the finished project will bear a striking resemblance to the first conception.

Dismantle Jersey City Trainshed of Pennsylvania R. R.

Trusses of 252-Ft. Span Cut by Blow-Flame and Removed Under Traffic—When Built Was Largest Trainshed

After dominating for more than thirty years the New Jersey shore of the Hudson River at New York, the Jersey City trainshed of the Pennsylvania R.R. has been dismantled. This follows as a natural consequence the diversion of the main stream of Pennsylvania passenger traffic to the 33rd Street terminal on Manhattan Island, New York City.

As originally built in 1891, the Jersey City shed was a wrought-iron riveted structure consisting of twelve pairs of main roof trusses designed as three-hinged arches with a span of 252 ft. 8 in. between centers of end pins. The lateral thrusts at the points of support were taken by lower chords or tie beams each consisting of an I-beam weighing 100 lb. per yard connecting opposite end pins. These passed under all the tracks, having their top surfaces 1 ft. below base of rail. The shed was 652 ft. 6 in. long and 256 ft. wide, with a clear height at the center of 86 ft. The height from the top of rail to the ridge monitor was 110 ft. Twelve tracks and eight platforms were under the shed arranged as shown in Fig. 1. At the river end was a lobby from which access was had to the waiting room, the ferry slips, and, of recent years, to the elevators to the Hudson tunnels beneath the station.

The distance between the two trusses of each pair was 14 ft. 6 in. and the distance betwen the pairs of trusses was 43 ft. 6 in. Purlins 3 ft. in depth, framed into the main trusses at the panel-points, spanned the distance between the pairs of main trusses and supported intermediate trusses, spaced 14 ft. 6 in. apart.

The shed was designed by C. C. Schneider, detailed by the Pencoyd Bridge & Construction Co. and erected by the Pennsylvania Railroad Co. under the direction of William H. Brown, chief engineer. At the time of its construction it was the largest trainshed in existence, the next largest being that of St. Pancras in London, which had been built twenty-five years earlier and spanned 243 ft. Except for the roof of the machinery hall at the 1889 Paris Exposition, which was 364 ft. 2 in. in span and 1,390 ft. in length, the Pennsylvania shed was at the time it was built the largest single-span roof on record.

In 1899 the shed was extended in length 125 ft. at the river end. In the new section the same type of construction was used but the material was steel instead of wrought iron. The total length of the shed, then, at the time of its removal was 778 ft.

The plant used in dismantling the trainshed consisted

FIG. 4. GENERAL VIEW OF TRAINSHED SOON AFTER COMMENCEMENT OF WORK

of a main or dismantling traveler, flanked by two protection sheds, one on each side, as shown in Figs. 1 and 2. The dismantling traveler carried two derricks each with a 60-ft. boom. These were supplemented by two locomotive cranes operating from the ground and handling that portion of the structure beyond the range of the traveler derricks. The main traveler spanned tracks 6 and 7, its wheels resting on the inside rails of tracks 5 and 8. The south protection shed spanned tracks 2, 3, and 4, and was carried on the inside rail of track 1 and the outside rail of track 5. The north protection shed spanned tracks 9, 10, and 11, and was carried on the outside rail of track 8 and the inside rail of track 12. By this arrangement tracks 2, 3, 4,

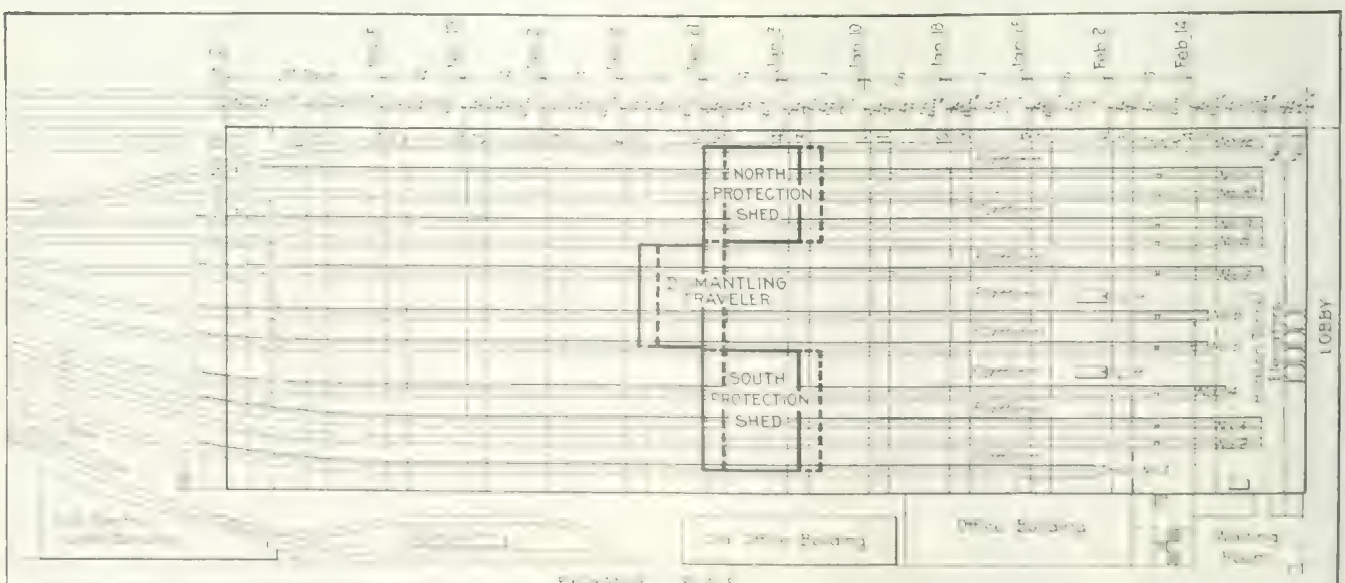


FIG. 1. [illegible] AND DISMANTLING PLANT

[illegible] shown in broken lines as moved up to handle truss No. 15 [illegible] the purlins, intermediate [illegible] bracing between [illegible] Nos. 15 and 14. [illegible] dates on which the various operations had reached the in-

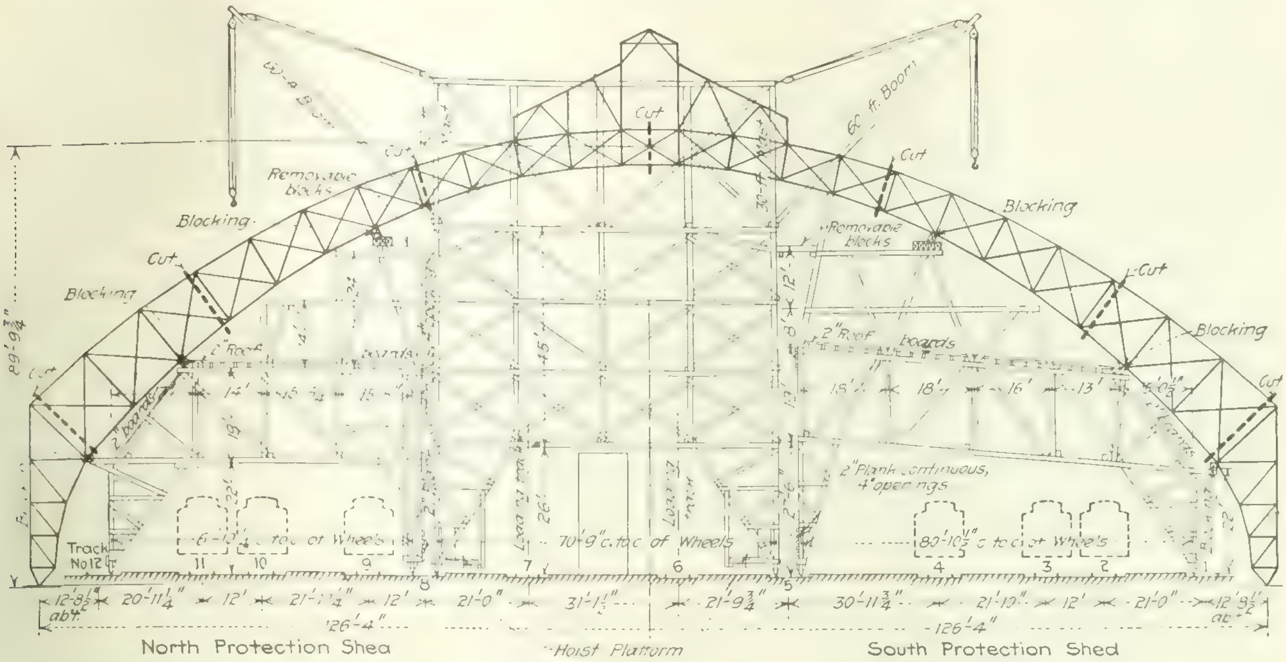


FIG. 2. CROSS-SECTION OF TRAINSHED SHOWING DISMANTLING TRAVELER AND PROTECTION SHEDS

The cuts at the center hinge and next on each side of it were made with the traveler derricks holding the two center sections of the truss. The sections next lower were handled in the same manner, while the lowest two sections on each side were handled by locomotive cranes on tracks 1 and 12. The tracks on which are shown cross-sections of cars were kept in service to handle railroad traffic while tracks 1, 5, 6, 7, 8, and 12 were used by the contractor.

9, 10, and 11 were left free to handle railroad traffic, tracks 6 and 7 were used as loading tracks for the main traveler, while tracks 1 and 12 were occupied by the locomotive cranes which swung the lowest sections of the trusses. All this is clearly shown in Fig. 2.

As shown in Fig. 3, the main traveler was approximately 71 x 50 ft. in plan and 72 ft. high and was equipped with two derricks. Each of these had a 60-ft. boom and a 30-ft. mast braced by stiff-legs and cross-braced by wire rope guys. Two hoisting engines, one for each derrick, were installed on hoist platforms at the outside rear corners of the traveler, and were used both for moving the traveler and for operating the derricks. The traveler moved on six wheels, one pair of which was placed under the derrick masts and the others at the extreme forward and rear ends. The main supporting verticals were 12 x 12 in.; intermediates were 6 x 12 in., and the lateral, longitudinal and horizontal bracing were, in general, 4 x 10 in.

The protection sheds were about 70 ft. long and extended therefore under two adjacent pairs of roof trusses. Fig. 3 shows a longitudinal section of the north protection shed. The south protection shed was similar in general design but its cross-section was varied slightly owing to the unsymmetrical layout of the plant with respect to the cross-section of the trainshed. The protection sheds were framed in general with 6 x 12-in. main members in the north shed and 8 x 12-in. in the south shed, the bracing in both being 4 x 10-in. material. They were considerably heavier at their rear ends, where they carried an extension trestle sufficiently high to support the main trusses while they were being cut. The main verticals here were 12 x 12 in. The tops and sloping sides of the protection sheds were sheathed with 2-in.

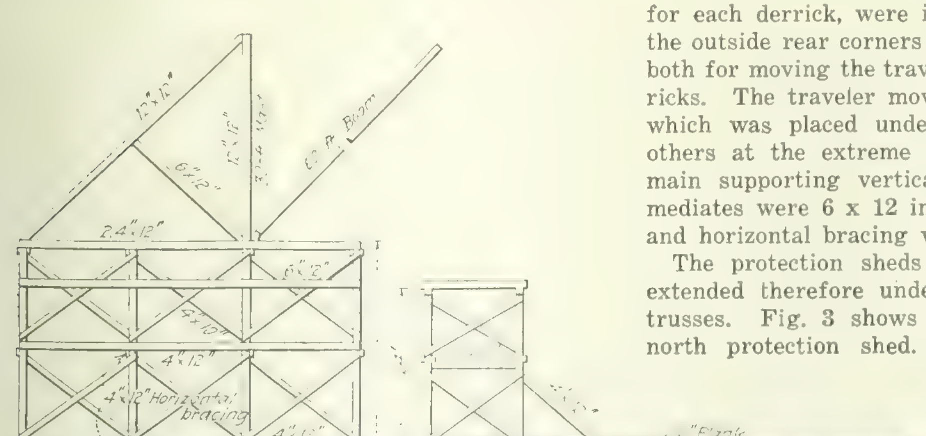


FIG. 3. LONGITUDINAL SECTIONS OF DISMANTLING TRAVELER AND PROTECTION SHEDS

Here are shown details of the traveler and shed construction. The derrick masts were braced by wire rope guys from their top to the rear corners of the traveler on the opposite sides. The extension trestles on the rear end of the protection sheds afforded support for the trusses while they were being cut. The south shed was of somewhat different lines as shown in Fig. 2.

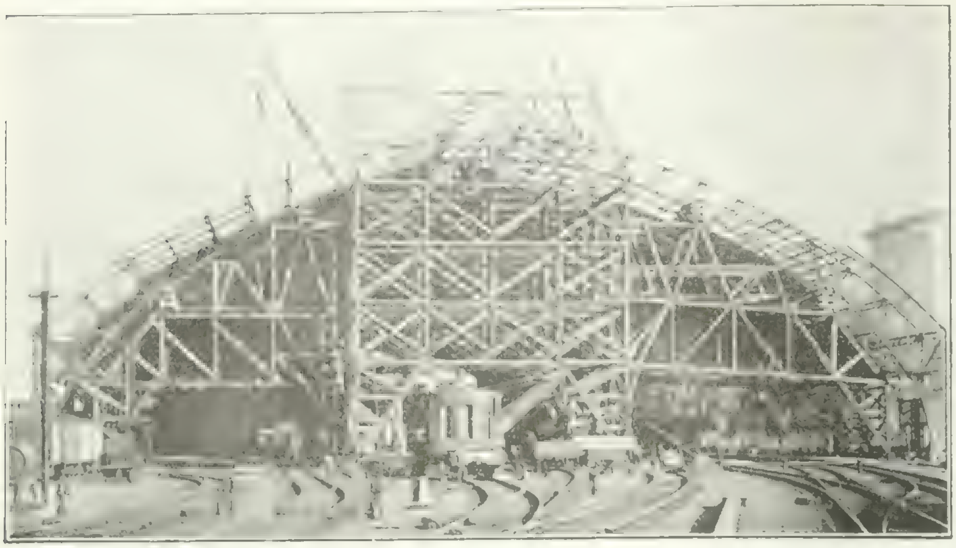


FIG. 6. END VIEW OF DISMANTLING OPERATION

Here is shown clearly the construction and arrangement of the dismantling plant. The lower ends of truss No. 28 are still supported on the protection sheds, while the traveler derricks are removing small members from between trusses No. 27 and No. 26. The purlins, intermediate trusses and bracing have been removed from the center down to the point at which the man is standing to the left of the derrick. The locomotive crane in the center is loading scrap. The cranes that handled the lowest sections of the trusses are not shown.

ting was done by blow-flame.

The contractor entered upon the site in the middle of July and commenced operations by removing the end hangers from the western end of the shed and stripping the sides. He commenced also to build the travelers on the outer tracks under cover of the trainshed. In the beginning, an effort was made to save the glass in the roof and the ends of the shed, but this was given up as no market for the material could be found. The wooden roof beams were bundled and lowered to the center loading-tracks. The present contract does not include the removal of the tie-beams under the track. Except for two pairs of trusses at the river end, which were left standing until underpinning could be provided to support the roof of the lobby, which had been framed into them, the demolition was completed by the middle of February, 1922.

The work was done under the direction of A. C. Shand, chief engineer of the Pennsylvania Railroad, by Henry A. Hitners Sons Co., contractors, of Philadelphia. Theodore I. Etter was superintendent for the contractor.

boards, and the vertical sides were covered by continuous 2-in. plank slats with 4-in. openings. These sheds were supported on eight wheels, of which four were concentrated at the rear under the supporting trestles, two were at the extreme front end, and two were midway between the front end and the supporting trestles. The relative positions of the main traveler, protection sheds, and trusses, while dismantling was in progress are indicated in Fig. 1. The sequence of operations was to remove at one set-up of the traveler one main truss of a pair and the longitudinal bracing between the two trusses composing the pair. The traveler was then moved up 14 ft. 6 in. and from the new set-up the second truss of the pair was removed together with the purlins, intermediate trusses and bracing between it and the next pair.

Each main truss was cut in seven places, thereby forming eight sections. Four of these were handled from the main traveler and two by each of the traveling cranes on tracks 1 and 2. The heaviest section handled weighed about 4 tons. The first section of the main truss was removed on Oct. 12, 1921, and the progress thereafter is indicated on Fig. 1. Two thousand gross tons of metal were handled, of which about 200 tons were of steel. This was burned into charging sizes not to exceed 18 in. x 24 in. x 6 ft., and the wrought iron was cut into convenient sizes for shipping. All cut-

FIG. [illegible] CLOSE-UP VIEW OF DISMANTLING OPERATION

The center four sections of truss No. 28 have been removed and the traveler derricks are preparing to take hold of the center two sections of truss No. 27. The remaining sections [illegible] protection shed

Detour Practice Standardized on Ohio State Roads

Engineering Department Locates and Marks Detour Routes—News Bulletins and Maps of All Detours Published Periodically

DETOUR practice is intensively developed in Ohio. Highway improvement there is a task of filling in gaps in a system which is already state-wide. It follows that construction consists of numerous small-mileage, widely-scattered operations, and consequently, that detours are numerous and widely-scattered and that their sufficiency comes under the observation of the people in all portions of the state. Efficient methods are therefore required to meet the situation so as to avoid criticism. These methods cost in 1921, when work amounting to $35,000,000 was under way, about $200 per county for 88 counties, and perhaps $4,000 a year in main office expenses.

Practice in Ohio in detouring traffic around sections of road which is being improved keeps in mind primarily (1) that the location and maintenance of detours must be such that travel is not unnecessarily inconvenienced; (2) that news that detours are established must be prompt and complete and (3) that the marking must be so clear that strangers to the locality can easily follow the route.

Detours are located, maintained and marked by the highway department engineers. The only task imposed on the contractor is to erect and maintain barriers. This practice keeps responsibility centralized. In the matter of location, the instructions are, where choice is possible, to search out the best detour route, taking into account the condition of the roads as well as the mileage. Where the detour route is over dirt roads, as it commonly is, the roads are kept in condition by dragging and such other work as will make possible traveling without excessive cost.

With the detour selected, the proper signs and barriers and their location conform as closely as possible to a standard arrangement as indicated by the sketch, Fig. 1. The specifications for signs and their location

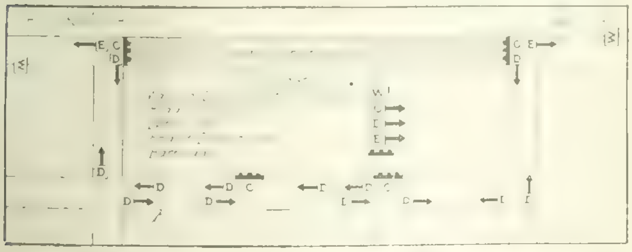


FIG. 1. STANDARD MARKING OF DETOUR ROUTE

are rigidly enforced and cover every detail of constructing the standards and attaching the printed placard, 18 x 27 in., of white on dark blue. The specified standards are 19 x 28 in. "boards" on 4 x 4-in. posts 7 ft. long. The placards are tacked to the boards by border strips of wood. Boards, posts and strips are painted white and the placards are coated with paraffine. A weekly inspection is made and when necessary the signs are restored or replaced.

The fundamental rules governing the marking of detours are: (1) a road shall not be closed to traffic until all signs necessary to indicate clearly the route of the detour, are in place; (2) when a road which has

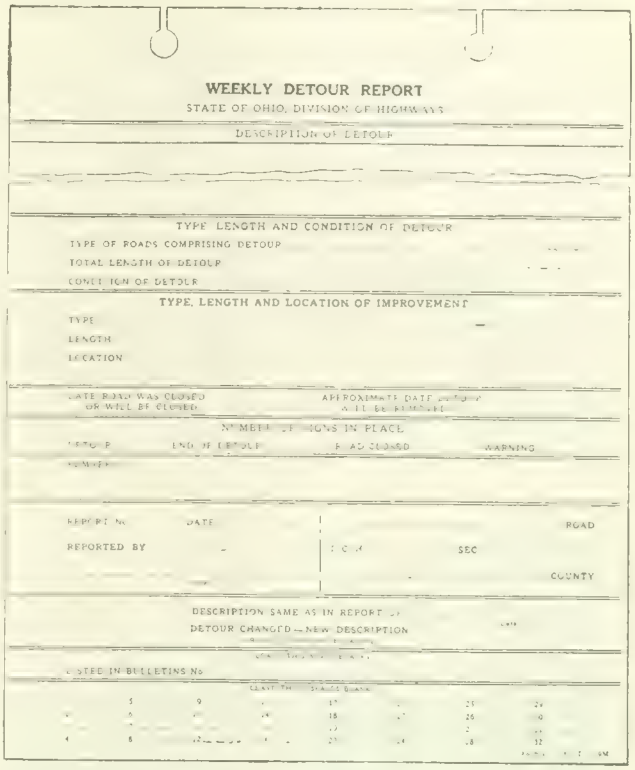

WEEKLY DETOUR REPORT
STATE OF OHIO, DIVISION OF HIGHWAYS
DESCRIPTION OF DETOUR
TYPE LENGTH AND CONDITION OF DETOUR
TYPE OF ROADS COMPRISING DETOUR
TOTAL LENGTH OF DETOUR
CONDITION OF DETOUR
TYPE, LENGTH AND LOCATION OF IMPROVEMENT
TYPE
LENGTH
LOCATION
ROAD
REPORTED BY
SEC
COUNTY

FIG. 2. STANDARD FORMS FOR REPORTING DETOURS

been closed is permanently opened to traffic all detour signs shall be promptly removed, and (3) all barricades shall be painted white and have red lights between sunset and sunrise.

As soon as a detour is marked it is reported by the division engineer on the form shown by Fig. 2. In this report particular attention is given to the description of the detour. This is circumstantial and precise to the extent of noting every surface condition or other physical characteristic of concern to travelers. After the first report a weekly report noting all detour changes is made until the detour is abolished.

On the information provided by the detour reports, a map and bulletin are prepared each month and copies are placed at division offices and in garages where travelers may consult them. Each monthly bulletin is corrected each week by a supplement recording changes and additions. This news service is maintained with exactness and has proved to be popular.

Selection, marking and maintenance of detours are the tasks of the division engineers conforming to the practice established by commission headquarters. Headquarters prepares the monthly detour news, maps, and bulletins, and arranges for their circulation. Leon C. Herrick is director of the department of highways and public roads, and E. C. Blosser highway engineer.

Large Venturi Meters for London

Venturi water meters, each 108 in. in diameter and the whole group having a capacity of 360 U. S. m.g.d., have been contracted for by the Metropolitan Water Board of London, England. *Municipal Engineering* of London states these will be the largest Venturi meters ever installed in the United Kingdom and the second largest ever built in that country, the largest being 120 in. in diameter, built some fifteen years ago for the Divi Irrigation Works, Madras.

Slenderness-Ratio and Strength of Concrete Columns

Effect of Length Found To Be Negligible—Influence of Water Ratio and Mixing — Buckling Controlled by Eccentric Loading

By F. E. Giesecke
Head of Engineering Research Division, University of Texas, Austin

VARIOUS regulations or formulas to express the relation between strength and slenderness-ratio of reinforced-concrete columns are in current use. The most important ones known to the writer fix the relation between allowable load on long columns (P') and on short columns (P) as follows:

1. French regulations of 1906, for l/d greater than 20,

$$P' = \frac{P}{1 + \frac{k}{10{,}000}\frac{l^2}{r^2}}$$

in which k is $\frac{1}{4}$ for square-ended columns and 1 for round-ended columns.

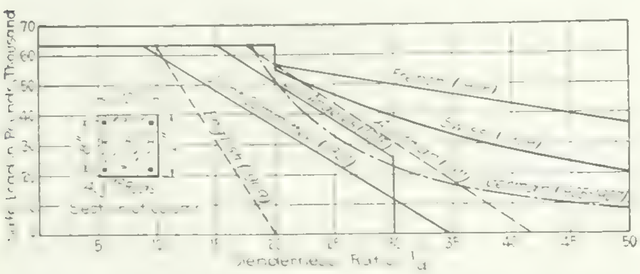


FIG. 1. SAFE LOADS ON 12 x 12-IN. CONCRETE COLUMNS UNDER DIFFERENT REGULATIONS
Computed for equal base stress

2. German regulations of 1905 and 1907, for l/d greater than 18,

$$P' = \frac{\pi^2 E I}{s\, l^2}$$

where s, the factor of safety, is 10 in the German regulation.

3. English regulations of 1909, fix values of P'/P for ratios of virtual length to effective diameter of a square pillar ranging from 15, 18, 21, 24, 27, 30 at 1, 0.8, 0.6, 0.4, 0.2, and zero. The virtual length of the column varies from l to $4\,l$, depending on end conditions; the effective diameter is measured to the outside of the outermost vertical reinforcement.

4. Swiss regulations of 1909, for l/d greater than 20.

$$P' = \frac{45}{35}\,\frac{P}{1 + \left(\frac{l}{100\,r}\right)^2}$$

5. Austrian regulations of 1911, for l/r greater than 60,

$$P' = P\left(1.72 - 0.012\,\frac{l}{r}\right)$$

6. Los Angeles regulations of 1915, for l/d greater than 15,

$$P' = P\left(1.6 - \frac{l}{25d}\right)$$

7. Joint Committee, in its tentative specifications of 1921, for l/r greater than 40,

$$P' = P\left(1.33 - \frac{l}{120\,R}\right)$$

FIG. 2. GANG MOLD FOR 3 x 6-IN. COLUMNS
Upper edges of plates held together by clamps until concrete was set.

where R is the least radius of gyration of the core.

In order to be able to compare these six formulas, the strengths of 12-in. square columns of various lengths, reinforced with four $\frac{1}{2}$-in. square bars $7\frac{1}{2}$ in. on centers, were calculated by each of the six formulas, for equal loads on short columns. The results, plotted in Fig. 1, indicate that the French and Swiss regulations are based on Rankine's formula and the German regulations on Euler's formula, while the Austrian, Los Angeles, Joint Committee, and English rules seem to be straight-line approximations of Euler's formula.

Since there is a considerable variation in the results it was decided to make experimental determination of the strength of plain concrete columns, and a series of tests was begun by the Engineering Research Division of the University of Texas in 1919.

Test Procedure.—The columns tested were 3 x 6 in. in cross-section and varied in length from 15 to 75 in., so that the slenderness-ratios were 5, 10, 15, 20, and 25. They were made in molds formed by bolting 8 x $\frac{1}{2}$-in. steel plates to 3-in. channels and inserting dividing plates to limit the lengths of the columns (Fig. 2). The columns were thus poured from their sides. As all columns of a series were made at the same time, the character of the concrete was exactly the same in any one series.

Eight such series were prepared, differing in mix and consistency. In some of the groups the concrete was rodded; in others it was tamped. The columns were

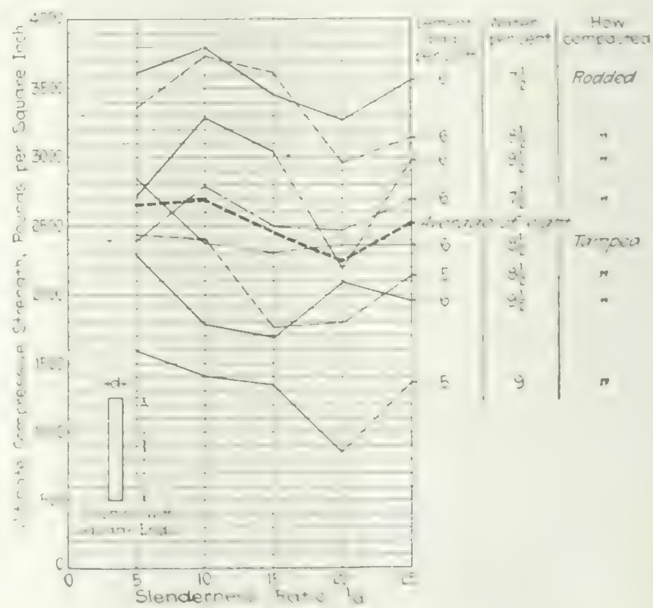


FIG. 3. SQUARE-END TEST RESULTS
Each point of the full lines represents one column; the dash line is the average of the eight series. Maximum size of aggregate 1¼ in. in Series 1, ¾ in. in others. Reading from top down on right hand side, series numbers are 2, 4, 6, 1, average, 3, 7, 5 and 8.

tested at the age of 28 days. The results of this series of tests are shown in Fig. 3.

Inspection shows that the strength of these concrete columns varied only slightly with the slenderness-ratio, which, however, did not exceed 25; but it also shows that a variation in the consistency of the mix, or a variation in the degree of richness of the mix, or a variation in the method of placing the concrete may produce a very great variation in strength, more than 100 per cent.

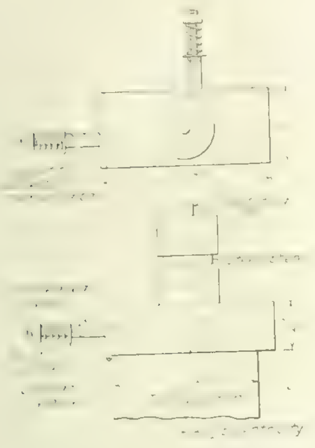


FIG. 4. END SUPPORT FOR ROUND-END COLUMNS
Eccentricity adjusted to prevent buckling in 6-in. direction.

Round-End Tests—Since these columns showed such a slight variation in strength with slenderness-ratio, it was decided to repeat the experiment on round-end columns between spherical bearings. This method of testing would insure central loading and would double the virtual length and therefore the slenderness-ratio of each column. For this purpose the bearing blocks shown in Fig. 4 were constructed. Since the addition of the two bearing blocks made the longest column of the first group too long for the testing machine, that column was divided into two parts (dotted line in Fig 2). Thus each series of the 1920 group consisted of six round-end columns having slenderness-ratios of 7.34, 9.75, 12.25, 17.17, 19.63, and 22.13, or, for the equivalent square-ended columns, 14.68, 19.5, 24.5, 34.34, 39.26, and 44.26.

For each series one or more 6 x 12-in. cylinders were made to identify the type of concrete. Five series of columns were made in the fall of 1920 and tested during the summer of 1921, at an average age of about 9 months. Each series consisted of five sets of columns, and the entire group consisted of 150 columns. The five series differed from each other in the type of concrete. In all, more mixing water was used than was necessary, in order that the experimental columns might be no better than those generally found in practice.

Anomalous Buckling—When the testing of the columns was begun, it was found that the columns bent in the 6-in. direction instead of in the 3-in. direction, as in Fig. 5, showing a column 15 in. long; it is evident that this column failed by flexure in the 6-in. direction. This peculiar condition was concluded to be due to the fact that the columns were poured from the side and into fairly tight steel forms, and that therefore the concrete on the upper side of the column contained more mixing water than that in the lower side; the strength effect of water content was sufficient to overcome that of slenderness-ratio.

In order to test the columns satisfactorily, it was necessary to apply the load eccentrically about ¼ in., as shown in Fig. 4. This degree of eccentricity seemed to be just sufficient to overcome the effect of the variation in the strength of the concrete in the direction of the width of the columns.

Fig. 6 shows the results of the tests of this group. The lengths used in this diagram are the actual lengths of the specimens from center to center of the spherical bearings; the virtual lengths are twice as great.

Results—The diagrams of Figs. 3 and 6 show that, for the limits of slenderness-ratio examined, the strength of the column is almost independent of the slenderness-ratio. But they also show that the results of the tests are not as uniform as they should be in a carefully conducted investigation. The writer believes that the irregularities in the results are due to a difference in the water content of the concrete, which, in turn, was due to the particular location of the column in the mold and to the location of the mold.

For example, Fig. 3 shows that the 30-in. columns were the strongest and the 60-in. columns the weakest of the entire group. If the mold shown in Fig. 2 sloped downward in the direction from the upper right to the lower left of the plan, the water which was worked out of the concrete flowed so that the 30-in. columns would contain the least water and the 60-in. columns the most; this would produce the differences in strength shown in the diagram. In the second group

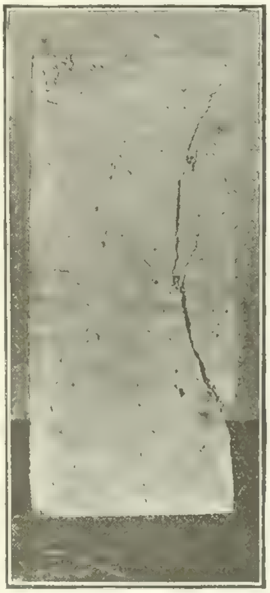


FIG. 5. SHORT TEST COLUMN FRACTURED IN 6-IN. DIRECTION

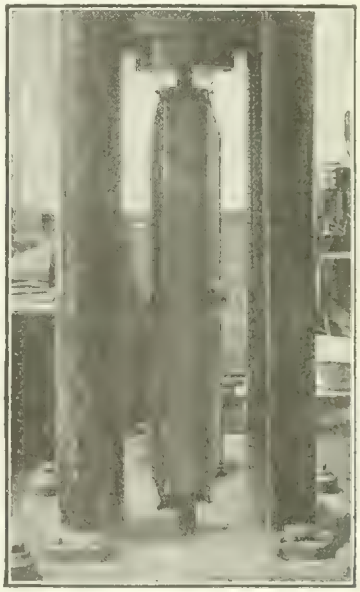


FIG. 6. ROUND-END TEST ARRANGEMENT
Two dials measured deflections

(Fig. 6) the two center columns, i.e., the 22½-in. and 52½-in. columns, were the strongest. If the mold was level and the concrete a little thicker in the center columns than in the side columns, the water worked out of the center columns would flow over the side columns and, as a result, the side columns would be weaker than the center columns.

Another interesting fact developed in the second series of tests was that the strength of the 6 x 12-in. check cylinders was in several cases somewhat lower than the strength of the slender, round-ended columns. This was probably due to the fact that the cylinders, being twice as deep as the columns, retained relatively a higher proportion of the mixing water, and therefore attained a lower strength.

Theoretical Length-Relation—Considering the column from a theoretical point of view, it is evident that

so long as the column does not bend, its strength is independent of its slenderness-ratio, and that after flexure has taken place, either due to non-homogeneity of the material or due to eccentric loading, the load which can be safely supported by the column will decrease as the flexure increases. Since the bending moment in the column at any point is proportional to the deflection at that point, and since the flexure of a bar can be determined by considering the moment diagram as the loading diagram and finding the resulting moment, it can be shown that the deflection of a long column is proportional to the square of its length.

Then the stress due to flexure also varies as l^2, and since Euler's formula gives the ultimate strength of a long column as $\frac{\pi EI}{l^2}$, it is evident that Euler's formula can only be applicable in those cases where the stress due to flexure is infinitely great as compared with the direct stress due to the load. However, in the tests

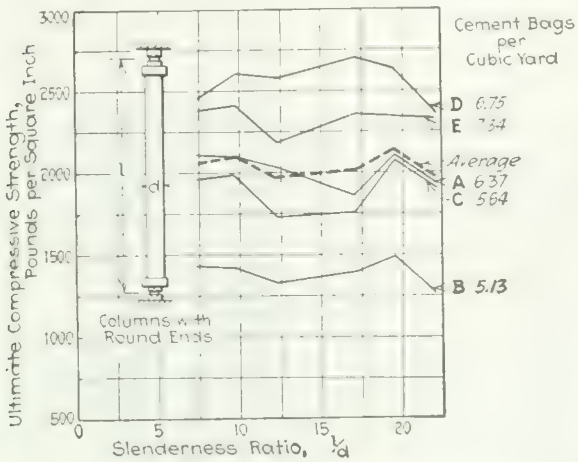


FIG. 7. ROUND-END TEST RESULTS

Each point of the full lines represents five columns; the dash line is the average of the five series.

reported above, measurement of the deflections by means of Wiesler dials (Fig. 6) showed a maximum deflection of only 0.013 in. This occurred in a round-end column 67 in. long, at a load about 90 per cent of the ultimate, at which time the deflectometers were removed. The stress due to flexure was therefore 59 lb. per square inch and the direct stress was 2,240 lb. per square inch.

In order that the two stresses might have been equal, the column would have had to deflect about ½ in., or about 38 times as much as it did.

It therefore seems clear that the stresses due to flexure in concrete columns will always be very much less than the direct stresses due to the loads and that therefore Euler's formula and the straight-line formulas based on Euler's cannot be correctly applied to concrete columns. The error due to their use is on the side of safety, however.

The columns of the first group were prepared and tested by G. A. Parkinson, assistant testing engineer. Those of the second group were prepared by F. L. Snodgrass, laboratory assistant, and tested by Mr. Snodgrass, Mr. Parkinson, and H. R. Thomas, testing engineer. The latter gave special attention to the testing of the long columns for which the deflections were determined.

Lime Treatment of Sewage Compared With Direct-Oxidation

Study of Easton Tests and Working and Experimental Results at Worcester with Lime Alone Against Electrolytic Method

BY ROY S. LANPHEAR
Supervising Chemist of Sewage-Works, Worcester, Mass.

THE "direct-oxidation" method of sewage treatment has not been generally accepted by sanitary engineers as satisfactory, either as regards efficiency or cost. Lime treatment of sewage at Worcester has been practiced for more than thirty years and has been studied from many angles. The results obtained both in every-day operation of the plant and in some recent experiments taken in conjunction with the Easton tests indicate that the "direct-oxidation" process gives no results of practical value not readily obtained at less expense by using an excess dose of lime alone.

"Direct-Oxidation" Tests at Easton, Pa.—Operating data concerning this method of sewage treatment are meager and usually represent comparatively short test periods of operation. This is unfortunate and makes the data of no real practical value. The results of the Easton, Pa., tests, given in *Engineering News-Record*, Sept. 18, 1919, p. 569, cover a number of tests, no one of which is longer than 24 hours. In this plant, the fresh, rather dilute domestic sewage passed through a coarse bar screen, centrifugal pump, flat plate screen with closely spaced ¼-in. round holes and a grit chamber. It was then treated with lime, passed through electrolytic cells, thence to settling reservoirs, giving 2½ hours detention when free from sludge. The result for the 24-hour test is summarized in Table I.

TABLE I—EASTON "DIRECT-OXIDATION" TESTS COMPARED WITH WORCESTER WORKING RESULTS IN 1921 WITH LIME ONLY

	Raw Sewage		Effluent		Removal P. P. M		Per Cent Removal	
	Easton	Worcester	Easton	Worcester	Easton	Worcester	Easton	Worcester
Total solids	217	615	640	497	423	118	—194.9	19.2
Volatile solids	114	285	94	207	20	78	17.5	27.4
Suspended solids	74	151	26	58	48	93	64.9	61.6
Free ammonia	11.3	17.2	9.3	14.8	2	2.4	17.7	13.9
Organic nitrogen	34.5	4.9*	21.6	3.1*	12.9	1.8*	37.4	37.3*
Oxygen consumed	53	81.3	44	37.4	9	43.9	17.0	54.0

* Albuminoid ammonia instead of organic nitrogen is reported at Worcester

The bacterial content of four samples of sewage was from 48,000 to 1,200,000 per c.c., averaging 600,000; of effluent, from 54 to 30,000 per c.c., averaging 12,391. These four samples were stable.

In connection with these results, attention is particularly directed to the fact that the promoter set the rate of application of lime so that it was used at a rate of 3,720 lb. per million gallons of sewage treated. Lime addition was supposed to have been made only "to insure positive alkalinity" and "satisfactory operation required an alkalinity of 30 p.p.m." The total alkalinity of the screened sewage previous to the lime addition was about 90 p.p.m. and of the effluent, from 252 to 380 p.p.m. The effect of this excess alkalinity is not stated.

The Franklin Institute tests at Easton, summarized in the same article, do not give alkalinity or stability results, nor is the quantity of lime used per million gallons of sewage treated given, but Table V, p. 572 of the article cited, indicates that lime had a greater effect upon bacterial reduction than electrolytic treatment.

Chemical Precipitation at Worcester, Mass., 1921—The yearly average results of sewage treatment at Worcester during the year 1921 are summarized in Table I, for ready comparison with the Easton figures. The bacterial content of the effluent is variable, but is generally less than 50,000 per c.c.; the average stability is from one to two days and the average alkalinity less than 20 parts per million.

While the analyses of the two effluents are not strictly comparable on account of the period of operation, it appears that the chemical precipitation effluent is not of as good quality as that obtained at Easton. The quantity of lime used at Worcester averaged 538 lb. p.m.g. of sewage treated, or only about one-seventh of the quantity used at Easton. What would be the result of sewage treatment at Worcester if lime was used at the rate of 3,720 lb. p.m.g.? The results obtained at Easton are not enough better, except perhaps as to stability, to warrant the expense of using seven times as much lime. How was this perfect stability of effluent obtained? If it can be shown that chemical precipitation of sewage—a much stronger sewage—will give an effluent having perfect stability by using an equal or less quantity of lime, then the electrolytic treatment of sewage with costly patented machines will evidently be a needless operation and an unwise expenditure of money.

Lime Treatment of Chemical Precipitation Effluent—The study of Worcester now to be outlined was first intended as an investigation of the relation of organic content of the effluent to its stability. While the details of the first portion of the work are not strictly essential to the purpose of this paper, the results indicate possible similar effects of treatment of "direct-oxidation" effluent, if the exceedingly large quantity of lime had not been used. Briefly, it was demonstrated that the usual samples of effluent from chemical precipitation of sewage, when diluted after additional dosing with lime, had the stabilities shown in Table II.

TABLE II.—STABILITY OF DILUTED CHEMICAL PRECIPITATION EFFLUENT

Dilution of 1 to 1		Dilution of 1 to 2		Dilution of 1 to 3	
Alkalinity P.P.M.	Stability Per Cent	Alkalinity P.P.M.	Stability Per Cent	Alkalinity P.P.M.	Stability Per Cent
60 or more	99	30 or more	99	20 or more	99
40 to 60	80	20 to 30	87	10 to 20	80*
30 to 40	75	10 to 20	78	0 to 10	91*
20 to 30	55	0 to 10	58		
10 to 20	16 to 99				

* Samples having low alkalinities and varying organic content affected the average results.

Alkalinity was determined using phenolphthalein in the cold form and stability tests were made at 20°C.

According to these results, if no allowance is made for the dissolved oxygen in the diluting water, the undiluted effluent should be perfectly stable if the alkalinity is about 80 to 120 p.p.m. The chemical character of the undiluted effluent was slightly stronger than that of the effluent at Easton (Table I); therefore, it would appear that a similar statement could be made concerning the alkalinity and stability of the undiluted "direct-oxidation" effluent. If this be demonstrated to be so, and bearing in mind the actual use of lime at Easton, there was a reckless and extravagant expenditure of money made for lime in connection with the "direct-oxidation" method.

Undiluted regular samples of effluent from the Worcester chemical precipitation plant, some of which were alkaline and some acid, were treated with milk of lime solution of known strength so as to make a set of three samples of increasing alkalinity. The first series of tests, covering a period of three weeks, gave results shown in Table III.

TABLE III.—STABILITY OF UNDILUTED LIME TREATED CHEMICAL PRECIPITATION EFFLUENT

— Alkalinity Range	P.P.M.— Average	Bacteria Per C.C.	Stability Per Cent
100–150	129.2	5,787	99
150–200	172.6	2,973	99
200–400	273.3	1,650	99

Every sample having 100 p.p.m. alkalinity was stable; a few samples having an alkalinity of from 51 to 93 p.p.m. had a percentage stability ranging from 37 to 99 and showed variation in results. Almost without exception every sample showed reduction in bacterial content with increased alkalinity, but there were single days with comparatively high counts which increased the average results above the usual result. For instance, the usual bacterial count of the samples having 100 to 150 p.p.m. alkalinity was from 1,000 to 4,000 per c.c.; 150 to 200 p.p.m. alkalinity, 200 to 1,200; 200 to 400 p.p.m. alkalinity, but little reduction of usual counts and large reductions of high counts. Perfect stability of sewage effluents, similar in character to those at Easton and Worcester, is readily obtained, but it is not possible to obtain a sterile effluent unless greater alkalinities than 350 p.p.m. are used.

The second series of tests of undiluted effluent were similar and covered alkalinity ranges of 50 to 75, 75 to 100 and 100 to 150 p.p.m. The samples having at least 100 p.p.m. alkalinity averaged 123.3 p.p.m., the bacterial count averaged 8,630 per c.c. and all samples but one were perfectly stable, that one having 90 per cent stability. Samples having less than 100 p.p.m. alkalinity generally showed increased stability and decrease of bacterial content with increasing alkalinity, but the improvement was variable and very slight, especially when the alkalinity was less than 75 parts per million.

Lime Requirement for Stable Effluent—The usual daily quantity of lime used at Worcester at this time was 7½ tons, averaging 449 lb. p.m.g. of sewage treated. Increased alkalinities were produced at a rate of from 50 to 60 p.p.m. by using 500 lb. p.m.g., indicating an additional lime requirement for a stable effluent of about 750 lb. p.m.g., or a total of 1,200 lb. The average sewage flow was 26 m.g.d., requiring an additional quantity of 10 tons of lime, a total of 17½ tons per day. The cost of the necessary additional lime to produce a stable effluent would be $143 per day, lime costing $14.30 per ton, or $5.50 per million gallons.

Conclusions—A sewage, noted for its trade-waste content, and much stronger than that at Easton, can be treated with lime at a rate of about 1,200 lb. p.m.g. and a stable effluent obtained. Why use 3,720 lb. as at Easton?

The results of the Worcester experimental work indicate that the stable effluent, having excessive alkalinity, obtained at Easton by using this large quantity of lime, was probably due to the use of excessive quantities of lime rather than to the electrical treatment of the sewage.

It has been shown that an effluent from chemical precipitation having 100 p.p.m., or more, of alkalinity was perfectly stable; this being regularly obtained only when the alkalinity was at least 100 p.p.m. The char-

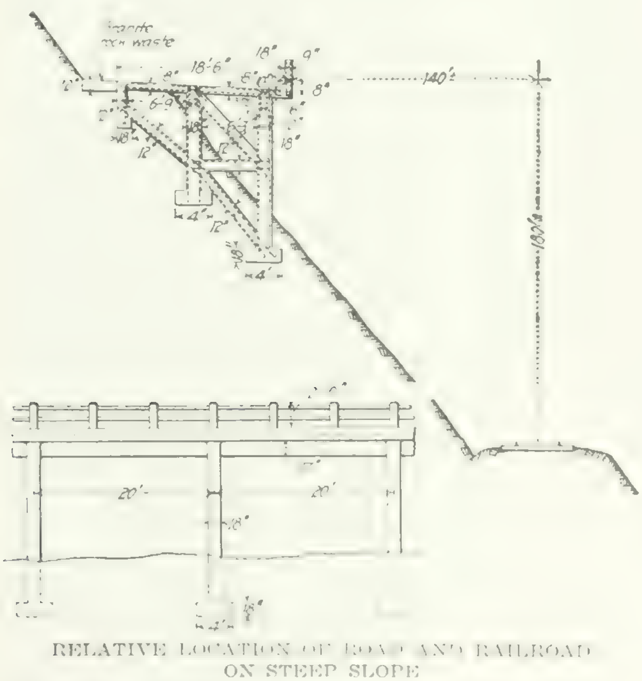
acter of the sewage treated was nearly twice as strong and the effluent was slightly stronger in organic content than at Easton; it would appear that an effluent from lime treatment at Easton, having from 252 to 380 p.p.m. alkalinity, should be stable without the use of electric current.

The lime-electrolytic or "direct-oxidation" method of sewage treatment must take an effluent from lime treatment, of approximately the character of Worcester or Easton effluent, having an alkalinity of about 30 p.p.m. (necessary for method) and a probable stability of from 20 to 30 per cent and obtain a perfectly stable effluent by electrical treatment. Otherwise sewage treatment by electric current can not be seriously considered. Further, since the use of additional lime gives a perfectly stable effluent, it is necessary that the cost of electrical treatment of sewage be less than that of the additional lime.

Sidehill Viaducts Carry Highway in Canyon Above Railroad

Slopes as Steep as ½ to 1 Between Highway and Railroad Made Material Handling a Problem on California Job

IN LOCATING the new highway from Santa Cruz, Cal., to the "Big Trees" it was found possible to reduce greatly the distance if a route paralleling the Southern Pacific R.R. through a narrow canyon could be followed. This route was selected and by using care in the design and location of the necessary sidehill structures, as well as means of handling material, the



RELATIVE LOCATION OF ROAD AND RAILROAD ON STEEP SLOPE

Where these sidehill structures were built, excavated material could not be dumped over the bank on account of the track below.

work was completed with practically no interruption to train schedules. The slope on which the roadway and railroad are located is as steep as one-half to one in many places and a fair average for several miles is one to one. The new highway is four miles long and is to be paved for its entire length. The major portion of the work was done last fall.

Through the sections where construction was most difficult the line skirts the side of the canyon from 100 to 180 ft. above the railroad with a horizontal separation of only 50 to 75 ft. In this portion of the road there are sixteen concrete retaining walls ranging up to 23 ft. in height and four sidehill viaducts. The latter have their outer edges supported by bents sometimes as much as 20 ft. high, while the inner edges are buried in the steep slope of the bank.

In the section where the chief problems were met, the slope of the sidehill averaged about three-quarters to one. In loose material whose stability and angle of repose are uncertain when moisture is in the ground, the final location had to be studied very carefully on paper and in the field before decision could be made as to comparative costs of the alternative methods of construction. The disposal of excavated material was a major problem, but excessive haul was avoided by making a careful study of the slopes below the roadway and utilizing to a maximum all depressions or pockets in which material would stand without danger of sliding down onto the track.

Where the roadway curved around slight depressions in the sidehill the subgrade was held in place by retaining walls resembling arch dams. Because of the convenience and probable low maintenance cost of this type of construction the location was shifted to favor the retaining wall in place of the sidehill viaduct wherever feasible. The retaining walls also had the advantage that material filled in behind them helped to reduce overhaul. Both the cantilever and buttress types of retaining walls were used according to conditions. Retaining walls as well as sidehill viaducts were heavily reinforced, ½-, ⅞- and 1-in. bars being used.

The sidehill viaducts are located at points where no simpler types of construction seemed feasible. In working out detailed designs for these structures primary consideration was given to proper drainage. Because the material traversed is largely disintegrated granite and other porous material, tile drains or similar methods of unwatering the slopes above the road were not used and endeavor was concentrated on preventing seepage water or water coming down the slopes from getting under the structures where it might soften and undermine the supports.

Along the hillside or inside edge of the structure an excavation was made into which Logan waste, the product of a local granite quarry which packs in an impervious layer, was placed to form a water seal. This material was placed in a layer about 14 in. thick and extended into the bank about 6 ft. from the edge of the pavement. When the concrete roadway was poured it was embedded in this seal so that surface water coming down the steep slope or out of the cut would be diverted upon the pavement. As the roadway is nowhere without at least a slight grade, the surface water is readily retained by a curb along the outer edge terminating at suitable points in culvert discharges.

The longest sidehill viaduct is 160 ft. in length and involves a reverse curve. One expansion joint was put in the pavement about midway of this structure. No joints were used in the other sidehill viaducts, however, several of which also contain reverse curves. No effects of expansion and contraction appeared during the winter months that followed the completion of these structures and close observation will be made to see whether any

develop during the coming summer. In the railings where expansion joints were put in every 40 ft., considerable movement due to temperature changes has already been noted. These joints are located in the posts and consist of tar filler between the abutting ends of the concrete rails. The strength of the railing

SIDEHILL VIADUCT ON HIGHWAY ALONG STEEP CANON WALL

Railing was cast monolithic in place. Footings protected against seepage by seal on inner edge of pavement.

at these points is retained by a dowel consisting of a $\frac{3}{4}$-in. smooth reinforcing rod partly embedded in one rail and projecting from the rail-end into a 1-in. pipe socket embedded in the concrete of the abutting rail.

The pavement is 5 in. thick where it is laid on the ground and this is increased to 8 in. where the sidehill viaducts are used. The mix was 1:2:4. The roadway width is 16 ft. with an increase of 2 ft. on curves of less than 200-ft. radius. Due to probable line changes and the desire to allow fills to settle, the pavement could not be laid continuously, and about eight "exceptions" or gaps were left unpaved. In anticipation of heavy traffic before these gaps could be completed and to prevent breaks at the ends of the concrete slabs, each slab end was thickened as a protection against impact. The thickening was begun 6 ft. back from the end of the slab and uniformly increased to a thickness of 12 in. at the ends.

As was expected, some material slid onto the roadway from above during the winter but this was not of serious extent and except in a few cases where heavy boulders smashed through the railing or cracked the outer edge of the pavement slab, the concrete structures were not damaged.

Lloyd Bowman, county surveyor of Santa Cruz County, had charge of design and construction on the work described in the foregoing.

Wrought Iron From an Old Chicago Bridge

EXAMINATION of the wrought iron from the old (and now dismantled) Rush St. drawbridge over the Chicago River, made an interesting showing of the character of structural metal used when that bridge was built, in 1884. The builders were Rust & Collidge. This examination was made by C. A. Akerlind, machinery inspector, who reported to Thomas G. Pihlfeldt, engineer of bridges for the City of Chicago.

Tensile tests on two samples from the web of a 10-in. channel gave the following results, the lower elongation in the second piece being due apparently to a crystalline spot.

Elastic limit..........	33,050 lb.	34,180 lb.
Ult. tensile strength...	49,950 lb.	49,300 lb.
Elongation in 8 in.....	22 per cent	15 per cent

Etching tests were made on specimens cut from truss rods and eyebars, and the report on these is as follows:

The $1\frac{3}{8}$-in. truss-rod specimens are particularly interesting as they show clearly that the bar is built up of muck bars and therefore is real new wrought iron. The $1\frac{7}{8}$-in. specimen makes a rather prettier showing, but the bloom from which this bar was rolled was made up of scrap iron. This is not necessarily detrimental to the quality of the iron if the scrap is selected and properly placed before welding and rolling, or forging. In those days scrap iron was always wrought iron, while now so-called "wrought-iron" manufactured, for example, in the neighborhood of Chicago, is welded up soft steel, the product being what is technically known as "bushel iron." At these mills wrought iron scrap is bought, like boiler tubes, old horse shoes and old freight car axles, but this material is getting more scarce and is used only for special purposes.

The 5 x 1-in. eyebar specimen shows the bar to have been rolled from a pile of muck bars, all new wrought iron. A small specimen cut from one of the broken test pieces of the channel iron indicates clearly that that channel was rolled from a bloom made up of scrap iron. This particular piece offered greater resistance to the acid than any of the others, indicating that some of the scrap used had consisted of "refined" or even "double refined" wrought iron. I have had cases of double refined wrought iron for locomotive boiler stay-bolts that resisted the action of the etching fluid for hours, while the more open iron would be affected in a few minutes. The 5 x 1-in. specimen indicates clearly the different qualities in the material to resist corrosion.

Railways in China

The railway system of China at the end of 1920 aggregated 6,805 miles, according to the report of the Ministry of Communications. This included 3,980 miles of government lines and 480 miles of provincial and private lines, making 4,460 miles under the control of the Ministry of Communications. The remaining 2,345 miles consist of five concession railways. Exclusive of the dependencies of Mongolia, Turkestan and Thibet, the country has 276 square miles of territory and a population of 54,000 per mile of railway, as compared with 16 and 8,000 for Japan and 12 and 3,800 for the United States.

Liverpool to Undertake Harbor Extension

An important extension of the Liverpool dock system has been decided upon by the Mersey Dock and Harbor Board, at an estimated cost of $1,988,301 (pounds sterling converted at par). The scheme is to arrange for the closing of the existing river entrance to the Gladstone dry dock, and for inclosing the dock so that it shall form part of a system to be known as the Gladstone System of Docks. This system will include two new wet docks now in the course of construction. The scheme, according to the chairman of the works committee of the dock board, includes the building of a new entrance 1,070 ft. long between the inner and outer pairs of gates, with a width of 130 ft. and a sill below bay datum of 20 ft., which will provide a depth of 21 ft. 4 in. at low-water ordinary spring tides and 41 ft. 7 in. at high-water ordinary neap tides. Steamers using the Gladstone dock will be able to proceed directly to a graving-dock without having to pass out into the river, and entrance to the new system will not be so exposed to the weather as the present entrance to the dry docks. The largest ships will be able to enter and leave on every tide of the year, and ships of ordinary size will be able to do so at any time of any day, except for a few hours each side of low water on the spring tides. It is anticipated that the entire scheme will be completed in two years.—*Commerce Reports.*

Public Health Courses and Degrees at M. I. T.

Although the Harvard-Technology School of Public Health no longer exists, there will continue to be interchange of facilities between the two institutions, according to an announcement just issued by the Department of Biology and Public Health of the Massachusetts Institute of Technology, signed by Prof. S. C. Prescott, head of the department. Students in the department may be candidates for the degree of Bachelor of Science, Master of Science, Doctor of Philosophy, or Doctor of Science in Public Health, or for a Certificate of Public Health. Women are accepted as candidates for degrees.

Simple Plant for Laying Large Diameter Pipe

Hook on Ditcher Boom Rips Out Concrete Pavement —Steel Fingers Fit Pipe Ends Together— Bonus Increases Output

A COMPACT outfit, with a number of unique attachments developed on the job, gave excellent progress last summer, under the urge of a bonus-system of wage paying, in laying 72-in. and 84-in. lock-bar pipe for the Torresdale filters in Philadelphia. The outfit, as it approached the finish of the operation, is shown by Fig. 3. Except the wheelbarrow gang, this is not a posed situation of the plant units, but is a fair representation of average close-working due to one crew crowding another in an effort to earn bonus wages.

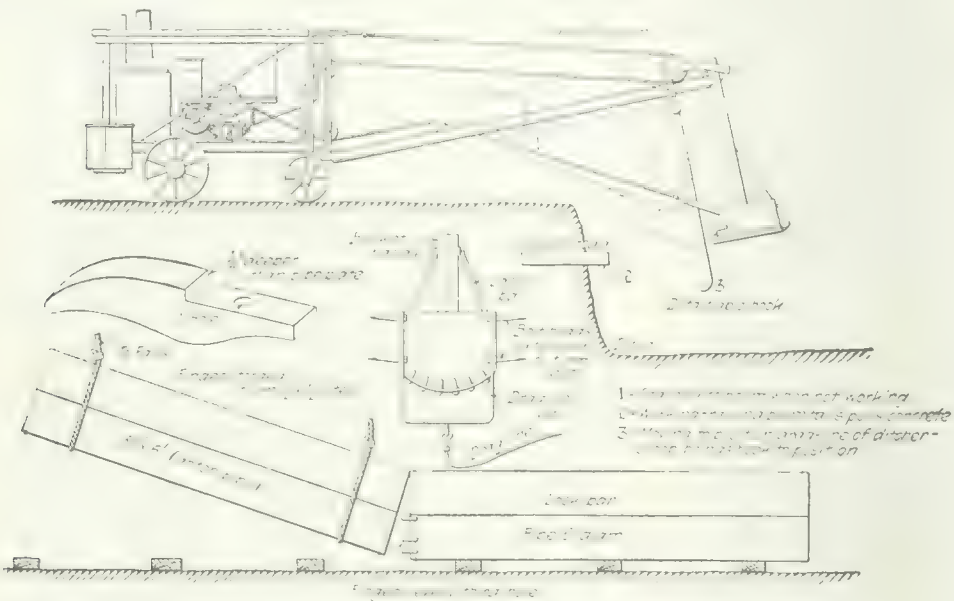


FIG. 1. JOB-MADE ATTACHMENTS EXPEDITE PIPE-LAYING

An 8-ft. trench, 10 ft. deep was dug for the pipe, 100 ft. of 84-in., with six connections for centrifugal pumps, and 2,600 ft. of 72-in., all set in a cradle of concrete. The soil was a wet sandy loam calling for strong bracing and much pumping. Close sheeting was not necessary, but without it fast work was advisable. A Keystone excavator, equipped with its standard ditcher bucket and handle attachment, dug the ditch, loading into dump wagons which returned the soil to the rear for backfilling. The only drawback to plain digging was the unexpected disinterment, about 18 in. below the surface, of an old concrete pavement as indicated in Fig. 2. To handle this and the wide trench sides, attachments to the excavator, Fig. 1, (detail sketches) were devised by Frank B. Lee, superintendent for the

FIG. 3. GANTRY OUTFIT LOWERING SIX-TON PIPE

contractors. A hook hinged [illegible], as indicated by the sketch tore up the old pavement. To cut the ditch sides, spurs were put on the bucket by lengthening and sharpening the heads of the bail bolts. By swinging the bucket and lifting and lowering the boom the trench sides were scored and broken down vertically.

Each 72-in. pipe weighed 6 tons and, as shown by Fig. 2, was handled into the trench with two gantrys. These were made of steel shapes and put on rollers with extended square hubs. Using wrenches on the hubs, four men were able to shift the gantry along the trench to adjust precisely the two pipes being joined. Another aid that was employed, with the most satisfactory results, was the jointing fingers indicated by Fig. 1.

The pipes were laid on six-inch square timbers and as the concrete mixer came along were filled underneath and up the sides with concrete.

FIG. 3 THREE-UNIT OUTFIT FOR LAYING 6-FT. STEEL PIPE

All construction was performed with a bonus system of payment in force. For each operation, trenching, pipelaying and concreting, a stint was set. For example, in pipelaying, three pipes in place made a day's work. If another pipe was put in each man got a dollar. In excavating, 50 ft. of trench was the stint established and for every additional foot each man got 50c. Sometimes five and six pipes a day were laid and 60 ft. of trench were opened. A feature of the bonus payment was that the men got each day's extra wage the day that they earned it, which appeared to be particularly pleasing to them; it was money they "did not have to account for in the Saturday pay-envelope."

The work as described was performed by the Beam-Craven Co., Philadelphia, Pa., for the Philadelphia water department.

Large Caisson for a Dry Dock

A pneumatic caisson 1,130 x 197 ft. weighing about 8,000 tons is to form the foundation of a new dry dock at Havre, France. Its framing will comprise six longitudinal trusses 21 ft. deep and 40 transverse trusses. The dock will be 1,024 x 174 ft., accommodating vessels of 100,000 tons displacement and with a draft of 44½ ft.

Unique Water-Works for Nabaclis, British Guiana

THE water-works of Nabaclis, British Guiana, includes an artesian well, an iron-removal plant, water mains and hand pumps. The working head without the pumps is 7 ft., of which 4 ft. is afforded by the artesian pressure and 3 ft. by laying the mains at that depth below the ground surface. The foregoing and the following facts are taken from *Public Health Engineering Abstracts* (U. S. P. H. S., Washington, D. C., July 29), which in turn gives credit to an article by Dr. E. P. Minett, medical officer of health, British Guiana, in *Transactions* Royal Society Medicine and Hygiene, Feb. 16, 1922.

The well is 600 ft. deep and has an 8-in. casing. The water before treatment contains much iron in the ferrous state (see table herewith) and has a temperature of 95° F. The country is flat. The aerator, filter, distributing mains and hand pumps are thus described in the *Abstracts:*

At the well the part of the casing extending above ground is perforated, the water flowing onto two trays having baffle boards and stones to aerate the water. The water then flows down a shoot having baffle boards on the staggered plan containing stones, to further break up and aerate the water. From the shoot, the water flows onto a flat concrete table with ½-in. holes; then to a layer of stones, gravel and fine sand underneath which removes the precipitated iron; then to a concrete and iron storage tank; then to 6-in. mains tothe village. The water is pumped from the mains by hand pumps on concrete slabs, the pumps being tied onto the mains direct and placed at suitable points in the village. To avoid pitting of the iron pipes, the whole of the 6-in. mains were lined with bitumen. It is necessary to clean the sand filters every three months, this being done by reversing the flow by special pipe arrangement.

WATER AT NABACLIS BEFORE AND AFTER TREATMENT

Government analyses on Dec. 9, 1921. Parts per 100,000 except last two items

	Water flowing From Casing	Water Aerated and Filtered as Delivered From Main
Iron	56	Nil.
Calcium	55	1.09
Magnesium	.56	.78
Sodium with traces of potassium	2 67	1.51
Chlorine	1 84	1.84
Sulphate ion	.06	trace
Nitrous ion...........	007	.003
Silicate ion	.95	1.27
Carbonate ion	3.96	2.61
	11.157	9.103
Oxygen absorbed from acid potassium permanganate at 82 deg. F.		
In 3 minutes	.08	Nil
In 4 hours	15	.25
Free Ammonia......	less than .001	less than .001
Albuminoid ammonia	less than .001	less than .001
Nitrogen in nitrites	002	001
Dissolved oxygen, per cent of possible	58 2	87 4
Relative proportion of free carbonic acid in solution	100	33

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Modern Tunneling Enlarged

MODERN TUNNELING. By David W. Brunton and John A. Davis. New Chapters on Railroad Tunneling by J. Vipond Davies. Second Edition, Revised and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall. Cloth; 6 x 9 in.; pp. 612; illustrated. $6.50 (39s net).

In this re-edition of a work first published at the beginning of the war, virtually two books are offered to the reader, the original treatise on mine and water-supply tunnels by Brunton and Davis and a book of 150 pages on other types of tunnel by J. Vipond Davies. Mr. Davies' competence for the task of dealing with this subject, including compressed air and shield work, is so thoroughly known that it gives the reader full guarantee for the character of the information offered to him here.

The new section is placed under the broad title "Railroad Tunnels," but it is much more comprehensive than its title, as it deals with all kinds of tunnel other than mining and water-supply tunnels. This is a field broad enough to claim the space of a large treatise, and, as it is compressed into 150 pages, the author necessarily proceeds with extreme brevity and condensation. The matter on general considerations: location, type of work, lining, and other features of design, is therefore not very detailed, but it is sufficient to give the reader a satisfactory general posting on the preliminary decisions to be made in undertaking a tunnel.

Under the heading "Construction" a marked simplification of discussion is achieved by eliminating all the so-called European systems of tunneling. The author, in fact, implies that they have lost their former importance rather completely: "The far simpler American system has been thoroughly proved in rock and in soft ground tunnels for many years, under nearly every kind of condition with complete success, and any engineer who is thoroughly conversant with the basic principles and with the possible modifications of this system has enough theoretical knowledge, at least, for this phase of any tunnel problem—other than shield driven—that may be presented." This conclusion permits of confining the treatment to the types of tunnel construction familiar in American practice, which constitutes one of the essential differences between the present work and Drinker's early treatise, for example.

The detail treatment then is worked out on the basis of making the book one of general posting and information as to methods and reasons for choice between different methods rather than a working handbook presenting data of various kinds, although the author includes many numerical data, in the aggregate. The author deals first with surveys and plant—properly giving special consideration to loading and hauling provisions—and then goes in detail into the excavation methods applicable to a hard-rock tunnel. Heading and bench arrangement, drill-hole layout, and the like are carefully summarized. Following a chapter on loose rock and soft ground tunnels, in which arch-set and related timbering forms are covered, subaqueous tunnels are taken up. Shield tunneling is here discussed in a most illuminating and clear way, though details such as shield design are not entered into. In conclusion, the caisson, cofferdam, and trench systems of tunnel construction are briefly treated.

In the book as a whole the reader has before him a full and modern compilation of information on tunneling procedure. Tunneling literature has been scant and unsatisfactory for many years, and foreign books have failed to meet the needs of the American constructor. In the present enlarged work a handy compendium of the general outlines of procedure is available that should fit working needs very closely.

An American Who's Who Among Engineers

WHO'S WHO IN ENGINEERING. A Biographical Dictionary of Contemporaries, 1922-1923. By John William Leonard. Brooklyn Borough, New York City: John W. Leonard Corporation. Cloth; 6 x 10 in.; pp. 1509. $10.

Members of the engineering profession, employers of engineers, the technical and daily press and many others as well have reason to be thankful for the publication of this engineer's Who's Who.

It contains sketches of 10,494 engineers along somewhat the same line as the well-known general Who's Who published in this and other countries, but with detailed extensions along professional lines that would not be feasible in a general Who's Who. An improvement in the arrangement of this compared with the general Who's Who is the giving of the name, business and residential addresses in a separate paragraph at the head of the sketch. The volume contains a geographical index of names.

Some of the professional records are quite detailed; others are much condensed. The variations evidently accord in many instances with the facts while in others they presumably reflect the human equations of the subjects of the sketches. Taking into account the uses to which the volume will doubtless be put, the details are as a rule well justified. They should be regarded as statements of fact rather than exhibitions of personal vanity. Considerable abridgements, by more use of summaries, may be required here and there as the volume grows in the number of engineers represented.

That this Who's Who will grow by the addition of many names seems beyond doubt, for it takes only a brief examination of the book to show that numbers of our leading engineers are conspicuous by their absence. Responsibility for this—we conclude from the Introduction and from our own inquiries and deductions—is due far less to the publisher than to the omitted engineers themselves, who through false modesty, oversight, neglect, or suspicion failed to supply the information they were asked to give.

That there should have been mistrust as to the motive of the publisher is not surprising in view of the fact that this is the first American "Who's Who in Engineering" and that there have been many ventures in the Who's Who and similar lines that were mere catch penny or catch sucker affairs. The ear mark of such ventures is a more or less veiled, or wholly barefaced intimation that the inclusion of your sketch depends

upon the purchase of one or more copies of the volume in which it is to be included. Contrariwise, the ear mark of the *bona fide* Who's Who is assurance, with the questionnaire, that filling in the latter does not in any way obligate the subject of the sketch. Such an assurance was given in connection with the present volume.

The publisher announces that the work will appear biennially, so in due time there will be an opportunity for those whose names really should be found in this useful work to ensure their appearance in the issue scheduled for May, 1924.

A Compendium of Highway Progress

HIGHWAYS GREEN BOOK (Third Annual Edition, 1922). Edited by M. O. Eldridge, Director of Roads, A. A. A. Good Roads Board, and published by the American Automobile Association, Washington, D. C. Cloth; 6 x 9 in.; pp. 429, illustrated. $3—$2 to A. A. A. members.

So rapid are the changes which are taking place in the field of American highway development that a summing up of each year's progress is needed to enable engineers and others concerned with good roads to orient themselves with respect to the new conditions. For several years, through the medium of its Highways Green Book, the Good Roads Board of the American Automobile Association has been performing this service. For those familiar with the publication it is enough to say that the third annual edition for 1922, just published, maintains the high standard of previous editions, follows the general arrangement of material formerly employed and brings the information up to date. Forming a compendium of the outstanding road-building activities of the year 1921, the volume contains a fund of interesting and informative data not only for highway engineer and contractor but for public speaker, legislator, journalist, manufacturer, motorist and citizen at large.

The book of 429 pages is divided into three parts, the first dealing with road improvement under federal, state and local control; the second with highway construction and maintenance; and the third with miscellaneous information, including such subjects as highway financing and taxation, automobile registration in 1921, highway research and transport economics. The chapters on all of the topics which are not essentially of a statistical nature have been prepared by selected specialists. The general situation on present and future prospects are summed up by Senator Charles E. Townsend, Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads and Charles M. Babcock, president of the American Association of State Highway Officials. The Federal Highway Act of 1921, creating an interstate system of highways, is reproduced in full and is followed by a detailed statement for each of the 48 states covering highway management and financing, together with a summary of local road and bond legislation. This portion of the book is exceedingly useful for reference purposes.

In Part II the chapters relating to the several standard types of highway construction appearing in former editions have been revised or entirely rewritten to bring the information up to date. This year the chapters on earth and macadam roads have been omitted and attention has been centered on the more durable types, beginning with sand-clay and gravel roads and ending with granite block.

Much new material is contained in Part III, "Miscellaneous." The increased interest in road transport economics is reflected in a number of articles on highway research, load restrictions, tractive resistance and similar topics. Of particular interest is the section on highway financing and taxation which lists, by states, the source and approximate amount of state highway funds available, exclusive of federal and county funds, and also a tabulation of state and county highway bond issues from Jan. 1, 1919, to Dec. 31, 1921.

In presenting a comprehensive picture of today's highway activities and in supplying a fund of valuable reference data, particularly on legislation, finances, design, and construction, the Green Book renders a real service. A nice discrimination has been exercised in the selection of material and in the manner of its presentation with the result that the volume makes interesting reading, covering the outstanding subjects adequately yet without getting into the detail which would make the text tedious except to the specialist. Produced under the editorship of M. O. Eldridge, director of roads for the A. A. A. and for many years on the engineering staff of the U. S. Bureau of Public Roads, the book testifies to a full understanding on the part of its maker of the economic, financial and engineering problems that today enter into the construction of highways.

Industrial and Social Problems

HUMAN FACTORS IN INDUSTRY: A Study of Group Organization—By Harry Tipper. New York: Ronald Press Co. Cloth; 5 x 8 in.; pp. 280. $2.

To the man not fond of abstract ideas but keen for light on the fundamentals of the industrial and social problems of the day this book will be helpful. "It is hoped," says the author in his preface, that the book "will present to the busy man and the student of industrial affairs a sufficiently complete and concise analysis of the difficulties which must be met and the outlook in meeting them." This hope has been fulfilled.

Mr. Tipper aims, he tells us, to confine himself to "the practical development of industry in the more or less immediate future." This does not preclude sketching the rise of the labor unions and analyzing the idea out of which they have grown. He relates our social and economic problems to the complications of modern life that have grown out of our rapid scientific and industrial progress. He points out the folly of any scheme of industrial organization based upon the assumption of a continuous state of warfare between two or more of the producing groups and presents in detail some of the plans that have been devised and are being tried to establish greater community of interest. In his final chapter, The Outlook, Mr. Tipper declares that the problems now before industry call for a new brand of leadership. The next generation, he believes, will determine by the intelligence of its leadership, whether the development of our industrial structure will be directed by the collectivists or whether a way out will be found that will conform to the requirements of individual human growth.

Further indication of the scope of Mr. Tipper's book is contained in some of the chapter-titles. One deals with Manufacturers' Organizations, another with Collective Bargaining, and a third with Experiments with Employee Representation. The use of labor-union machinery as a means for procuring industrial harmony and the open shop are discussed in still other chapters. These few subjects, selected at random, will suggest how concretely the author has presented his subject.

Accounting for Contractors

PRACTICAL ACCOUNTING FOR GENERAL CONTRACTORS—By H. D. Grant, Staff of W. B. Richards & Co., Accountants and Engineers, etc. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. [illegible]. $[illegible]

Accounting for contractors has generally been discussed in books and articles with the purpose of presenting simple methods which the contractor could himself learn and apply. In this volume the author has assumed that accounting in construction operations is no more a task for the works manager and executive than it is in any other business but is one to be performed by accountants. The book is, therefore, written for the accountant. It is not abstruse or super-technical but it assumes familiarity with book-keeping terms and processes. The author claims that the book presents certain methods of recording construction operations not previously formulated into a complete system.

Divided into three parts, the book first discusses accounting as related to types of contracts; purchases; recording income and expenses, and rendering financial statements in such number and of such character that the executive management may know at all times exactly the financial conditions and prospects of the business. Field accounting is covered in the second part. This is the part which the works manager will perhaps appreciate most and understand best since it deals with expense classifications, costs, and reports to the owner. The third considers payroll problems, control of equipment, preparation of estimates and bids, municipal contracts and the legal aspects of contracts. An appendix gives drafts of several forms of contracts.

Organizations, diagrams, sample pages of accounts, report and order blanks and item schedules, illustrate the text. There is a satisfactory index.

Purchasing

THE SCIENCE OF PURCHASING—By Helen Hysell. With an Introduction by J. George Frederick, Author of "Modern Sales-management." New York: D. Appleton & Co. Cloth; [illegible] x 8 in.; illustrated. $2.50.

So much has been written on the strategy and tactics of the commercial offensive, that is to say, the science and art of salesmanship, that one picks up this book with the feeling that here at last he is to have revealed to him something of the strategy and tactics of defense. He will not be disappointed. It will be found in the chapter entitled: "Attitude Towards Sales Solicitation." The book, however, contains much more than this. It is an effort to formulate the science of purchasing and takes into account every phase of that work. Development of principles and policies, the study of future trends and forecasts, the records and systems of the organized purchasing department and the ethics of modern business all find a place. The engineer in general will be interested in this application of scientific principles to still another department of business. If, as part of his work, he must conduct large-scale purchasing operations he will find the book helpful and suggestive.

British Building Operations

BUILDING CONTRACTS: The Principles and Practice of Their Administration—By Edwin J. Evans. Foreword by Sir Charles T. Ruthen, O.B.E., F.R.I.B.A., H.M. Director-General of Housing, and President of the Society of Architects. [The Directly-Useful (D. U.) Technical Series.] New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. [illegible]

Building in England is different enough in most of its trade practices from building in America to lend interest to this manual for British builders. In addition the author has a gossipy, readable style with a homely attraction, particularly suitable as a manner of addressing the building trades contractor and foreman. Its detail is the especial claim of the book to usefulness. It takes up the various building operations in order, first the direction of construction, then office management, and finally book-keeping, and goes into every minute detail to be observed and every possible trouble to be anticipated and guarded against. Most of the items considered enter into building practice everywhere, so the advice and the suggestions offered will assist the American building contractor as much as his British brother in business. The American builder will not find in the book specific practices which he can apply in his own operations but he can draw from it a wealth of practical advice on the management of a building construction business.

New Edition of Wegmann's Dams

THE DESIGN AND CONSTRUCTION OF DAMS: Including Masonry, Earth, Rock-Fill Timber, and Steel Structures; also The Principal Types of Movable Dams—By Edward Wegmann, C.E., M. Am. Soc. C. E., M. Am. Water-Works Assoc. Seventh Edition, Revised and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth, 9 x 12; illustrated; pp. 555. $10 (50s. net).

Wegmann's "Dams" is too well known to require an extended notice of this new edition. In so far as gravity section masonry dams go its theory is complete and satisfactory, though in the newer types of dam there is much left to be desired. Its strong point, however, is the record of existing structures, for, with all the progress in design, dam building continues to be somewhat empiric. The new edition differs from the old mainly in additional chapters on crest gates and siphon spillways and some description of later structures, but the revision has been something less than thorough.

For instance, both in the preface and in a table the Camarasa Dam in Spain is given as the "highest masonry dam in the world," while on another page the given dimensions of Arrowrock Dam show that structure to be higher. Both Arrowrock and Elephant Butte dams, described in the body of the volume, are omitted from the table of high masonry dams. Standley Lake dam, built in 1911, is described; its slips, both in 1914 and in 1916, matters of much greater importance to engineers than its design, are not mentioned at all. Nor is anything said about the Austin, Penn., and Stoney Creek failures, both most important to any one studying dam design.

These examples, which might be added to, are mentioned merely because the book is offered as a revision. What is old is still good but what is new does not seem to be complete.

Port Series Continued

THE PORT OF BOSTON, MASSACHUSETTS—[Port Series No. 2.] Prepared by the Board of Engineers for Rivers and Harbors, War Department, in co-operation with the Bureau of Research, United States Shipping Board. Washington, D. C. Paper; 6 x 9 in.; pp. 161; folding maps and tables.

The War Department and the Shipping Board are co-operating, through their engineers, in the complete study of the major ports of the country and as a part of the work are issuing descriptions and statistics of some 35 ports. The volume on Portland, Me., was published some months ago and now comes Boston. Nothing of interest in connection with the port is omitted. As records these books are invaluable.

Grain and Other Dust Explosions

DUST EXPLOSIONS: Theory and Nature of Phenomena, Causes and Methods of Prevention. By David J. Price, Engineer in Charge, Dust Explosion Investigations, Bureau of Chemistry, United States Department of Agriculture, M.N.F.P.A., and Harold H. Brown, Ph.D., Organic and Physical Chemist [as above], M.N.F.P.A., Assisted by Hylton R. Brown and Harry E. Roethe, Assistant Engineers in Dust Explosions [as above]. Published by Permission of the United States Department of Agriculture. Boston, Mass.: National Fire Protection Association. Cloth; 6 x 9 in.; pp. 246; 43 half-tones and line cuts. $3.

Grain elevator explosions are common enough to fix the dangerous inflammability and explosibility of grain dust in the mind of every designer and operator of such plants. It is not so well known that all manner of dust is subject to the same hazard and that any process that confines dust, of whatever sort, is a danger. This book, which bears every evidence of being the most elaborate study of the subject ever made, lists explosions in flour mills, grain elevators, feed and cereal mills, starch factories, rice factories, breweries (malt dust), and sugar mills as major instances, with aluminum, celluloid, cork, cocoa, cotton, fertilizer, powdered milk, phonograph records, rubber, shoddy, soap, spice, sulphur, seeds, etc., as further sources of danger.

The book describes the nature and theory of dust explosions, records the industries producing dust, explains the causes of explosions and finally details methods of design and operation whereby explosions may be avoided. It is a useful and authoritative work.

Engineering Publicity

PUBLICITY METHODS FOR ENGINEERS: A Manual for Men Engaged in Public Information Work—Proceedings of the First National Conference on Public Information Held Under the Auspices of the American Association of Engineers, 63 East Adams St., Chicago. Cloth; 5 x 8 in.; pp. 186; illustrated. $1.50.

Here are summarized the principles that govern the presentation to the public of information concerning the activities of engineers, together with examples. Among the contributors are Ivy L. Lee, advisor in public relations to the Pennsylvania Railroad; Richard H. Waldo, publisher, Hearst's International; J. G. D. Mack, state chief engineer of Wisconsin; F. H. Newell, the first director of the U. S. Reclamation Service; F. M. Feiker, vice-president, McGraw-Hill Co.; Alexander Black, editor, King Features Service, and others.

Bridge Souvenir Edition of Newspaper

The dedication of the new reinforced-concrete bridge across the Connecticut River at Springfield, Mass., has been made the occasion for a notable bridge souvenir edition of the Springfield *Republican*, dated Sunday, July 30. A number of supplements are devoted wholly or in part to the bridge, other notable bridges on the Connecticut and elsewhere, navigation on the river, and various historical and biographical articles relating to Springfield and the Connecticut valley. Numerous illustrations of the Hampden County Memorial Bridge, as the new structure at Springfield is officially named, and of other bridges and structures, as well as of the engineers and contractors, bridge commissioners, etc., add interest and value to the memorial bridge number. The front page of one of the supplements is devoted to poems suited to the occasion, written in a competition for prizes offered by the *Republican*. A feature of the souvenir number is a reprint of the sermon delivered in 1805 at the dedication of the old toll bridge which the new concrete bridge supersedes. The engineers for the new bridge were Fay, Spofford & Thorndike and the contractor was H. P. Converse & Co., all of Boston.

Data on Winds High Above Ground

A vast mass of data of atmospheric observation from kites is brought together in "Aerological Survey of the United States," part 1, just issued by the United States Weather Bureau. Like many other products of that office it contains some engineering data in its large amount of material, but these few data are not collated or digested in such a way that the engineer can make direct use of them. The observations recorded were made at eight points, from Broken Arrow, Okla., to Blue Hill, Mass. They cover temperature, humidity, barometric pressure, wind direction and velocity, etc., at elevations ranging up about three miles above sea level.

The wind data are important to the engineer, who has lately come to be concerned in the increase of wind pressure at some height above the surface. These data are brought together in a few diagrams expressing the variation of velocity and direction with height, at six stations (Fig. 17), and in two tables grouped on the last page of the publication (Tables 20 and 21), giving the average percentage frequency of wind velocities exceeding 10 meters per second and 20 meters per second, and maximum free-air wind velocities. Considering the great variability of wind phenomena, the information afforded by these diagrams and tables can hardly be regarded as complete, but it does form an important contribution to knowledge on the question of wind pressure variations. The tables indicate that in ordinary winds the pressure at ground level is considerably lower than that at some height, there being a maximum, apparently, between ½ and 1½ miles above ground. The most important question for engineers, whether the extreme velocities at upper levels are greater than the extreme velocities at the ground, is left unsettled.

Veteran Editor Retires

After 20 years of labor as editor of the widely known reinforced concrete journal, *Beton und Eisen*, which he founded, Dr. F. von Emperger has retired from active leadership of the paper with the issue of June 16. His work will be taken up by Dr. A. Kleinlogel, who will, however, continue to have the consulting assistance of his predecessor. With this change the eidtorial offices will be transferred from Vienna to Darmstadt; the business management remains in the hands of the original publishers, Wilhelm Ernst & Sohn, Berlin.

New Japanese Society Publications

The National Research Council of Japan (care of Department of Education, Tokio, Japan) has begun the publication of *Proceedings* and of a *Japanese Journal of Astronomy and Geophysics*. The latter includes Transactions and abstracts, the abstracts being devoted to papers published in Japan.

Italian Engineering Association Journal

Under the title *Ingegneria* the Associazione Nationale Ingegneri Italiani has started a journal. It is published at Milan, Italy, with Ulrico Hoepli as editor. The American agent is G. E. Stechert & Co., 151 West 25th St., New York City.

Publications Received

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS: Proceedings, 1922—Saint Petersburg, Fla.: C. C. Brown, Secretary. Cloth, 6 x 9 in.; pp. 648. Illustrated.

ARKANSAS RIVER FLOOD OF JUNE 3-5, [illegible]—By Robert Follansbee and Edward E. Jones. Water Supply Paper 487. Washington, D. C.: U. S. Geological Survey. Paper, 6 x 9 in., pp. 11; 1 folding map, 1 diagram, [illegible] halftones. No free copies left. 10c from Superintendent of Documents, Washington, D. C.

CAST-IRON PIPE—Fourteen Census of the United States, Manufactures, 1919. Prepared under the Supervision of Eugene F Hartley, Chief Statistician for Manufactures. Washington, D. C.: Bureau of the Census. Paper: 9 x 12 in.; pp. 8.

CHINESE GOVERNMENT RAILWAYS: Statistics for 1920—Peking: Ministry of Communications. Paper; 10 x 13 in.; pp. 50; diagrams and folding map.

COAL—Fourteenth Census of the United States, Mines and Quarries: 1919. By Frank J. Katz, Expert Special Agent for Mines and Quarries. Washington, D. C.: Bureau of the Census. Paper, 9 x 12 in., pp. 53; 1 map and 2 diagrams in text.

COMPRESSED-AIR ILLNESS AND ITS ENGINEERING IMPORTANCE. With a Report of Cases at the East River Tunnels—By Edward Levy. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 48; one copy free; 10c from Superintendent of Documents, Washington, D. C.

CURRENT METERS FOR USE IN RIVER GAGING—By M. A. Hogan, Ph. D., D.I.C. Prepared for the Committee on Gauging Rivers and Tidal Currents, Department of Scientific and Industrial Research. London: H. M. Stationery Office. Paper; 6 x 10 in.; pp. 33; 7 figures in the text and 3 halftones on plates. Postpaid, 1s. 7½d. net.

Prepared under the direction of a committee that includes in its membership Sir Maurice Fitzmaurice and Prof. W. C. Unwin, the author being technical officer to the committee. Summarizes "information available" on "design and use of current meters" and describes "types now in use." Both the text and the selected bibliography (48 entries) contain numerous references to American practice and literature.

DER KREISTRÄGER—By Georg Unold, Chemnitz. Berlin: Vereines Ingenieure. Paper; 8 x 11 in.; pp. 79.

DIE STATIK DES KRANBAUES: Mit Berüchsichtigung der Verwandten Gebiete Eisenhoch-Forder-und Bruckenbau—Von W. Ludwig Andrée. Dritte Auflage. Munich and Berlin: R. Oldenbourg. Paper; 7 x 10 in.; pp. 370; 554 illustrations. 348 marks in paper; 390 in cloth.

Considerably enlarged from first edition which was noted in *Engineering News*, Jan. 14, 1909, p. 4 of Engineering Literature Supplement.

DURABILITY OF CEMENT DRAIN TILE AND CONCRETE IN SOILS: THIRD PROGRESS REPORT (1919-20)—By G. M. Williams, Associate Engineer, Bureau of Standards, in Co-operation with R. J. Wig, Consulting Engineer; S. H. McCrory, Chief of Drainage Investigations, Department of Agriculture; E. C. Bebb, Engineer, U. S. Reclamation Service; L. R. Ferguson, Consulting Engineer; C. J. MacKenzie, Engineering Institute of Canada; D. A. Abrams, Engineer, Portland Cement Association; G. E. Warren, Manager, American Concrete Pipe Association. Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 29; illustrated. 10c from Superintendent of Documents.

Results of inspection in 1919 and 1920 of experimental drain tile and concrete block installations in eight alkali-bearing projects in the West.

FIRE TESTS OF BUILDING COLUMNS—Boston, Mass.: Inspection Department of the Associated Factory Mutual Fire Companies. Paper, 5 x 7 in., pp. [illegible], illustrated.

A digest, with interpretative comment, of 106 tests made in 1917-19 by the company named above, the National Board of Fire Underwriters, and the Bureau of Standards. Two illustrated articles summarizing the tests, written by R. E. Wilson, engineer of the company named in the above heading, appeared in *Engineering News-Record*, July 21 and 28, 1921, pp. 106 and 145.

FORMS, RECORDS AND REPORTS IN PERSONNEL ADMINISTRATION—Edited by C. N. Hitchcock. Chicago, Ill.: University of Chicago Press. Paper; 6 x 9 in.; pp. 128. Postpaid, $1.79.

HIGHWAY ENGINEERING AND HIGHWAY TRANSPORT—Proceedings of a Regional Conference Held at the Agricultural and Mechanical College of Texas, in co-operation with the Highway and Highway Transport Education Committee, United States Bureau of Education, Feb. 6 and 7, 1922. Edited by J. C. Nagle, Dean of Engineering. College Station, Tex.: Texas Engineering Experiment Station. [illegible]

HYDRAULICS—By Horace W. King, Professor of Hydraulic Engineering, University of Michigan, and Chester O. Wisler, Associate Professor of Hydraulic Engineering, University of Michigan. New York: John Wiley & Sons, Inc. London Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 237; illustrated $2.75. 13⅔s. net.

HYDRAULICS WITH WORKING TABLES—By E. S. Bellasis, M. Inst. C. E. Third Edition. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 315. $8.

A belated "American Market" offering of this British work, as revised in 1920 (see extended favorable review by Robert E. Horton in these columns for Jan. 20, 1921, and for lengthy review of the first edition, by the late George W. Rafter, see *Engineering News*, Aug. 20, 1903.

IRON ORE: Summary of Information as to the Present and Prospective Iron-Ore Supplies of the World. London: H. M. Stationery Office. Boards; 6 x 10 in. Part 3, British-America, pp. 115. 3s. 9½d. Part 4, British Asia, pp. 65. 2s. 8½d. Part 5, Australia and New Zealand, pp. 106. 4⅓s.

LECTURES ON ENGINEERING PRACTICE, 1921-22—Edited by John B. Whitehead, Dean of the Faculty of Engineering. Baltimore, Md.: John Hopkins Press. Paper; 6 x 9 in.; pp. 148. $1.

Four lectures, "one each in the general subjects of chemical, civil, electrical and mechanical engineering." The one under civil engineering is, "Construction of the Catskill Water Suply for the City of New York, from an Engineering Standpoint," by J. Waldo Smith, chief engineer, Board of Water Supply, New York City.

MATERIALS OF CONSTRUCTION—Prepared for the Extension Division of the University of Wisconsin by H. E. Pulver, B.S., C.E., Associate Professor of Civil and Structural Engineering, The University of Wisconsin. [Engineering Education Series.] New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 318; illustrated. $3.

MECHANIK—By Fritz Rabbow, Dr. Ing., Hannover. Berlin: Julius Springer. Boards; 6 x 10 in.; pp. 203; 237 text figures.

MUNICIPAL SANITARY PRECAUTIONS DURING EPIDEMICS OF INFLUENZA: Rambling Thoughts of a Civil Engineer—By Dr. Willim Paul Gerhard, C.E., Consulting Engineer, 17 W 42nd St., New York City. Reprinted from *Municipal and County Engineering*, April and May, 1922. Published by the Author. Paper; 6 x 9 in.; pp. 8. 30c.

NAVIGATION INTÉRIEURE CANAUX Cours Professé à L'École Nationale des Ponts et Chaussées. Par O. Jacquinot, Inspecteur Général des Ponts et Chaussées. [Encyclopédio du Genie Civil et des Travaux Publics] Paris: J. B. Bailliere. Paper; 6 x 9 in.; pp. 600; 244 illustrations. 45 fr. in paper.

Complete exposition of European, mainly French, practice in design and construction of canals and their appurtenances. Well illustrated by drawings of actual structures and installations. Includes studies of dams, locks, gates, etc., as well as the hydraulics of canalization.

NEW BUILDING ESTIMATORS' HANDBOOK, 1922—A Handbook for Architects, Builders, Contractors, Appraisers, Engineers, Superintendents and Draftsmen. By William Arthur, Author of "Estimating Building Costs," "Home Builder's Guide," "Contractors' and Builders' Handbook," etc. New York: U.P.C. Book Company, Inc. Cloth; 5 x 7 in.; pp. 1002; illustrated. $6.

Twelfth edition of a well known and much appreciated handbook first published in 1904 as a volume of 150 pages. Earlier editions were noted in these columns Aug. 18, 1904, April 15, 1909, and June 16, 1910.

PROCEDURE FOR SECURING STATE APPROVAL of Formation of Irrigation Districts, Issuance of Bonds by Irrigation Districts, Expenditure of Construction Funds by Irrigation Districts, Construction of Dams, Before State Department of Public Works, Division of Engineering and Irrigation, and California Bond Certification Commission. Sacramento: State Department of Public Works. Paper; 6 x 9 in.; pp. 14.

PROPOSED NEW WATER SUPPLY FOR HOBART, TASMANIA—Report by Herbert E. Bellamy, M.Am.Soc.C.E., City Engineer of Hobart. Paper; 9 x 13 in.; pp. 20; illustrated.

Recommends gravity supply from Lake Fenton, in National Park, through 54-mile steel pipe line, of which 40 miles would be of 27- and 14 miles would be 24-in. diameter. Total estimated cost, £660,000, including £500,000 for pipe line, £25,000 for balancing reservoirs and £86,100, a 15 per cent allowance, for engineering, etc.

RETAIL PRICES, 1913 to December, 1920—Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 217.

SURFACE WATERS OF KANSAS, 1895-1919—[Prepared by Roger C. Rice, District Engineer, United States Geological Survey, under a co-operative agreement between Kansas Water Commission and the Survey]. Topeka, Kan.: Kansas Water Commission. Paper; 6 x 9 in.; pp. 463.

Gives available stream flow data for period named, mostly as gauge heights, but includes many discharge figures.

THE THEORY OF GENERAL RELATIVITY AND GRAVITATION—Based on a Course of Lectures Delivered at the Conference on Recent Advances in Physics held at the University of Toronto in January, 1921. By Ludwik Silberstein, Ph.D New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 137. $2 net.

Assumes familiarity with "the essentials of Einstein's older or special relativity" or recourse to the author's "Theory of Relativity" (Macmillan, 1914). Special care has been taken in one of the chapters "to give readers a systematic exposition of the calculus of generally covariant beings called Tensors." The author feels that regardless of the fate of "Einstein's admirable theory" the time applied by readers of this book to "the Tensor Calculus and acquiring some skill in handling it will be well spent."

TRADE STANDARDS IN THE PUMP INDUSTRY—Recommended by the Hydraulic Society, 1922. Second Edition. (Prepared by C. H. Rohroach, Secretary, 50 Church St., New York City.) Paper; 6 x 9 in.; pp. 21.

Additional tables and explanatory data are given in this edition. Contains names and addresses of 28 pump manufacturers composing the Hydraulic Society, located in ten states from Massachusetts to California.

ZONING FOR CITIES AND TOWNS—By R[illegible] S. W[illegible] [illegible] Ames, Iowa: [illegible] Extension Department, Iowa State College. Paper; 6 x 9 in.; pp. 15.

[illegible] of zoning principles and practice

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Heavy Rainfall in Southern Alberta, Canada

Sir—The following account of what appears to the writer to be a record in concentrated rainfall may be of interest to your readers.

On July 7 a severe storm broke over a limited area in southern Alberta. It covered a strip of country about two miles in width and seven miles long lying five miles west of Nobleford, a small town on a branch of the Canadian Pacific Railway. Rain fell steadily for three hours with some lightning and much hail. A wagon box after the storm was found to have 16 in. of water in it, and a large slough with a surface area of about 1 sq.mi. and a catchment area of about 6 sq.mi., which was dry before the storm, was 3 ft. deep after the storm had passed. During the period of greatest intensity a competent witness estimated that the precipitation was at least 8 in. in 50 minutes, and that in one 20-minute interval at least 3 in. fell.

Surprisingly little damage was done by the storm. Uncompleted works of an irrigation district were damaged by flooding, and some crops were destroyed by the hail. But the damage by erosion appears to be little, owing, no doubt, to the small slope of the country.

H. B. Muckleston,
Chief Engineer,
Lethbridge Northern Irrigation District.
Lethbridge, Alta.

Questioning Abrasion Tests

Sir—In *Engineering News-Record*, March 16, 1922, there is an article under the caption "Abrasion Tests of Aggregates Disagree" which summarizes a series of investigations conducted recently by Prof. D. A. Abrams, of Lewis Institute.

In this article, Professor Abrams is quoted as stating that "It is difficult to draw any conclusions from these tests except to suggest a grave doubt as to whether any of the tests has any significance when applied to aggregates for concrete roads." The writer does not believe that Professor Abrams is warranted in drawing any such conclusions solely on the basis of these abrasion tests. In the first place, the so-called "Rea Method" was not designed for, and is never used for testing crushed stone aggregates. By this method, six cast iron shot are used as an abrasive charge entirely for the purpose of producing wear on the rounded gravel fragments. This method will, of course, give unusually high results when testing crushed stone aggregates, due to the excessive amount of wear on the angular fragments composing the test charge. Conversely, neither the "A.S.T.M. Method" nor the Mattimore modification of this method, were designed, nor are they ever used, for testing gravel. Professor Abrams has applied all of these tests indiscriminately to both types of aggregates and has found that the results disagree. Of course they disagree. One would hardly expect otherwise under the circumstances.

It is quite possible that the abrasion test when applied to concrete aggregates may not have the same significance as when it is used for the purpose of studying the suitability of stone for macadam road work. Experience in Illinois and other states where comparatively soft aggregates abound, would indicate that the percent of wear may be raised considerably above the limit which has previously been considered safe, without seriously affecting the quality of the resulting concrete and the writer believes that the orthodox interpretation of the results of "French Coefficient" tests may be questioned in the light of these service indications. He does not believe, however, that a blanket condemnation of the abrasion test is warranted simply because the results of tests made by various methods, some of which may not be applicable to the material under consideration, disagree.

F. H. Jackson.
Washington, D. C. Bureau of Public Roads.
May 26.

Permanent Bridges as a Menace

Sir—In your issue of June 29, pp. 1063 and 1064, you discuss bridge washouts and speak in favor of permanent bridge construction. In considering the relation between floods and bridges, however, the effect of permanent bridges in increasing the destructive possibilities of floods must be kept in mind, and may modify the conclusions you indicated.

Upstream from bridges there are frequently occupied areas, containing business and residential buildings. Water held back by a bridge is likely to flood such a district, causing great destruction. Exceptional floods, like that in the Sandusky Valley in Ohio in 1913, when the water rose more than 9 ft. above any previously recorded high-water mark, may convert a permanent bridge into a temporary dam, increasing the loss of property and of life in the surrounding territory. The loss may far outweigh the value of the bridge, and it may therefore be better to have a bridge go out than to have it withstand the flood.

Concrete bridges are particularly liable to become a menace, on account of their stability. Such bridges are comparatively new creations, while the adjoining territory is old and in many instances has been occupied for a long time under conditions not easily changed or modified.

New York, July 6. H. F. Dunham,
Consulting Engineer.

More Trouble with Metric Compensation

Sir—Referring to the article "How to Figure Grade Compensation for Metric Curves," *Engineering News-Record*, July 27, 1922, p. 141, Mr. Conard is not the only one who has trouble with this problem. Even so great an authority as the late A. M. Wellington became confused in comparing his line, "The American Line from Vera Cruz to the City of Mexico, via Jalapa," (see *Transactions, Am. Soc. C. E.*, Vol. XV, p. 791) with that of the Mexican Ry., and, regarding their respective grades, says: "Continuous 2 per cent (uncompensated) against a broken 4 per cent (uncompensated), including the effect of curvature or of compensation therefor, 2.6 per cent against 6 per cent."

Quoting, with minor changes, from my paper, "A Review of the report of Captain Talcott, chief engineer, Mexico & Pacific R.R.," *Transactions, Am. Soc. C. E.*, Vol. LXXX, p. 1624 (1916), "It is hard to understand what method of computation was used in arriving at the comparative rates of grades, after allowing for compensation. Wellington allowed for his line (3-ft. gage), in which 20 deg. curves occurred, a rate of 0.03 ft. per degree, which would give 0.6 ft. or an equivalent 2.6 per cent grade. For the Mexican Railway (4 ft. 8½ in.) he assumed a rate of 0.11 ft. per degree, which for 18 deg. curves, would give 2.0 ft. or an equivalent 6.0 per cent grade, certainly a most extraordinary method of calculation. With the same rate of curve compensation, the equivalent grade would have been on the Mexican Railway, 4.5 per cent."

It is to be regretted that this misstatement has never been corrected in Wellington's "Railway Location."

Emile Low.
Buffalo, N. Y., July 31.

Courses in Fisheries Engineering

The Department of Biology and Public Health of the Massachusetts Institute of Technology announces in a circular just issued that under Industrial Biology it now offers courses in "the relatively new field of fisheries engineering in which we have begun to train specialists."

NEWS OF THE WEEK

New York, August 17, 1922

Flood Control Subject of Texas Conference

Governor Calls Meeting at Which Committees Are Appointed to Formulate Program

Responding to Governor Neff's call, approximately 150 civil engineers from Texas and neighboring states met in conference at Austin, Texas, August 7 to work out a program for conservation of flood waters of Texas and the reclamation of overflow lands that will take into consideration every drainage area within the state. For the past few years much damage has been suffered throughout the state, overflowing rivers last spring destroying approximately $20,000,000 worth of Texas crops.

Before the conference began its business session addresses were made by Dr. Samuel Fortier, U. S. Department of Agriculture; N. C. Grover, chief hydraulic engineer, U. S. Geological Survey; Major B. B. Brown, assistant district U. S. Engineer, Galveston; Col. Glenn S. Smith, acting director, topographic division, U. S. Geological Survey, and Major W. N. Vance, Eighth Corps Area, Fort Sam Houston.

Advisory Committee Appointed

On motion of John C. Norris, chairman of the State Board of Water Engineers, Governor Neff appointed an advisory committee consisting of Dean T. U. Taylor, University of Texas, chairman; Major John B. Hawley, Ft. Worth; C. T. Bartlett, San Antonio; E. E. Sands, Houston; Fred A. Jones, J. C. Nagle and E. N. Noyes, Dallas; W. F. Shaw, Mercedes; F. A. Merritt, Galveston; Vernon L. Sullivan, El Paso; E. H. Sellards, Texas Bureau of Economic Geology; R. A. Thompson, Wichita Falls; and W. B. Tuttle, San Antonio.

A resolutions committee, consisting of Major John B. Hawley, Ft. Worth, Alfred Tamm, Harlingen, and E. B. Cushing, of Ranger, submitted a resolution recommending the mobilization of all engineering talent to develop data essential to the effective control of flood and surface waters, for reclamation, irrigation or for other beneficial uses; and urging upon the Texas congressional delegation full use of its power in securing for that state adequate topographic surveys and maps, hydraulic determinations and data of similar character.

The resolution also included a request that the state legislature appropriate adequate funds for weather-bureau work, in collaboration with the U. S. Weather Bureau, and that ample appropriations be made for extending the activities of the State Reclamation Department and the State Board of Water Engineers in securing data upon which to plan and design works for the control and utilization of the flood waters of Texas rivers.

Another conference was scheduled to be held in Waco yesterday.

ENGINEERS IN TWO STATES MOVE FOR REPEAL OF LICENSING LAWS

Repeal of the New York State engineer licensing law is the purpose of a movement that has been started under the auspices of the New York Section of the American Institute of Mining Engineers. A committee of the section has been appointed to raise funds, to cooperate with other engineering societies, and otherwise to forward this object.

A similar movement is under way in Pennsylvania under the endorsement of the Engineering Society of Northeastern Pennsylvania and the Anthracite Section of the American Institute of Mining Engineers. A test case under the licensing law is now in the courts, and in the event that the law is upheld an effort will be made to effect its repeal at the next session of the legislature.

Am. Soc. C. E. Canvasses Second Ballot for Officers

The second ballot to determine the official nominees for offices in the Am. Soc. C. E. was canvassed on Aug. 15 with the following results: For president, Charles F. Loweth, 2,332; Andrew M. Hunt, 701; John F. Coleman, 320; For vice-president, Zone 2; George S. Davison, 478; Richard Khuen, Jr., 257; C. P. Fortney, 64; W. M. Gardner, 31; S. T. Wagner, 26; L. L. Hidinger, 5. For vice-president, Zone 3; Anson Marston, 579; Charles H. Paul, 284. For director, District 3; Glenn D. Holmes, 54; Charles A. Poole, 52; G. G. Honness, 36; Bruce L. Cushing, 27. For director, District 5; E. B. Whitman, 139; H. K. Bishop, 66. For director, District 7; George H. Fenkell, 276. For director, District 8; A. S. Baldwin, 205. For director, District 9; R. N. Begien, 133; J. M. Johnson, 33; Charles H. Paul, 27. For director, District 12; George C. Mason, 124; J. C. Ralston, 95; Eugene Carroll, 20.

Under the constitution, those receiving the highest number of votes for the several offices become the "Official Nominees." The list of these official nominees together with the results of the second ballot are to be mailed to the corporate members of the society not later than Oct. 1. As a result of the death of A. S. Baldwin, candidate of District 8, the selection of a nominee for that district devolves upon the Board of Direction of the Society.

Water-Works Men To Meet

The first of the 1922-23 meetings of the New York Section of the American Water Works Association will be held at Utica, N. Y., Sept. 30. Burt B. Hodgman, 50 Church St., New York City, is secretary of the section.

Effect of Recently-Enacted Pay Bill on Corps of Engineers

Washington Correspondence

According to the best information, in the reduction of the number of officers in the United States Army as provided for in the recently-enacted pay bill, the entire army will be considered as a single list and officers will be eliminated according to the decision of a board of general officers which is now in session. After eliminations have been made it may be found that certain arms of the service have more officers than their quotas and other branches less. It is understood that such inequalities will be adjusted by transfers and temporary details.

Under the Defense Act of June 4, 1920, the Corps of Engineers was authorized to have 602 officers, including a chief of engineers and an assistant chief, and, in addition, a number of officers commissioned in the Corps of Engineers but carried on the General Staff and on the detached officers' list. This additional number ranges from 75 to 100. Under the provisions of the recent pay bill the number of officers in any branch was set at 70 per cent of the number authorized in the Defense Act of 1920. This would give the Corps of Engineers 420 officers, but a provision of the bill allowed an increase or decrease of 30 per cent upon the direction of the President, the total number, however, not to exceed that authorized in the Defense Act. Were the Corps of Engineers allowed the increase, it would then have a personnel of 548, including a chief of engineers and an assistant but not including those holding commissions in the Corps but assigned to duty with the general staff and on the detached officers' list.

The number of officers now commissioned in the Corps is approximately 510. That number is considered insufficient to carry on the duties assigned to the Corps and permit the schooling and training of younger officers. A conservative estimate has been made that 600 officers are needed in the Corps of Engineers to carry on duties assigned to it, to officer fully various engineer units, and to furnish additional officers for the general staff and the detached officers' list. This number would not include the number of officers under training or on river and harbor work.

Laying Track on New Ontario Road

St. John Correspondence

The work of laying the rails on the Temiskaming & Northern Ontario Ry. from Cochrane to James Bay has been started. Grading is about finished, and steel is arriving. The track laying machine arrived recently. Last fall the first sod was turned on this new road, and before winter sets in it is expected that trains will be running as far north as the Abitibi River crossing. This line will open up virgin territory in the north, as far as the coast of James Bay.

I.C.C. Officials Hear Priority Order Dangers to Road Work

Due to the fact that the Interstate Commerce Commission's priority order does not affect open-top cars with sides less than 36 in. in height, and to the fact that there is a surplus of open-top cars in all parts of the country except the states of West Virginia, Virginia, Kentucky, Tennessee and Alabama, which contain the producing coal mines, no great amount of interference with the movement of road-building materials has resulted, except in the states mentioned. The principal danger in the situation, in so far as it concerns the highway program, is that the existing surplus of cars will quickly disappear once that the coal strike is settled. It is regarded as probable that the control of distribution will have to continue until the end of the calendar year and possibly until the end of the coal year on March 30.

In an effort to meet that situation, representatives of the state highway officials and officials of the Bureau of Public Roads have laid all facts of the situation before Interstate Commerce Commission officials.

There has been some interference with the movement of road materials, as a result of the railroad strike, but the reports reaching the Bureau of Public Roads in Washington indicate that, outside of the states comprising the non-union coal district, this has not been serious. It was stated at the Bureau that interference with the transportation of road materials at this time would be particularly bad, since it comes just at the peak of road building activities. It would mean heavy losses to contractors and would make it necessary to carry over into next year most of the projects which were scheduled for completion this year.

Report Made on Trent Valley Water Power

Shortage of water for power in the Trent Valley district of Ontario is due to the operators of the Hydro-Electric Power Commission of Ontario, according to the report just made by Henry Holgate, consulting engineer, of Montreal, to the Dominion Department of Railways and Canals. Mr. Holgate's findings are summarized by the department as follows:

"The cause of complaint was due to the commission's use at their Healey's Falls development of a quantity of water in excess of the inflow to the reach between Hastings and Healey's Falls.

"The demands for power exceeded the capacity of the water supply to produce it, and there was no sufficient foresight shown by the commission in the use of the water—their operators knowing the flow at Nassau and the conditions existing between Nassau and Healey Falls—both as increment and losses due to the absorption and evaporation.

"The officers of the canal have done and are doing everything possible consistent with navigation requirements to facilitate the operations of the commission, but cannot protect the commission against acts of its own operators. The action of the canal officers has plainly been in the interest of the power users and the public generally."

SPRINGFIELD BRIDGE IS OPENED WITH CEREMONY

On Aug. 3 the new Memorial Bridge across the Connecticut River between Springfield and West Springfield, Mass., was dedicated as a part of a two-day celebration which included boat races, an evening pageant, band concerts, community dancing, baseball games and fireworks, as well as a final ceremony participated in by the Governor and a christening by a popular musical comedy actress. The bridge was described in this journal Mar. 30, 1922, p. 514.

Coal Strikes Heading Toward Early Settlement

Following a conference at Cleveland between representatives of the United Mine Workers and operators in five states a break has been made in the bituminous coal strike which has been in force since April 1. Wage scales are now being drawn (Tuesday) on the basis of an agreement reached yesterday between the labor and operating interests that affect an annual output of 60,000,000 tons. Interests representing another 15,000,000 tons, which were originally in the conference withdrew yesterday because of the refusal of the miners to incorporate in the agreement a provision for arbitration of future differences as to wage-scales and working conditions.

It is expected that the agreement will provide for a continuance until next March of the wage-scales in force prior to April 1, and that an advisory fact-finding commission will be established to handle future negotiations. Acceptance of the agreement is open to any bituminous operator. It may be signed by individuals or by organizations, and provides for immediate reopening of mines upon acceptance.

Negotiations looking to a settlement of the anthracite strike will be opened in Philadelphia tomorrow. Prevailing sentiment is optimistic and a speedy agreement is forecast.

Bids Asked for New Aqueduct for Providence, R. I.

Bids for the tunnel portion of the Scituate Aqueduct of the new water supply for Providence, R. I., will be received by the Water Supply Board on Aug. 30. The work consists of about 3⅓ miles of horseshoe-shaped concrete-lined tunnel with a cross-sectional area equal to a circular tunnel 7¾ ft. in diameter, except that at and near the portals a 7½-ft. circular section will be used. A construction shaft 140 ft. deep is included. Frank E. Winsor is chief engineer.

Chicago Forest Preserve Will Spend $2,000,000

A bond issue of $2,000,000 placed recently by the Forest Preserve District of Cook County will be used largely in the purchase of land, but will provide also for the construction of roads (concrete and tarred macadam), bridges, sewers and water mains. The construction program has not been completed. Most of the work now in hand consists in building shelter houses and comfort stations in order to provide toilet accommodations for the people visiting the forests. Wells are being put down for water supply, small filter plants built and small isolated chemical sewage plants built. About 22,000 acres have been acquired. Daniel Ryan is president of the District; William J. Gormley, secretary, and E. J. Flavin is the chief engineer.

American Trade Association Executives to Meet

The third annual meeting of the American Trade Association Executives will be held at the Inn, Buck Falls, Pa., Oct. 25, 26 and 27. In view of the discussions that have been going on concerning trade association activities, this meeting is expected to be of particular interest and benefit to everyone in trade association work.

St. John Floods Damage Railroads

St. John Correspondence

Floods on the St. John River have not yet subsided. The Canadian Pacific branch between Woodstock and Hartland in New Brunswick has been greatly damaged by washouts and motor transportation has replaced rail between those points. On the Maine Central continual washouts have delayed service for as much as forty-eight hours at a time and some of the smaller bridges have been threatened by the swollen streams.

A. L. Johnson

A. L. Johnson, president of the Corrugated Bar Co. of Buffalo, who died July 21, was one of the pioneers in reinforced-concrete construction in this country. From 1895, when he became engineer and manager of the St. Louis Expanded Metal Fireproofing Co., until his death he was one of the leaders in the reinforcing steel business, but with his commercial connections he at the same time kept in the closest touch with the scientific development of the field and in his earlier days contributed much to the then limited knowledge of the theory of reinforced concrete.

Mr. Johnson was born at Marlboro, Ohio, Dec. 15, 1865, and when fifteen years old went to St. Louis to live with his older brother, Prof. J. B. Johnson, author of so many well-known text-books and the authority on the subject of materials, who at that time was professor of civil engineering at Washington University. From that school Mr. Johnson graduated in 1887 with the degree of Civil Engineer. During his student days he assisted his brother in government survey work and after graduation immediately became connected with various bridge enterprises, first under Morison & Corthell and later under Robert Moore. These earlier years, too, were spent in water-works design and construction, surveying, and analysis of the federal timber tests made under the direction of Prof. J. B. Johnson.

In August, 1895, he became engineer and manager of the St. Louis Expanded Metal Fireproofing Co. and started the more intimate study of the subject to which he gave the rest of his life. At that time the literature of reinforced concrete in English was most meager, so he set to work to translate into English the various continental texts which were fairly large at that time, and to develop his own theory of reinforced concrete. Much of the literature of the last five years of the last century and the first five years of this was enriched by Mr. Johnson's contributions. Readers will find in 1904, for instance, a long discussion in the columns of *Engineering News* between Julius Kahn, now of the Truscon Steel Co., and Mr. Johnson on the then quite novel subject of shear in concrete. About this time, too, Mr. Johnson developed the deformed bar now made by the Corrugated Bar Co. and known for many years in the trade as the Johnson bar. From 1906 to 1909 he was abroad, organizing various companies for the development of his patented bar, and on his return he became vice-president of the Corrugated Bar Co. manufacturers of reinforcing steel. Later he became its president.

Mr. Johnson became a member of the American Society of Civil Engineers in 1896 and took part in many committee meetings of that society and others. He was a member of the first Joint Committee on Concrete and Reinforced Concrete.

Denver Near Water Shortage

In an open letter to the citizens and water consumers of Denver Colo., dated Aug. 1, the Board of Water Commissioners give warning that the danger point has been reached, for should even one conduit fail to carry its maximum capacity, a serious water shortage would immediately confront the city. The normal carrying capacity of the conduits aggregates 80 m.g.d.; 90 m.g.d. of water was consumed on June 22 and for many days in June the consumption exceeded the carrying capacity. If the water had been available the water-works officials believe the consumption would have risen to 100 m.g.d. Apparently answering the cry for more distribution mains, the letter states that further extensions without additional conduits would spell disaster to the city. While the present pipe system is able to furnish neither adequate supply nor pressure to some sections of the city the large number of new buildings this season brought an increase in the number of customers to an already overburned system. To assuage the critical condition an appeal is made to curtail waste.

The normal annual increase in consumption of a city the size of Denver is 5 m.g.d. Denver's consumption in May and June, 1922, exceeded the rate for these two months in 1921 by 6 m.g.d. Only 47 per cent of the water is filtered; the remainder is made safe by sterilization. Of the water filtered the rate at one of the rapid filter plants is 275 m.g.d. per acre, more than twice the usual 125-m.g.d. rate. In anticipation of the report of the Engineering Board of Review (D. H. Maury, H. T. Cory and H. S. Crocker), which has been at work for several months, the water-works officials state that even larger expenditures will be recommended than were asked for in the bond issue voted on adversely last year. Safety demands, in the opinion of the officials, a total capacity of 150 m.g.d. in conduits and filter plants plus main extensions and reserve capacity in reservoirs and pumping plants.

Contract Let for Part of Buffalo Water Purification Plant

The contract for the substructure of the water filtration plant for Buffalo, N. Y., has been awarded to the Thompson-Starrett Co., New York City, for $1,800,000. George C. Andrews is engineer and George W. Fuller, New York City, consulting engineer for the work.

Garbage Disposal Fund Provided for Section of Philadelphia

An ordinance appropriating $350,000 for municipal street cleaning, destructors, buildings, and machinery has been signed by the mayor of Philadelphia. A destructor plant in the vicinity of Sixth and Romona Streets, to serve the 33d and 42d wards is proposed.

Engineer Reserve Officers Attend Summer Training Camp

Twenty-three engineers were included in the 250 reserve officers of the 2nd Corps Area that attended a two-week training period at Camp Dix from July 18 to Aug. 1. Under the new plans for development of the organized reserve the summer training-camps are designed to impress upon reserve officers the unity of the army and the importance of their place in the scheme of things, as well as to keep them abreast of the developments in the military art during and since the World War.

During the training period, mornings were devoted to terrain exercises in which engineer field officers participated with those of the line, while company officers received special technical instruction. In the afternoon detachments of regular troops illustrated combat manoeuvers, using all arms and equipment. Company A of the 1st Engineers worked out full-scale problems in wiring and demolition.

Reserve officers who attended the camp have expressed high approval of the scope and conduct of the work and indicate a desire to support extension of the training-camp scheme along the lines of current development.

ENGINEER RESERVE OFFICERS AT CAMP DIX

Top row: 1st Lt. V. J. Milkowski, 2nd Lt. S. J. Vastola, 1st Lt. John Arthur, 1st Lt. [illegible], 1st Lt. R. J. Martin, 2nd Lt. R. P. Liddell, 1st Lt. F. M. Thornburn. Center row: Capt. M. Kern, Capt. S. J. Maddaugh, 1st Lt. F. I. Gallegher, 1st Lt. H. G. Lambert (instructor), Capt. C. H. Crooks, Capt. O. V. Derr, Capt. A. J. Fisk, Capt. [illegible]. Bottom row: Capt. A. J. Cram, Maj. G. W. Cobb, Maj. W. A. Smedhurst, Lt. Col. [illegible], Maj. R. E. Guyer (instructor), Capt. W. N. Thomas, Jr. (instructor), Maj. W. R. Turner, 1st Lt. (Chaplain) J. A. Hammond.

The Engineer in Public Life

JAMES ELMO SMITH

Since 1919 Urbana, Ill., has had an engineer as its mayor. After service in the City Council from 1913 to 1917, James Elmo Smith received both the Republican and the Democratic mayoralty nominations and was elected by a large majority three years ago.

Mr. Smith was born in Sharon, Wis., in 1877 and after graduation from the University of Wisconsin in 1902 with the degree of B.S. in Civil Engineering he entered railroad construction in Tennessee under the late W. D. Taylor. He was successively with the C. B. & Q. R.R., the Wisconsin Central R.R. and the Virginia & Southwestern Ry. as resident engineer or in some similar capacity. In September, 1907, he was employed as instructor in the civil engineering department of the University of Illinois and has been with that institution continuously up to the present. He is a member of the American Society of Civil Engineers, the Society for the Promotion of Engineering Education, the Illinois Society of Engineers, and for several years a member of the American Railway Engineering Association. He is also a member of the executive committee of the Illinois Municipal League.

As mayor of Urbana, Mr. Smith's aim has been to give an efficient administration, and to make Urbana measure up to her opportunities as a great educational center. About $750,000 has been spent on local improvements, the city is well equipped with pavements, lights and parks.

Mayor Smith has also for several years been a member and the secretary of the Urbana Board of Education.

Contractors Propose Excursion to South America

A winter excursion to Panama, Argentine and Brazil to study opportunities for construction work and to learn the conditions under which construction has to be prosecuted is proposed by *The Earth Mover*, of Aurora, Ill. It is planned to start early in December and remain two or three months visiting the principal cities and such construction operations as are accessible along the main routes of travel. It is pointed out that in all South America there is prospect of great activity in railroad, public works and highway construction.

It is believed that a visit by a representative body of American contractors would result in some contracts, as well as establishing acquaintance and confidence leading to future business relations of mutual benefit and profit. Contractors interested in the trip may secure further information by addressing the editor of *The Earth Mover*, Aurora, Ill.

New Kind of Engineering

Dr. Frank A. Waugh, professor of landscape engineering, Massachusetts Agriculture College, has been appointed recreation engineer in U. S. Forest Service. His work will be the development of public camp grounds and summer home sites in the National Forests of the western states. It is part of an established plan toward providing adequate camp and sanitation facilities for the 5,500,000 tourists who visit the national forests yearly.

Program for Port Authorities' Convention Announced

Operation and management of the ports of New York, San Francisco, Chicago, and New Orleans, besides general questions relating to port management, make up the major portion of the discussions to be had at the annual convention of the American Association of Port Authorities which will be held in Toronto, Sept. 14-16 inclusive. Among the speakers will be E. H. Outerbridge, chairman, Port of New York Authority; B. F. Cresson, Jr., chief engineer, Port of New York Authority; Bancroft Hill, J. H. Walsh of New Orleans, John Meigs, John H. McCallum of San Francisco, Joseph B. Strauss of Chicago, and Dr. Herman von Schrenk.

The convention will be opened by an address by C. Alfred Maguire, Mayor of Toronto.

Arbitration Court Plans to Cut Legal Red Tape and Delays

Based upon a little-known law passed by the New York State legislature in 1920, which provides that any persons who wish to arbitrate a dispute may present it to an arbitrator of their own selection, free from the formalities of the ordinary court, the Arbitration Society of America has been organized and has opened headquarters in New York City.

Under this plan, the arbitrator may be any one selected by the parties to the controversy and may be of any vocation. He will have the power of subpoena and of rendering judgment, financial or otherwise, from which there is no appeal except in case of proved fraud and corruption. The society now has pledges of assistance and of service as arbitrators from hundreds of prominent business and professional men who are willing to serve without compensation. All kinds of controversies, except criminal, divorce and a few special actions, may be lawfully determined by these arbitrators. The tribunal will be open to trade disputes, but will not be a trade court, and settlement of industrial controversies will, for the time being, be discouraged. The cost of arbitration will be small and it is expected that these courts will become "poor men's courts."

The society plans to conduct an international campaign of education to promote the general cause of arbitration for all disputes and differences, to move for a uniform arbitration law in all the states, to urge the insertion of arbitration clauses in all trade and industrial contracts, and to organize and operate in New York City and elsewhere, tribunals of arbitration to carry on this work. The executive offices are now at 115 Broadway, New York.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal, Que.; Professional Meeting, Winnipeg, Man., Sept. 5-7.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

The Texas Section, American Society of Civil Engineers, will hold its fall meeting in San Antonio, Texas, October 20 and 21.

PERSONAL NOTES

M. B. GREENOUGH, who has been secretary of the National Paving Brick Manufacturers' Association for the past several years, will sever his connection with that organization Jan. 1, 1923. He has been offered, and has accepted, an opportunity to become associated with W. M. Lasley, of the Southern Clay Manufacturing Co., Chattanooga. His new association will be with a firm, not only dealing in paving brick, but doing contracting and other business as well.

C. H. BIRDSEYE, chief topographer of the U. S. Geological Survey, is making an inspection trip through the western states. On September 1 he will join the party being formed by E. C. LaRue for a trip from the Colorado river. During Col. Birdseye's absence, E. M. Douglas will be acting chief topographic engineer.

COL. WM. KELLY, chief engineer of the Federal Power Commission, is in California making a personal inspection of water-power projects.

MAJOR E. A. WOOD, formerly engineer for the metropolitan development association of the Dallas Chamber of Commerce, was appointed city plan engineer for the City of Dallas, Texas, on Aug. 1. Major Wood has been engaged in city planning in Dallas for the past three years under the direction of George E. Kessler. He had practiced engineering in Canada, the Far East, and later in Texas, with the Texas & Pacific R. R. and the state highway department.

E. W. ROSSITER, formerly chief engineer of the Interstate Iron & Steel Co., Calumet River, Chicago, has been appointed engineer of construction for Freyn, Brassert & Co., engineers, Chicago. Prior to Mr. Rossiter's connection with the Interstate company he was with the American Sheet & Tin

Plate Co., the Minnesota Steel Co., and the Canadian Steel Corporation, Ltd.

FRANCIS S. FRIEL has resigned as assistant engineer in the engineering division of the Pennsylvania Department of Health, Harrisburg, to become associated with Albright & Mebus, civil engineers, Philadelphia, Pa.

GILES B. KEENEY, of Meriden, Conn., has been chosen superintendent of public works of Rockville, Conn., to succeed Clayton E. Swain, resigned.

FRANK A. BARBOUR, consulting civil and sanitary engineer, has associated with himself G. GALE DIXON, until recently chief engineer of the Bureau of Water Works Improvement of Akron, Ohio, under the firm name of Barbour & Dixon, with offices in the Tremont Building, Boston, and the Finance Building, Cleveland. The firm will continue practice in Mr. Barbour's specialty of hydraulic work, including water supply, sewerage and sewage disposal, flood control, etc. Mr. Dixon has been connected with the development of Akron's water supply for about ten years; from 1912 to 1915 on design and construction of the original works under Mr. Barbour. Since that time he has been in complete charge of the enlargement of the system to meet the demands of Akron's remarkable growth.

DOUGLAS SIMPKIN has joined the engineering staff of the Lackawanna Bridge Works in Buffalo as a detailer in steelwork. He was formerly a draftsman in the Canadian Reclamation Service.

O. W. GATCHELL, up to a few months ago assistant engineer in the Ohio State Highway Department, is now with Frank T. Miller, Greensboro, N. C., consulting engineer.

E. H. WARD, Jr., formerly with the Virginia Bridge & Iron Co., has become associated with the Truscon Steel Co., Youngstown, Ohio, as a designer in the concrete division.

RAY Z. MYERS has been made an assistant division engineer of the Ohio State Highway Department. He was formerly assistant engineer of Licking County, Ohio.

CHARLES F. SLOAN, former instructor in structural engineering at the University of Wisconsin, has become associated with the engineering contracting firm of Engstrom & Knapp, Wheeling, W. Va. Mr. Sloan is at present engineer on building construction work.

WILLIAM E. O'BRIEN, who has been for some time with the Foundation Co., New York City, as civil engineer, has been made office manager for that company.

REINHOLD J. TAPPERT, who has been with John S. Fairchild, civil engineer and surveyor, has become engineering assistant in the construction department of the Erie R. R.

LAWRENCE D. MARKELOFF, former field engineer for Stone & Webster, Inc., Boston, Mass., is now with the Fougner Concrete Steel Co., New York City, as draftsman and designer.

J. C. GARDNER, city engineer of Niagara Falls, Ont., has tendered his resignation. He has made no announcement as to future plans.

E. A. CROSS, until recently superintendent of construction for W. L. Stoddart, New York City, has joined the engineering staff of Albert Kahn, architects and engineers, Detroit, Mich.

H. W. RUSSELL, former senior civil engineer with the Interstate Commerce Commission, is now with the department of tests of the Illinois Division of Highways.

PHILIP J. ENDLICH, until recently supervising engineer for the Detroit office of Lockwood, Greene & Co., is now a designing engineer for John Finn & Son, contractors, of Detroit.

G. A. STANTON, former resident engineer with the Thompson-Starrett Co., New York City contractors, is now resident engineer with the White Construction Co., New York.

F. W. BUHRMEISTER has recently become affiliated with the American Bridge Co. as a detailer of steelwork. He was formerly junior highway engineer with the Illinois Division of Highways.

C. M. REED has been made production manager of the Quality Cement Products Co., Medford, Minn. He was formerly drainage engineer of Worth County, Iowa.

G. NEVILLE WHEAT, former structural engineer with the Kansas City Power & Light Co., is now structural engineer with the Capitol Steel & Iron Co., Oklahoma City, Okla.

J. G. BENNETT, until recently city manager of Fort Myers, Fla., is now in the bridge designing department of the Wisconsin Highway Commission.

JOHN G. GOUNDRY, formerly a draftsman with the Lackawanna Bridge Works, is now a draftsman for the Virginia Bridge & Iron Co., Roanoke.

R. O. PARSONS, until recently district engineer of the Southern Ry., is now assistant engineer with the Georgia State Highway Department. He is stationed in Gainesville, Ga.

C. V. BAIR, former county engineer of Monroe County, Iowa, has accepted a position as superintendent of construction for Thomas Carey & Sons, Des Moines contractors.

W. A. STACEY has been appointed county engineer of Reno County, Kansas, by the State Highway Commission. He has been acting county engineer of Reno County for some time.

OBITUARY

E. R. MORGAN, consulting engineer of Salt Lake City, Utah, died at his home in that city recently, aged 50 years. Mr. Morgan was with the U. S. Geological Survey for several years in the water resource branch, during which time he studied stream-flow conditions in Utah. For eight years he served in the state engineer's office as principal assistant engineer and in 1912 was appointed road engineer by Governor Spry. Under his direction the first concrete highway in Utah was constructed. Aside from his doing consulting engineering work, he was president of the Morgan-Tanner Equipment Co., Salt Lake City.

WILLIAM C. CRAMER, at one time city surveyor and municipal engineer, died July 27 in Philadelphia, aged 78 years. Mr. Cramer made the first plans for the Park Way of Philadelphia, and surveyed the line for the Market Street elevated railroad, later directing construction of both these projects. Previous to settling in Philadelphia Mr. Cramer did the preliminary work on the Kansas City Bridge Park, and was assistant on location and construction for the Pittsburgh, Fort Wayne and Chicago R.R.

J. O. HOLLWORTHY, an engineer in the bridge department of the Missouri State Highway Commission, lost his life recently while inspecting a bridge in Grundy County. It is believed that while he was inspecting this bridge he lost his footing and received a fatal fall.

JOSEPH B. CONDRON, for forty years a leading contractor and builder of Hollidaysburg, Pa., died Aug. 7 at his home, aged 67 years. He entered the contracting business in 1883 with his father.

WILLIAM C. GARRETT, member of the engineering firm of Garrett & Dill, Greenville, S. C., was drowned recently when the boat in which he was inspecting some engineering work on the Wateree River near Camden, S. C., was capsized. Mr. Garrett was 31 years of age. He received his engineering education at Clemson College, S. C.

BUSINESS NOTES

EDWARD N. LAKE and JAMES N. HATCH announce the formation of the Chicago Engineering Associates Engineers, as an association of established engineering and construction organizations. Mr. Lake is general manager and Mr. Hatch, chief engineer.

ARTHUR WHITCRAFT, in addition to his duties as manager of the manganese steel sales for the Hadfield-Penfield Steel Co., has been placed in charge of all foundry operations at the south works at Bucyrus, Ohio.

THE FLORANDIN EQUIPMENT Co. has been organized in New York City by C. H. Florandin, to act as representatives of the Conveyors Corporation of America. The new organization will also make industrial plant installations in New York and vicinity, erecting and installing lines of equipment which the Conveyors Corp. handles. Mr. Florandin was Eastern manager of the Conveyors Corp. before forming his own company.

HENRY HARNISCHFEGER, the president of the Pawling & Harnischfeger Co., Milwaukee, Wis., has re-

cently returned from a six months' tour of the world. Mr. Harnischfeger visited Japan, China, the Philippine Islands, India, and several European countries. The object of his trip was the investigation of business conditions in the Far East, particularly in Japan, China, and India, where the Pawling & Harnischfeger Co. has branch offices.

THE DODDS-FINNEY ENGINEERING CO., has opened an office for consulting work in structural engineering in the Crawford Building, Topeka, Kansas.

THE SCHEID ENGINEERING CORP., New York City, has been appointed metropolitan and export representative for the Franklin Moore Co., Winsted, Conn., manufacturers of material handling machinery for industrial plants.

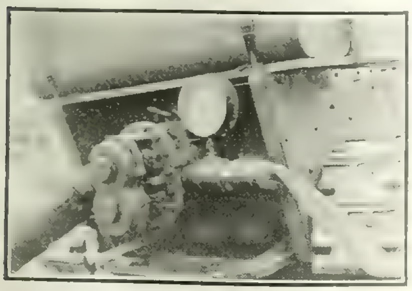
EQUIPMENT AND MATERIALS

Rotary Pump Attachment for Caterpillar Tractor

A rotary pump attachment as an accessory to the standard 5-ton Holt caterpillar tractor has recently been made available through the co-operation of the Holt engineers and the Goulds Manufacturing Co. The pump is of special compact design attached to the countershaft from the motor in the rear of the tractor in the same position as the power pulley attachment. Under normal speeds of 1,000 r.p.m. a $1\frac{1}{8}$-in. stream can be thrown 100 ft. into the air. The capacity is 220 gal. per minute

under 100-lb. pressure. About 25 hp. is used, two-thirds of the normal motor capacity, giving reserve for long suction and discharge lines.

The pump weighs 225 lb. and is of the rotary gear wheel type. A positive jaw clutch connects and disconnects the

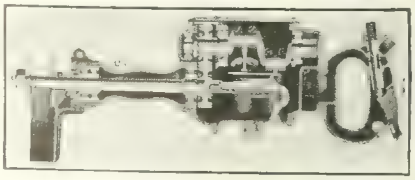


power to the pump in the same manner as the power pulley is controlled.

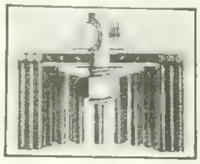
Special fields of usefulness are work in forests in inaccessible places, emergency use in cities, fires or floods, and pumping out excavations.

Improvements Are Made in Air-Grinder Equipment

Improvements to its air grinder equipment for such uses as removing rust or paint from structural steel and



cleaning gondola cars, are announced by the Chicago Pneumatic Tool Co., of New York. A new oil separator applicable to Little Giant machines permits the operation of these grinders continuously for 48 hours without replenishing the supply of lubricant. The oil-laden air enters the holes in the separator, shown in the accompanying illustration, where centrifugal action separates the oil from the air, conserving the oil for reuse. For cleaning rust or paint from steelwork the company has placed upon the market a new wire brush consisting of three units, a $\frac{1}{8}$-in. back plate dished as shown, a $\frac{1}{8}$-in. front plate with a series of slots, and the brush proper consisting of 30 renewable units of heat-treated crucible steel.



Concentrated Colloidal Coagulant Is Discovered

Announcement is made of the discovery of a means of holding in collodial form a concentrated solution or emulsion of aluminum hydrate which on dilution precipitates almost instantaneously. The solution contains from 45 to 55 per cent as much actual metallic aluminum as does commercial sulphate of alumina, $Al_2(SO_4)_3 \cdot 18H_2O$.

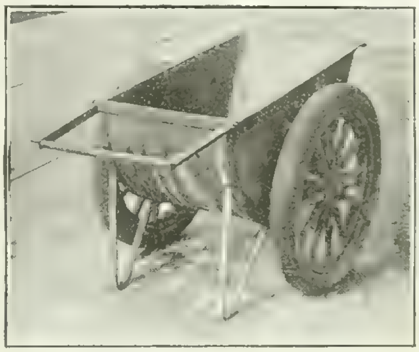
The makers, the Seydel Chemical Co., Jersey City, N. J., explain the means by which this highly concentrated solution is obtained as follows: The aluminum hydrate is peptized by infinitely small quantities of certain organic compounds that are physiologically harmless. For the precipitation of the hydrate in the floculant state the concentrated coagulant is not dependent upon the hydrogen-ion concentration of the water. The water does not have to be naturally or artificially alkaline to coagulate. This is because the peptizing substances that hold up the hydrate exist in a certain tension that is proportional to the volume of the solution rather than to the aluminum hydrate, which is their substrate. So, although the hydrate bears a definite ratio to its peptizing substances, when the colloidal coagulant is diluted the ratio of the volume of water to the peptizing substances is changed and for certain chemical reasons the peptizing substances no longer hold up the hydrate and it precipitates with subsequent clarification of the solution.

Since the colloidal coagulant is almost neutral in its reaction the natural alkalinity of the water is preserved and the corrosion of pipes due to the hydrogen-ion of carbonic acid is therefore less.

No precautions are needed in handling the solution as it is far less corrosive than a sulphate of alumina solution. It may be shipped in tank cars and iron drums and can be applied through the ordinary solution dosing apparatus.

Concrete Buggy With Pneumatic Tires

The A. J. Penote Co., Cleveland, Ohio, underground conduit and cable contractors, has equipped its concrete buggies with pneumatic tires, finding this scheme of great benefit in wheeling



concrete over rough streets, thus avoiding separation of coarse aggregate from the rest of the mix. It also allows the buggies to be handled much more easily.

Out-of-the-Ordinary Trade Publications

Conveyors and Loaders—THE GEORGE HAISS MANUFACTURING CO., INC., New York City, has issued a 24-p. booklet describing its belt conveyors, bag loaders, and wagon loaders. Aside from presenting the usual manufacturers' data concerning mechanical equipment, the booklet is enhanced by comparative costs of loading sand, gravel, and crushed rock by handloading and by the Haiss-loading methods, and by full specifications of each type of machine described. The contractor who is looking for such equipment should have little difficulty in being able to select by reading over this Haiss booklet the particular equipment which will fit his specific needs.

Steel Sash—Full specifications, physical descriptions, details of erection and photographs of many installations of steel sash in various types of buildings make up a 70-p. booklet just issued by DAVID LUPTON'S SONS CO., Philadelphia, Pa. Though most of the material in this booklet is a condensation of previous trade catalogs issued by the company on the installation of Lupton counterbalanced and pivoted sashes, a new feature is a chapter describing the use of steel windows for apartments and residences. This chapter explains the advantages in using steel sash for such construction; and wall and erection details together with standard dimensions for projected windows make the publication a valuable addition to trade literature.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Cement Shipments Heavier Than Production

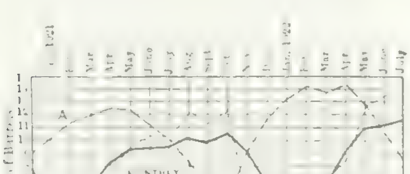
High Fuel Prices and Uncertain Coal Shipments Seriously Affect Industry at Peak of Season

Large cement manufacturers generally agree that uncertain coal shipments and high coal prices, both growing worse, have brought on a serious situation in the industry. In the Lehigh Valley, for example, what coal there is costs $8 per ton at the mines, and the cement companies have only two or three weeks' supply. Some of the plants are running light; others are shut down. The situation is no better in the Middle West. In the Northwest it is reported that there is no coal.

The pressure is increased by the fact that June, July and August are the peak months in the cement industry. Ordinarily shipments then are 12 to 13 per cent of the annual total, as compared with 3 or 4 per cent in the winter and a monthly average of 8⅓ per cent. The Geological Survey shows shipment and production in barrels in the summer months as follows:

1922	Shipments	Production
May	12,749,000	11,176,000
June	13,470,000	11,245,000
July	13,850,000	11,557,000
	40,069,000	33,978,000
Difference	6,091,000 bbl	

At the same time it is gratifying to note that July stocks, 10,718,000 bbl., were only 432,000 bbl. under those of a year ago. It must be borne in mind, however, that even if the coal strike were settled tomorrow, there would remain the danger of a car shortage.



July exports were 96,263 bbl., or 3,805 under June, while the total for the last three months was 271,743 bbl. June imports were 14,179 bbl. as compared with 2,521 in May; July figures are not yet available. Ten barge loads arrived recently from Canada by way of the Welland Canal. Swedish cement is being shipped to a project in North Carolina. The domestic market, however, is handling the great bulk of the demand, as usual.

Price changes at mills have been fewer, owing to the tendency on the part of manufacturers not to book orders for deliveries prior to Nov. 1. Current mill quotations per bbl. in carload lots, without bags, to contractors, with dates of last price changes are shown in the following table:

Buffington, Ind	$1 80	July 6
Universal, Pa	1 85	July 6
Steelton, Minn	1.95	Aug. 1
Fordwick, Va	2 10	Aug. 1
Mitchell, Ind	1 95	Apr. 6
La Salle, Ill		
Iola, Kan	1 95	Apr. 6
Mason City, Ia	2 05	Aug 1
Hudson, N. Y	2.10	Aug. 1
Leeds, Ala	1.95	Aug. 1
Hannibal, Mo	1 95	Aug 1
Lehigh Valley Dist	2 00	Aug 1
Kingsport, Tenn	1.95	Jan. 5
Richard City, Tenn	1.95	Jan. 5

In addition to the coal strike, the railroad strike has a direct effect on the cement supply. The equivalent of 377,000 box cars of 50-ton capacity each were required to haul last year's cement output to the consumer, and if the strike ties up transportation it will be impossible to get the cement shipped to the points where it is needed. Incidentally, the textile strike, if it ties up the production of the textile mills, would have a serious effect on the cement industry, as thirty million new cloth sacks are needed every year by the cement mills. These sacks require an immense amount of cloth—a strip 30 inches wide and over 17,000 miles long—and if the mills were unable to supply the cloth for sacks it would be a difficult matter to handle the cement orders.

Bad Order Cars Increase 17,496 in Two Weeks

Car loadings as reported by the American Railway Association for the week ending July 29, totaled 859,733 cars, an increase of 1,391 over the previous week and 64,301 above the total for the corresponding week in 1921.

Coal loadings totaled 76,374 cars, an increase of 314 over the preceding week.

Idle freight cars for the week ending July 23 totaled 387,322, a decrease of 29,707 cars in a week. Of these, 203,322 were freight cars in good repair and in excess of current freight requirements. Bad order cars totaled 184,000 in excess of the normal number unfit for service and idle because of business conditions.

Of 2,258,267 cars on lines, 342,079 were in need of repairs during the week of July 15, as against 324,583 for the week ending July 1, an increase of 17,496.

Wholesale Index Numbers and Commodity Prices

Even if it were not generally known that the price tendency is upward, this list of index numbers, compiled by D. L. Bissell, San Diego, Calif., would clearly establish the fact. Of the ten numbers seven have advanced since June, while dairy products did not change. The rise in farm products was slight, while prices of citrus and deciduous fruits declined from five to seven points since June. In foods, the greatest advance was in provisions; meats rose only one point.

Construction materials stand at 172 in July against 166 in June. It is interesting to note that the *E. N.-R.* Construction Cost Index was 167 in June, 170 in July, and is 173 at present.

INDEX NUMBERS OF WHOLESALE PRICES (COMPILED BY D. L. BISSELL)

1922	Jan	Feb	March	April	May	June	July
Farm products	116	123	126	132	128	125	126
Crops	127	131	131	141	134	129	128
Live-stock	100	112	118	116	116	118	122
Orchard products	143	154	162	151	160	170	165
Citrus	77	94	104	100	111	107	100
Deciduous	216	216	217	205	202	215	211
Food	121	125	126	131	132	137	140
Provisions	132	136	143	150	151	157	164
Dairy	128	127	112	113	114	117	117
Meats	99	104	107	111	120	126	127
Textiles and leather	163	166	169	177	182	191	193
Fuel and metals	147	143	144	146	150	153	155
Materials of construction	158	162	166	159	162	166	172
All commodities	134	138	140	144	145	148	151
Raw materials	118	124	126	132	137	137	138
Manufactured products	155	156	158	160	155	160	164

The all-commodities index has risen steadily since January, the total rise being 17 points or 13 per cent.

Average wholesale cash prices of fifty-four commodities, in the principal markets of the country, show twenty-seven advances and 16 declines, with eleven remaining unchanged during July. Prices rose perceptibly in cotton, vegetables, sugar, fresh beef, calfskin leather and bituminous coal and dropped on flour, silk, wool, petroleum and gasoline. Nearly all metals advanced with the exception of lead; cement was the only building material to show an average decline. Dry goods, dairy products, anthracite coal and steel billets remained fairly stable.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 83 to 96, are the following:

A medical school at Cleveland, Ohio, for Western Reserve University, $2,500,000.

A dam at Lake Kenegami for the Provincial Government of Quebec, Canada, $1,800,000.

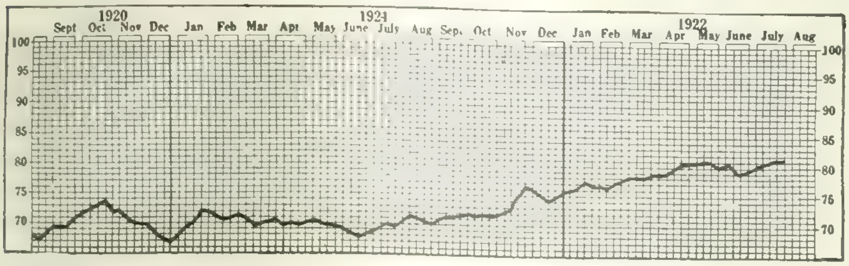
A reinforced-concrete and steel warehouse at Long Island City, N. Y., for J. Butler, Inc., New York City, $1,750,000.

A clubhouse at Milwaukee, Wis., for Milwaukee Elks' Lodge, $1,200,000.

Bond market dull; few offerings, in consequence of smaller demand at this season. See table of representative public bond sales, this issue.

Representative Recent Public Bond Sales

Long term municipal bond sales during July totaled $91,839,171 as against $116,672,630 in June and $104,584,124 for July, 1921, according to records kept by the *Commercial and Financial Chronicle*.



AVERAGE OF 40 LISTED BOND ISSUES—(*The Annalist*)

Among the more important issues were: Philadelphia, $6,000.000 4s at par; Chicago Sanitary Dist., $3,000,000 4s at 97.195, a basis of about 4.36 per cent; Alabama, $2,000,000 4½s at 100.125; Cleveland City School Dist., $3,000,000 4½s at 100.08, a basis of about 4.49 per cent; Essex County, N. J., $2,241,250 4¼s at 100.04 a basis of about 4.24 per cent.

Short-term securities issued during July totaled $25,605,000, including $21,150,000 in New York City corporate stock notes.

The trend of forty listed bond issues, published by the *Annalist*, shows the average price at 18.5 points below par during the last week in July as against 30 below for the corresponding period in 1921 and 32 below in August, 1920.

The price movement of bonds other than public is well shown by the *Annalist* curve which averages twenty-five railway bonds, eight industrials, four street railways, two public utilities and one municipal. It will be seen that the rise has been fairly steady since June, 1921. Just at present the curve appears to be flattening, which is to be expected under the conditions created by the two great strikes.

Of the thirty-nine representative issues shown in the accompanying table, five sold at par, thirty-two above and two below par; the yields ranging from 4.13 to 5.80 per cent. The rates varied from 4¼ to 6 per cent. All those drawing 6 per cent were in the Southern and Western states excepting one, in Michigan; the 5s and 5½s were mostly located in the Middle West; the 4½s and 4¾s in New England and the Middle Atlantic states and the single 4¼ in Massachusetts.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 83 to 96, are the following large projects:

Forty-eight miles of railroad from Ellinor to Eldorado for Atchison, Topeka & Santa Fe R.R., to Bates and Rogers, Old Colony Bldg., Chicago, Ill., $3,000,000.

A hotel at Syracuse, N. Y., to Amsterdam Building Co., 138 East 44th St., New York City, $2,500,000.

A hotel at St. Paul, Minn., to Smith and Vandanaker, 501 Exchange Bank Building, $1,600,000.

An office building at San Francisco, Cal., to P. A. Palmer, Monadnock Bldg., $1,500,000.

A water filtration plant at Oklahoma City, Okla., to Tibbens and Pleasant, 202 Daniels Bldg., Tulsa, $282,700.

REPRESENTATIVE BOND SALES OF JULY AND AUGUST, 1922

State	Purpose	Amount	Maturity	Rate Per Cent	Basis	Sold For	Dated	Purchased By
Alabama	Road Highway Bridge	$2,000,000	....	4½	....	100.125	July, 1, 1922	Barr Bros. & Co. of New York
County								
Allen, Ind.	Road	72,000	1923–32	4½	4.49	100.034	July 15, 1922	Lincoln National Bank, Fort Wayne, Ind
Armstrong, Pa.	Road	800,000	1925–42	4½	....	100	Aug. 1, 1922	M. M. Freeman & Co., Philadelphia.
Barry, Mich.	Road	35,000	.	6	....	102.18	July 22, 1922	Detroit Trust Co. and Stacy & Braun.
Clark, Ind	Highway improvement	17,000	1923–32	5	4.81	100.91	July 12, 1922	Thos. D. Sheerin & Co., Indianapolis.
Cooper, Mo.	Road	125,000	1924–42	5	....	103.16	Aug. 1, 1922	The Liberty Trust Co. of St. Louis.
Consolidated Irrigation Dist., Fresno, Tulare and Kings Co., Cal.	Ditch	850,000	1924–33	5½	5.28	101.25	July 1, 1922	Bank of Italy and E. H. Rollins & Sons, San Francisco.
Cuyahoga, Ohio.	Sewer and water imp'v'ment	91,000	1924–36	5	4.82	101.189	July 1, 1922	Guardian Savings & Trust Co. of Cleveland
	Road	50,181	1923–31	5	4.85	100.67	July 1, 1922	
	Road	18,978	1923–31	5	4.85	100.669	July 1, 1922	
Huron, Mich.	Road	18,000	1932	5½	.	101	July 1, 1922	R. L. Hubbard & Co., Caseville, Mich.
La Porte, Ind	Road	34,200	1923–32	5	.	100	July 22, 1922	A. P. Andrews, Jr., & Son., La Porte, Ind.
Montgomery, Ohio	Bridge	18,000	.	5½		101.453	July 1, 1922	Otis & Co. of Cincinnati.
Orange, N. Y.	Road	200,000	1932–51	4½	4.13	104.91	Sept. 1, 1922	Barr Bros. & Co., New York.
St. Louis, Minn.	Road	2,000,000	1931	5	4.70	102.07	Jan. 1, 1921	Wm. R. Compton Co. and others.
San Gabriel Co. Water Dist., Cal.	Irrigation	220,000	1926–50	5	. .	97.36		Banks, Huntley & Co. and Freeman, Smith and Camp Co.
Shelby, Ind.	Highway improvement	21,160	1923–32	5	4.79	101.02	July 15, 1922	J. F. Wild & Co., State Bank of Indianapolis
Township								
East Pennsboro, Pa.	Road	35,000	1925–40	5	4.54	104.012	July 1, 1922	E. H. Rollins & Sons of Philadelphia.
Municipality								
Andover, Mass.	Highway	100,000	1923–27	4½	4.16	100.95	Aug. 1, 1922	White, Weld & Co.
Belmont, Mass.	City improvements	111,000	1923–37	4¼	4.20	100.691	June 1, 1922	R. M. Grant & Co., Boston.
Bexley, Ohio.	City improvement	64,831	1923–31	5½	5.27	101.044	April 1, 1922	Citizens Trust and Savings Bank of Columbus.
Clyde, N. Y.	Street improvement	36,000	1924–35	5	4.75	101.55	Sept. 1, 1922	Geo B. Gibbons & Co., N. Y. C.
		12,000	1924–29	5	4.94	100.25	Aug. 1, 1922	
Condon, Ore.	Water	90,000	1942	6	..	100.50	Aug. 1, 1922	Clark, Kendall & Co. and the Western Bond & Mortgage Co.
Forest City, N. C.	Water	50,000	1925–52	6	5.80	102.15	July 1, 1922	Farmers' Bank & Trust Co. of Forest City.
	Sewer	15,000						
Fredonia, N. Y.	Street improvement	42,000	1923–32	4¾	4.625	100.59	Sept 1, 1922	Barr Bros. of New York.
Granada, Col.	Water	22,000	1937	6	.	97	Aug. 1, 1922	James H. Causey & Co. of Denver.
Hoboken, N. J.	School	1,170,000	1924–62	4½		100	Aug. 15, 1922	Kissel, Kinnicutt & Co., B. J. Van Ingen & Co. and Eldredge & Co.
Hudson, N. Y.	Sewage disposal	12,400	1932	4½		100	Aug. 1, 1922	Hudson City Savings Institution.
Lapeer, Mich.	Paving	15,000	1937	5		103.91	Aug. 1, 1922	Bolger, Mosser & Williams of Chicago
Mead, Col.	Water	16,000	1932–37	6		101.07	July 1, 1922	Bankers' Trust Co. of Denver.
Monroe, Mich.	Water	200,000	1936–43	4¾	4.54	102.605	July 1, 1922	Benj. Dansard & Co. of Detroit.
	Sewer	100,000	1937–44	4¾	4.54	102.605	July 1, 1922	
Mount Kisco, N. Y.	Sewer	32,000	1926–41	4½	4.43	100.599	Aug. 1, 1922	Farson, Son & Co., New York.
Newport News, Va.	Schools	300,000	1957	5	4.90	101.66	Aug. 1, 1922	Geo. B. Gibbons & Co., New York.
	Streets	150,000	1952	5	4.92	101.33	Aug. 1, 1922	R. M. Grant & Co., New York.
	Equipment	100,000	1932	6	5.66	102.50	Aug. 1, 1922	R. M. Grant & Co., New York.
Orrville, Ohio.	Street improvement	47,000	1923–32	5½	5.26	101.14	Aug. 1, 1922	Title Guarantee & Trust Co. of Cincinnati.
Peru, Ind.	Electric light plant	70,000		5		101.257		Fletcher-American Co. of Indianapolis
Saranac Lake, N. Y.	City improvements	65,000	1923–46	4.6	4.58	100.17	Aug. 1, 1922	John B. Thayer of New York.
Sauk Center, Minn.	Waterworks	100,000	1937–52	5	4.64	104.325	July 1, 1922	Lane, Piper & Jaffray, Inc., of St. Paul.
	Storm sewer	2,500	1924–28	.		103.12	June 15, 1922	First National Bank of Sauk Center.
	Electric light	10,000	1932	.		100.70	July 1, 1922	First National Bank of Sauk Center.
Seneca Falls, N. Y.	Street improvement	43,000	1926–35	4½	4.44	100.565	July 1, 1922	Wm. R. Compton Co. of New York.
	Paving	10,000	1927–36	.		.		
Springfield, Minn.	Waterworks	22,000	1929–34	5	4.97	100.36	July 1, 1922	Kalman, Wood & Co. of Minneapolis
Tahoka, Tex.	Paving	30,000	....	6	....	100	......	Breg, Garrett & Co., Dallas.
Upper Arlington, Ohio.	Street improvement	100,800	1923–31	5½	5.20	101.30	July 1, 1922	Citizens' Trust and Savings Bank of Columbus.

Building Strike in Chicago Not "Settled"

Recent press reports have been so confusing concerning the present status of the building controversy in Chicago that the executive committee of the Citizens' Committee to Enforce the Landis Award has sent out the following statement of the situation:

"The last week in July a committee of international presidents of the building trades came to Chicago, and after investigation made recommendation to the officers of the American Federation of Labor that the Building Trades Council of Chicago be re-organized to include only those unions that are willing to accept the Landis Award. This committee apparently proposes that all 'outlawed' unions that accept the Landis Award be reinstated by the Citizens' Committee and contractors' associations, and thus eventually the entire building industry be turned back to union control.

"The Citizens' Committee welcomes any action on the part of leaders of union labor which will enable workmen in the outlawed trades to return to work in Chicago. However, in justice to the public, whose trustee the committee is, the committee is determined to carry on until permanent fair conditions are established in the building industry and not allow itself to be maneuvered into a settlement which bids fair to be only temporary. The Citizens' Committee has no confidence that the American Federation of Labor or the international presidents could control these outlaw unions should they be restored to power and should these unions again desire to break their contract. Three international presidents last fall came to Chicago to persuade their locals to accept the Landis Award but found themselves powerless as these unions refused to change their position."

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 3; the next, on September 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$2.83	$3.65	$4.00	+$2.80	$2.95	+$3.70	$3.10	$3.75	$3.75
Structural rivets, 100 lb.	3.00	4.35	5.50	+3.35	3.52½	4.80	4.25	3.75	6.50
Reinforcing bars, ½ in. up, 100 lb.	2.73	3.50	3.50	+2.70	2.85	+3.67½	2.55	3.60	2.90
Steel pipe, black, 2½ to 6 in. lap, discount	+60%	61.15%	45%	59½%	61.9-5%	46%	+46.6%	+50%	30.00
Cast-iron pipe, 6 in. and over, ton	53.30	+49.00	51.50	45.20	+52.00	57.00	51.00	+53.00	50.00
Concreting Material:									
Cement without bags, bbl.	+2.60	2.50	2.25	2.05	2.39	2.85	2.71	2.90	2.78
Gravel, ¾ in., cu.yd.	1.75	1.85	2.25	1.80	1.50	1.75	2.25	−1.00	1.50
Sand, cu.yd.	1.00	1.15	2.25	1.80	1.00	0.75	1.50	—1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	51.00@52.00	40.00	38.00	47.00	40.00	50.00	31.00	23.00	56.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.14½	1.80	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	11.00	11.15	11.00	17@18	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.0741	.086	.08	....	.11	.09
Hollow partition tile 4x12x12, per block	.1112	.0776	.115	.0657	....	.08	.108	.11	+.09
Linseed oil, raw, 5 bbl. lots, gal.	.91	.97	1.07	−.97	1.03	1.18	1.04	.86	+1.12
Common Labor:									
Common labor, union, hour	.60	.35	....	.80	....	.50@.55	.56¼	.50@.60	....
Common labor, non-union, hour	.44@.60	.30	.25	.72½	.35@.50	.35@.50	.47½@.50	....	+.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars; other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.13 cents. Bag charge is 80c per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Recent mill rise in price of structural steel, consequent to curtailed production caused by fuel shortage, reflected in higher quotations in Chicago and Denver warehouses. Shapes quoted in Chicago at $2.80 as against $2.68; structural rivets at $3.35 advanced from $3.25, and reinforcing bars at $2.70 as compared with $2.60 per 100 lb., one week ago. Denver quotes $3.70 on shapes as against $3.60 and bars at $3.67½ as compared with $3.57½, last week. Price of steel shapes and reinforcing bars, f.o.b. Pittsburgh, nearing minimum of $1.80 per 100 lb. Quotation of $1.70 fast disappearing, except on orders for shipment during last quarter. Steel pipe discounts reduced 1 point in New York warehouses, 2.5 points in San Francisco and 3 in Seattle, effective Aug. 8. Cast-iron pipe also following general upward trend in iron and steel prices. Advance of 50c. in Seattle, $1 in Atlanta and $1.50 per ton on 6-in. c.-i. pipe, in Minneapolis.

Linseed oil (raw) down 4c. in Chicago but advanced 8c. per gallon (5 bbl. lots) in Montreal.

Common labor rates, in Montreal, quoted at 30c.@35c. as against 25c.@30c. per hr., one week ago. Common labor rate for the whole United States remains at approximately 44c. per hr., with an average of 31c. per hr. for common labor on Federal Aid road projects throughout the country.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN Editor

Volume 89 NEW YORK, AUGUST 24, 1922 Number 8

The Mis-Step

It is easy, if one agrees with our comment on the President's cures for transportation strikes, to explain why the shopmen's dispute has dragged on so long. The President has condemned his own action. He declares that the Railroad Labor Board's decisions must be made enforceable. Yet he failed to put his great moral influence back of the board when the strike began. He actually proposed a settlement that went contrary to the board's views on seniority. Once he weakened his influence was gone. Both sides have rejected his overtures. His course should have been to support the board solidly. He could have aroused the country as it was at the threatened tie-up last year. The strike would have faded. The seniority issue—the present barrier to peace—would not have been resurrected.

Truth, the Tortoise

TRUTH, we are often told, is stranger than fiction. Unfortunately, this aphorism, like so many of its kind, is subject to many reservations. Some truth, we may say, is stranger than some fiction; but as a rule drab fact must yield to the more stimulating product of imagination. This observation is prompted by Mr. Ridgway's review in this issue of the recent accidents in the New York subways. Many of our readers in New York and elsewhere have learned through the daily press of happenings that seemed to be of most serious import and consequence, but relatively few have seen the later accounts announcing the facts as disclosed by investigation. The facts received nowhere near the prominence accorded to the earlier sensational and imaginative accounts. Truth was neither so strange nor so startling as fiction and suffered the consequences. And in addition to being commonplace, truth often labors under the handicap of arriving so late that everyone has lost interest in its subject.

Wise City Mapping

MAKING city maps for either special or general uses often requires actual field work, despite the fact that the necessary data have been previously secured, though for other purposes. Uncertainty as to exact boundary courses, monument positions or important topographic features may require a trip to the field for every new map prepared, unless definite record and use are made of all survey data acquired. Then, in changes in city engineering personnel important records may be mislaid or lost, and the loss of one may mean extensive resurveying. Again, an engineer stepping into a municipal position is often apt to view the work of his predecessor as more or less unreliable unless he have convincing proof to the contrary. Resurveys should be unnecessary except under unusual conditions. Needless duplication of effort in map production indicates weakness in office administration. Such processes are costly, and they abet an inclination to question the general surveying accuracy. How to adapt original information to any desired use, whether general or special, and how to produce maps with the least duplication in drafting detail is told on page 312 of this issue. Mr. Cotten describes a procedure that is well worth following.

Another Activated-Sludge Advance

CONFIDENCE in the activated-sludge process of sewage treatment, already strong in many quarters, will be materially increased by the report of Messrs. Eddy, Fuller, and Hatton recommending a plant of that type for the North Side of the Sanitary District of Chicago, and by the adoption of the recommendations by the district trustees (see p. 324). Works of the same type are already being constructed at Chicago, but they are relatively small. The estimates for the North Side plant are based on a *maximum* daily flow of 263 m.g.d. in 1930. The Milwaukee plant—many times the largest of any activated-sludge works yet put under construction, or even projected before the Chicago North Side works—is based on a maximum flow of 165.5 m.g.d. in 1930 and 231 m.g.d. in 1950. The population of Milwaukee in 1920 was 457,000. We have, then, one activated-sludge plant well under way to serve more than a half million people and another one, to serve well towards a million population. Besides these, activated-sludge works for Indianapolis (1920 population, 314,194) are well on towards completion. The 10- and 5-m.g.d. plants of Houston have been in operation for several years, as have a few other and smaller ones in the United States, Canada and England. If there are sceptics as to the activated-sludge process being worthy of consideration with other methods wherever a considerable degree of sewage treatment is required, their doubts should be removed by the Chicago report and its adoption and by the other facts just outlined.

Sludge Dewatering in Abeyance

ALTHOUGH the experts called in by the Chicago Sanitary District did not hesitate to recommend the activated-sludge process they did not feel that the time had come to install a sludge-dewatering plant for the recovery of the fertilizing value. As to this, it should be noted, first of all, that there are local reasons for postponement of sludge-dewatering on so large a scale at Chicago. The Sanitary District expects to test dewatering at one or both of the two activated-sludge works it now has under construction. Moreover, the sludge from the larger North Side works is to be forced to lagoons on land owned by the district, suitably located to serve as a site for a central dewatering plant for several works. It should also be noted that the experts'

report was made last February and adopted by the district trustees in May, before the conclusions of the more recent of the sludge dewatering tests at Houston, Tex., were announced (see *Engineering News-Record*, July 27, 1922, p. 132). When details of the later Houston dewatering results are available, and can be considered in the light of working results from the plants now being built for Milwaukee, Indianapolis and Chicago, we may at least hope that the dewatering of sludge from activated-sludge plants will have been placed on a stable basis, both mechanically and financially. By then the fertilizer market may be on a more certain basis, both for sewage sludge and garbage tankage, than it has been of late.

Sewage Treatment Extending

BROADER aspects of the adoption at Chicago of a sewage-works scheme for the North Side deserve notice. The Chicago Sanitary District is now well committed to a change from sewage disposal by diversion and dilution. This means sewage treatment to a relatively high degree for some three million people, whereas heretofore Baltimore, with its population of 734,000 in 1920, has been the sole example of a large American city that was treating its sewage. With Baltimore, Milwaukee, Indianapolis, and now the Chicago Sanitary District, which embraces the second city of the country, treating or committed to the treatment of their sewage, other large cities may be expected to follow, each with its own interesting and often complex problem for the solution of engineers, chemists and biologists, and with the resulting train of work for manufacturers and contractors; and after that a demand for trained operators and operating advisors that will increase both in the number and skill required. This outlook is encouraging for all concerned, including the cities themselves and the progress of river cleansing and water sanitation.

Is it Merely Summer Madness?

A FAVORITE topic in "polite" circles since the war has been the "panning" of the workingman for getting as much as possible for a minimum of work. Everybody has some evidence, the manufacturer, the contractor, the office manager. Even the housewife is qualified to testify: Hilda, who got $30 per month in 1914 for doing "everything, including washing," gets $65 now for the cooking alone. If perchance she gets $75 she has to have a helper to shortcut the potatoes to the garbage pail and de-sand the spinach. "The higher the wage, the fewer the work"—to paraphrase the old by-word.

We confess that we joined the chorus. We went farther. We wrote editorials about it. We preached the gospel of work.

We were right. We stand by what we said. Only we now wonder whether we saw only the mote in our brother's eye.

And did the manufacturer and the contractor, the office manager and the housewife likewise miss the beam in their own.

We've thought a lot about it this summer, just because we had to print a paper, which means doing business with other men. That has been a hard job. "Mr. Dobbins is away for the month." "Mr. Robbins does not come in Saturdays." "Mr. Bobbins leaves Friday noon for his rock farm in Connecticut, returning Monday at 12."

We were too polite to ask whether the salaries were still going on.

Nor was Dobbins or Robbins or Bobbins carrying the big burden of the business. He was pretty well down the ladder.

And we wondered how the rest of the organization was working, and whether Dobbins *et al* were in some of the "panning" parties we had attended.

We've felt pretty badly about it. We've written, mentally, homilies about the "uphill climb being the only one that develops real character and stamina." We've read de Tocqueville's counsel that the older a man grows the more work he needs to do to prevent him falling behind. We've pondered how Carnegie and Rockefeller, Edison and Westinghouse, Lincoln and Roosevelt performed their prodigious tasks. We've recalled how successful businesses have been built.

And then has come the thought, Is it merely summer madness? Will it pass when September crisps the air? Will hard work—giving all one can because of one's enthusiasm for the job—reassert itself?

Possibly and possibly not. Our own feeling is that all too many men are flattered by a little success and, proceeding to swell up and to regard themselves as "big" men, believe they can rest on their oars. Sometimes there is a fatal element of "four-flush" in it.

Certainly the man or the business that thinks the hard-work days are over has dropped behind. A man who has a copper-riveted competence may be able to ease up. A business, never.

The President and the Railroad Strike

THE PRESIDENT'S views on the remedy for the ills that now beset the public by reason of the railroad strike fall into two categories—that the decisions of the Railroad Labor Board must be made enforceable and that there must be no interference with men who desire to continue at work. The last was given a special emphasis that has been much commended. Unfortunately there was nothing in the President's address to Congress that pointed to immediate remedy. He explicitly said that he would not ask action on his first suggestion, while by his own confession the moral influence of the federal government has availed little in the present strike to prevent violence and intimidation. Indeed there are difficulties in the way of both of his solutions.

It will be readily agreed that the Railroad Labor Board should have the power to enforce its decisions. A service so vitally affecting public welfare may properly be hedged about with the condition that all who enter it undertake to forego the right to strike. Whether Congress will lay down this condition and set a penalty for violation, whether it will take even the smaller step of holding the union leaders responsible for organized stoppage of work remains to be seen. It refused to accept such provisions when the Transportation Act was passed. Has the present strike changed its views; which is another way of asking whether union influence has waned with Congress.

But even if such provisions are written into the law, will they be effective? Compulsory arbitration has failed in Canada and Australia. Will it succeed here? It will only if the true seriousness of the offense is put

strongly before the public or if the public's toes are stepped on. Only then will the public exert its pressure. Of instant disapproval we had an excellent example when the train-crew brotherhoods threatened to strike last year. The public's protest was menacing—and the strike was canceled before it started. But when, as in the present instance, the public does not suffer, it will not exert pressure unless some one arouses it by a strong statement of the facts, the losses and the consequences. That "some one," in the case of a railroad strike, must be the President of the United States.

A Roosevelt would get action.

As to his other cure, protection from violence and intimidation of men who want to work, strong executive support is equally needed. Even then this protection may not be afforded. Local opinion determines the enforcement of law. Herrin today is a disgrace to America. The law is flouted because the law officers and the community are on the side of the law breakers. Yet the effort must be made. Some one must thunder and put the public back of the law.

Again the President is that "some one" when the strike is national and affects interstate commerce. The effective officers may be the governors of states, but the President can dramatically put the public behind them.

From mere legislation then we are not sanguine of results. From legislation backed by the Rooseveltian passion for the maintenance of the law there will be effective action.

The Heart of the Problem

THE BITUMINOUS coal industry has declared a truce to run until April, 1923. By it, the United Mine Workers have won their demand for a continuation of war-time wages and the public is already reaching into its jeans to pay the bill. Negotiations now under way give promise of a similar result in the anthracite field, and by the time this is printed an agreement may have been reached.

Meanwhile, President Harding has submitted to Congress two definite requests. One is for authority to create a commission to investigate the coal industry and "to reveal every phase of coal production, sales and distribution." This he intends as a first step toward finding a cure for the economic ills of the industry. His second request is for a temporary national coal agency with power to use public funds for the purchase, sale, and distribution of coal in interstate commerce. This is frankly an emergency measure designed to curb exploitation of the public through the impending coal shortage.

The more far reaching and, in the long run, more important of these recommendations is that which proposes the commission of investigation. As a rule we are not enthusiastic over governmental commissions but in this case there seems to be no other way out. The President is right in his insistence that such a commission shall be non-partisan rather than bi-partisan, as is so persistently argued by some in the industry. It is almost time that both miners and operators were made to realize that theirs is not a "private fight." The President should see to it, moreover, that the personnel of the commission does not consist of actual or would-be politicians, office holders, legislators, or other members of the axe-grinding, vote-serving fraternity.

Real work lies ahead of such a commission, for the coal industry appears to be in an astonishing mess. For five months we have been deluged with "facts" at the hands of both miners and operators. From these "facts" anything might be proved, depending on who did the proving. The prime need is an impartial and thoroughgoing investigation, conducted to ascertain facts that are four-square and that will bear the light of day from whatever direction it may shine. But beyond this fact-finding function the most important work of such a commission will be the formulation of the "constructive recommendation" the President declares to be so imperative. The tenor of such a recommendation we scarcely can anticipate. But the nature of the problem is not far to seek, and the questions that will loom before the commission have already begun to shape themselves in the minds of thinking people. Without generalizing too broadly, we might almost boil most of these questions down to one, "Why is not the coal industry as other industries are?"

The basic difficulties appear to arise from interference with the operation of economic laws. Here is an industry with a productive capacity of nearly 800,000,000 units annually and a maximum recorded annual demand of less than 600,000,000 units. Some of its 10,000 producing elements are efficient, others are not. In any ordinary industry under the influence of a restricted demand, the normal operation of economic law will strike down the inefficient. But in the coal industry, this does not come to pass. An explanation might be found in monopoly or far-reaching combination, but as a matter of fact, the market seems to be wide open and competitive. What is the reason for this?

This industry, furthermore, is overmanned in proportion to its over-capacity and as a result, there is not steady work for all its workers. In other industries under these conditions, forces are reduced and workers seek employment in other fields. But in the coal business, all are kept at work, even though most of them can put in so little time that high unit wages produce but small income; and the coal-buying public is forced through a needlessly high price for coal to contribute to the support of idleness. And this idleness is not the idleness of seasonal production, for contrary to popular belief, the output is remarkably constant. What, again, is the reason for this?

These are the fundamental questions that will confront the investigating commission. Somewhere in the coal industry there is a departure from the process of what we usually regard as economic law. This divergence may be a natural and inevitable result of circumstances peculiar to the industry; if so, the matter has not yet been explained. On the other hand it may be due to a wholly artificial and possibly predatory interference with normal processes. Whatever the cause, it is certain that any violation of economic law entails a loss to someone; and when the violation affects the supply of necessities, producers are almost invariably enabled to shift the loss to the consumer.

Before there can be peace and progress in the coal industry, the source of this difficulty must be run down and corrected. If the trouble be due to artificial interference with economic law the remedy must be sought in the re-establishment of normal conditions and not in the imposition of further artificial regulation. We cannot find a cure in the hair of the dog that has bitten us. This is the task before the commission for which the President has asked.

Telescoping Tower on Scow Shifts Arch Centers

Ten Steel Centers Used for Spans of New Harrisburg Bridge Across Susquehanna—Set Up Twice Under Each of 46 Arches —Scow Trips of 3,000 Ft. With 60-Ton Centers Assembled

ASSEMBLED steel centers for 66-ft. arches will be set up and taken down some ninety times by means of a floating erector employed at the Susquehanna River bridge of the Philadelphia & Reading R.R., at Harrisburg, Pa. This erector consists of a steel-frame tower mounted on a scow, and made of three parts which slide up and down on each other, or "telescope," so as to alter the height of the tower. A variation, between bridge ends of 24 ft. in the height of the spring lines above water level, made an alteration in the height of the center necessary for each arch. The telescoping feature of the tower provides for this adjustment of the center vertically, while the floating support is a most flexible means of conveyance from span to span and from side to side of the bridge.

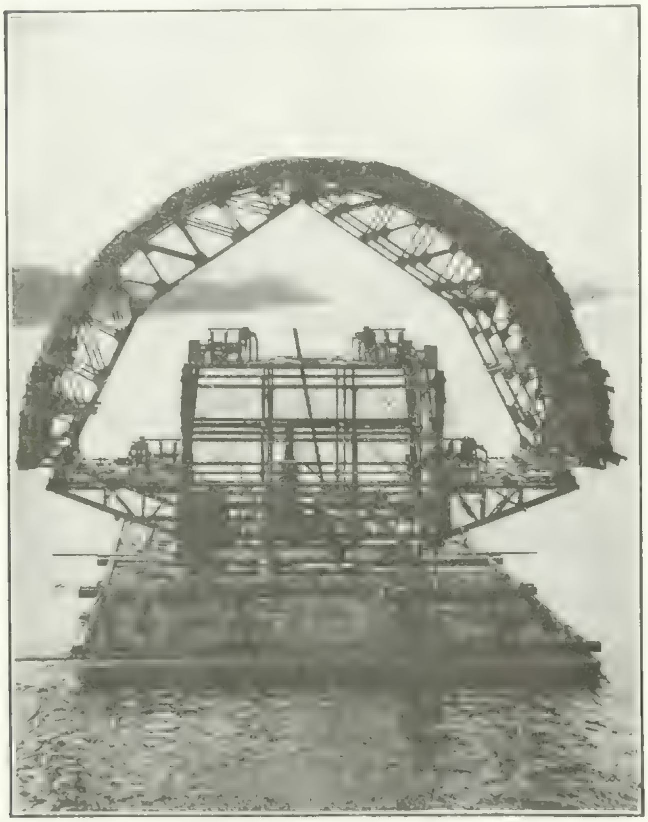


FIG. 1. CENTER ON ERECTOR MOVING TO NEW POSITION

There are 46 spans in the new bridge only two of which are wholly on shore. Under all the others, with perhaps a little crowding at the banks, scows can be floated. The clear spans are all 66 ft., but the two shore spans are 70 ft. 6 in., center to center of piers and the others are 73 ft. 3 in. The arches are circular with a 3-ft. ring at the crown. Between parapet walls the width is 31 ft. 6 in. and it provides for double tracks. One-half of the width comes directly in the place occupied by the present steel bridge so that the new bridge is being built a half at a time except the piers. These were built full size encasing and extending with concrete the old steel bridge piers and building additional intervening piers of concrete. The arches were built first for the half of the bridge not interfering with the old steel bridge. When the tracks are shifted to this half from the old bridge that structure will be removed and the remaining half of the concrete arch structure will be completed.

Half of the bridge being built at a time, the center for each arch has to be erected and taken down twice. With water under all but two spans and high water, drift, ice and navigation obstacles to fixed falsework, the natural thought was to plan a few centers which could be used repeatedly and to employ water craft as the means of shifting the centers. The hard usage of repeated shifts made steel the obvious material for the centers. For the same reason it was apparent that the arrangement for placing, removing and transferring the steel ribs ought to be of the erector type—a mechanism which would lift down the assembled structure, safely carry it to another place and put it up again, performing, incidentally, all the necessary adjustments. In these circumstances centers and erector were parts of a single problem in design and fabrication and were arranged to be handled together by the Blaw-Knox Co., Pittsburgh, Pa.

Each center consists of three steel-arch ribs with hinges at the crown. The ribs are assembled, completely braced and lagged, as a unit. In place they rest on brackets set into niches molded into the concrete piers. The view, Fig. 2, shows a series of centers in place, with the old steel bridge visible through them. When being erected, lowered and shifted they rest on

FIG. 2. CENTERS IN POSITION ON HARRISBURG BRIDGE

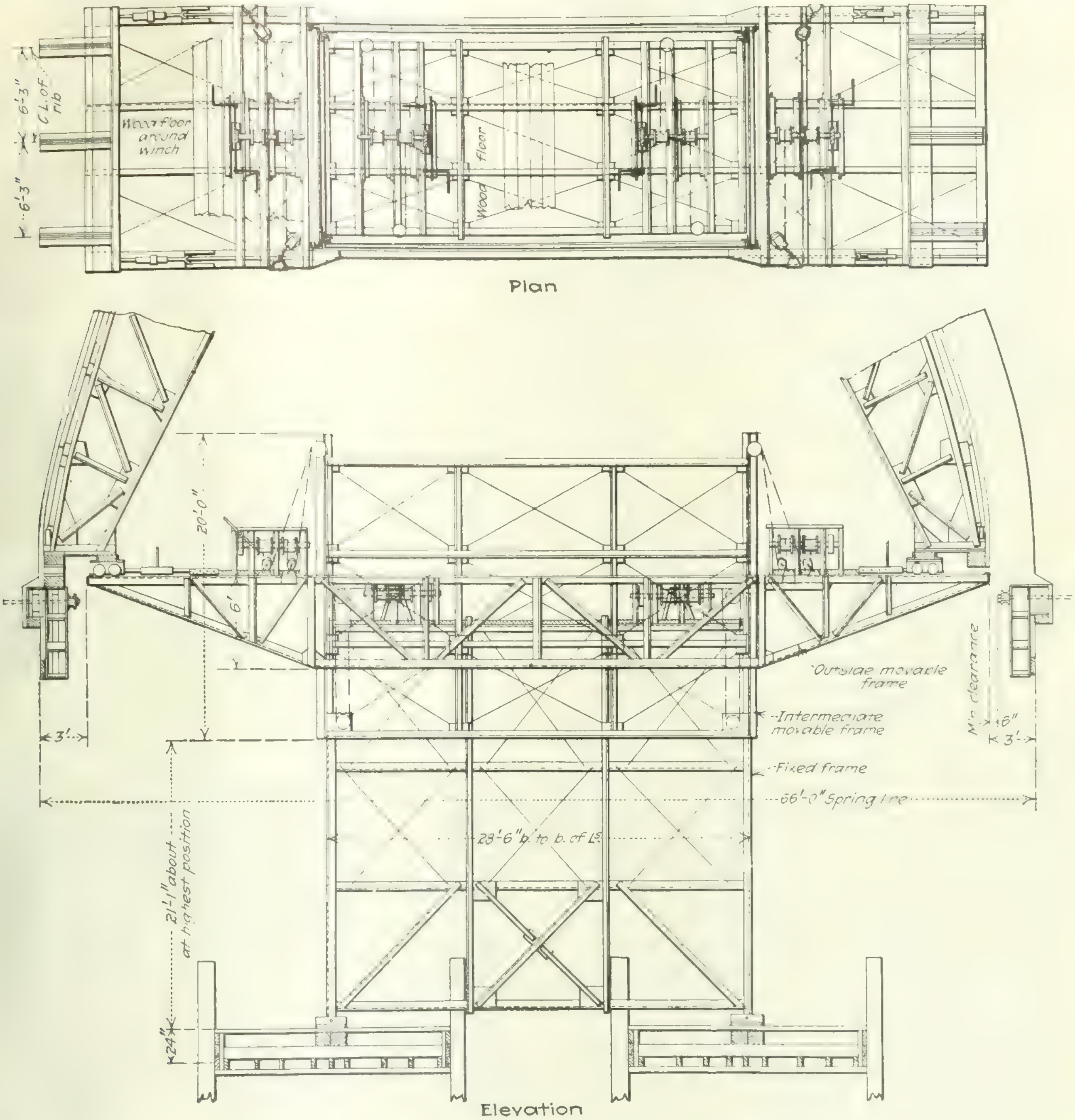


FIG. 3. DIAGRAM OF ERECTOR FOR MOVING CENTERS

the cantilever arms of the erector as shown by Figs. 1 and 3. Once assembled a center does not need to be dismantled and none of them were while one-half of the bridge was being built. In the considerable intervals between the building the first and second half, it was necessary to dismantle and store the centers.

The distinctive feature is the erecting tower. This is shown in general detail by Figs. 1 and 2. It consists of (1) a rectangular steel frame fixed on the scow; (2) an intermediate movable frame which slides up and down on the fixed frame, and (3) an outside movable frame, with cantilever arms, which slides on the intermediate frame. The movable frames are operated by winch drums operated by a worm drive so that the movements are always under control. Fig. 3 shows the position of the centers on the erector, on the left side when the center is in position for concreting and on the right side when it has been contracted for moving. For transfer from arch to arch the movable frames are lowered so as to bring down the center of gravity and make the load safe for towing. Fig. 1 shows the center in towing position.

A change of center from arch to arch requires about one day, including all adjustments and getting ready to concrete. To raise the center from its lowered position while being towed, takes about 2½ hours. Experience with the erector has demonstrated that for the work it has to do the structure has to be strong and rigid and there must be ample reserve power in the hoists to make operation easy and sure.

The contractors for the bridge are the James McGraw Co., Philadelphia, Pa. It was designed by the engineers of the Philadelphia & Reading Ry., Samuel T. Wagner, chief engineer.

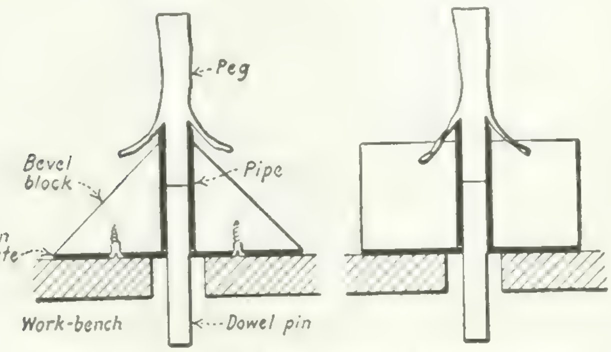
From Job and Office

Hints That Cut Costs and Time *For Contractor and Average Engineer*

Dowel Pins Made from Pick and Shovel Handles with Improvised Device

According to a recent issue of *Engineering and Mining Journal-Press*, a supply of dowel pins was needed to dowel wooden air pipe at a certain isolated mine. To send out for the pins would have involved a delay of two weeks, so the pins were made from pick and shovel handles with a device improvised for the purpose.

The device consisted of a 3-in. length of pipe with an internal diameter equal to that desired for the dowels. This pipe was filed square on one end and beveled toward the inside on the other end. The pipe was set vertically with the beveled end upon an iron plate over a hole of the same diameter as the pipe. It was held in position by a beveled wooden block, which was screwed to the iron plate in the fashion shown in the accompanying illustration.



IMPROVISED DEVICE FOR MAKING DOWEL PINS

Old pick and shovel handles were sawed into 4-in. lengths and then split roughly into square pegs. The pegs were then driven through the pipe with a wooden mallet. The dowel pins were thus made rapidly and at a small cost.

Plan and Photograph of House on Same Print

In *Engineering News-Record*, May 25, p. 886, there appeared an article entitled "Plan and Photograph of House Shown on Same Print." This journal has received a letter from G. H. KcKelvey, Westfield, N. J., in which another method of doing substantially the same thing is described. Part of the letter follows:

> If the plan of the house had already been drawn on paper or tracing cloth to a scale different than that desired on the finished print, the quickest and cheapest method would be to photograph it on a portion of the same negative which was to be used for the picture of the house, or on a separate one. This plan photograph could be reduced or enlarged, as desired, and there would be no necessity for redrawing or retracing it. Personally, I would prefer to make a photograph of the house, get a print of it or enlarge it to the proper size and then mount plan and photograph together on white paper. Then a photographic copy giving both could be made, with the same density of film for both parts. This would obviate any difficulty in unequal development of plan and photograph. If the plan of the house had to be drawn especially, separate negatives could be made and the development of the prints simplified.

Replacing Roller Bearings and Bed Plates Under Bridge Spans

By A. A. Blaeser
General Contractor, Allentown, Pa.

In replacing the bed plates and roller bearings under the expansion ends of several spans of the Pine Street Bridge across the Lehigh River at Catasauqua, Pa., use was made of a device, which, besides presenting several structural advantages, allowed all the work to be done from the tops of the piers. The bridge trusses were 19 ft. on centers and the span lengths were 147 ft. for the seven-panel and 168 ft. for the eight-panel trusses. The roadway was laid with a wood-block pavement on 3-in. creosoted planks resting on I-beams running to girders at the panel points. The bridge was provided with 6-ft. cantilevered sidewalks of 2-in. creosoted planks.

The device used consisted of a saddle placed under the batter post of the truss and hung on U-bolts from a 4-in. pin that was run through the center of the web of a 15-in. H-beam used to stiffen the batter post. Two flat straps engaged this pin at their lower ends and another pin at their upper ends. This second pin was cradled in a U-strap and took bearing on steel plates placed on short 15-in. I-beams set perpendicular to the truss axis and high enough to clear the batter post. Under the ends of these short beams were placed the jacks.

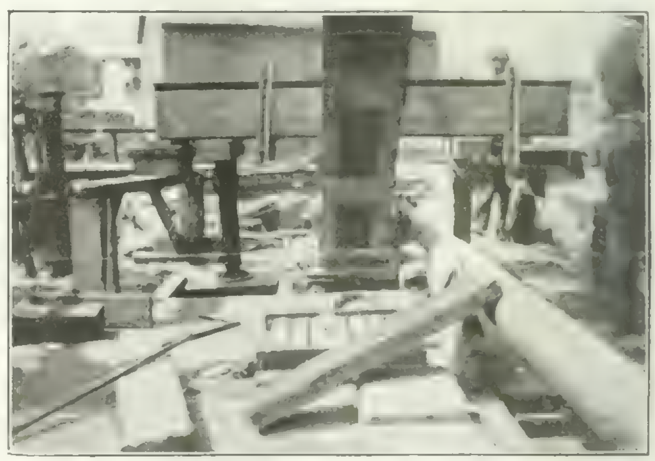


FIG. 2. TRUSS JACKED AND ROLLERS REMOVED

The plates under the second pin had the effect of distributing the load over the top flange of the short beams, lessening the possibility of buckling the web when the truss had been jacked. The centers of the plates were cut out and slipped over the U-straps before the pin was placed, preventing the I-beams from spreading. The beams were tied together by light angles fastened with long bolts.

In raising the first span one 35-ton ratchet jack was used under each truss. The off side was blocked about 4 in. before jacking operations began. When the

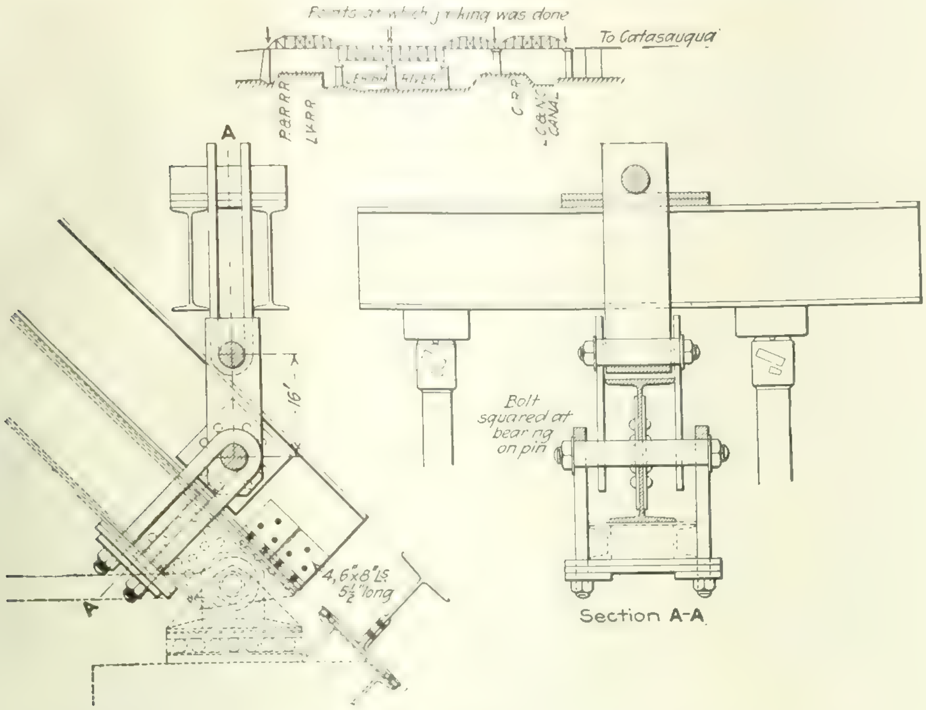


FIG. 1. DETAILS OF TRUSS JACKING RIG

sufficient lift had been attained the jack was then about 4 in. higher. After this first span had been jacked, however, it was found more practicable to use two jacks under each truss, a method that was followed in remaining operations. The 15-in. H-beam which reinforced the batter posts was held at its upper end near the top of the batter post by a heavy clamp and at its lower end by removing eight rivets and replacing them with bolts.

By means of this device we were able to work entirely from the top of the pier by cutting out a 3-ft. x 3-ft. square in the flooring. This was a decided advantage inasmuch as the top of the pier was more than 30 ft. above the track and canal bank level. The double-pivot arrangement allowed uneven jacking and allowed for expansion or contraction. When the truss was jacked up the necessary distance (about 1½ in.) the old rollers and bed plates were removed and blocks were inserted under the shoes so that all unnecessary risk would be avoided. After the rust had been scraped from the shoes the blocks were removed, the bed plates and rollers set in and the bridge lowered.

We also lifted the ends of two half-deck spans which came together on the river pier. This operation was comparatively simple. The latticing was removed at one point and holes were drilled into the flanges of the vertical end-post channels. Heavy plate was then bolted onto either side of the post, the base of the plate being cut to fit over a 4-in. pin placed in the pocket and acting as a beam to carry the load to the 15-in. H-beam placed on either side of the post and extending over the pier. This permitted the placing of the jacks between the posts.

The only difficulty met in working on this pier was the necessity of resetting the capstone under one of the posts. To do this we worked two ½-in. flexible cables under the stone through the mortar joint and then attached the tops of these slings to steamboat rachets. The stone was raised as soon as the roller bearings and bed plates had been removed. The old mortar was then cut out and the stone lowered onto a new mortar bed. The slings were then drawn out. The holes made in the end-post channels were closed with rivets after the jacking was concluded.

The crew that accomplished this work consisted in a rigger foreman, four riggers and one carpenter. It took about a week to finish each span, though at no time was it necessary to stop traffic over the bridge. The work was done under the immediate supervision of the writer and the inspection was in charge of the county engineer, J. H. Sieger.

Method of Setting Slope Stakes With Rod, Hand Level and Tape

By Paul McCombs
Roswell, N. M.

An ACCURATE and quick method of setting slope stakes wherein the only instruments needed are a hand level, a rod and a specially-marked tape is explained in the following paragraphs. The system has been in use by the writer for some time and has proven highly successful.

When Grade is in Cut—Referring to Fig. 1, which is the explanation of the first case, the finished grade is completely in cut. *E* is the center grade stake and *EF* is the height of the observer's eye. *LB* and *OM* are distances out from the finished road edges to the position of the slope stakes, and *IA* and *KD* are rod readings. It is apparent from the figure that the slope stake is to be set at that point at which the rod reading plus the tape reading minus half the width of the road bed equals

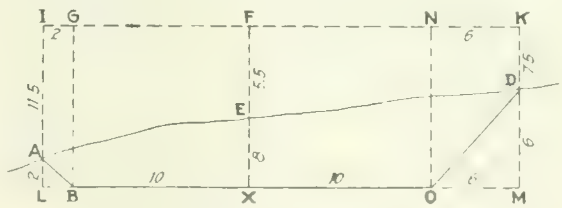


FIG. 1 -SETTING SLOPE STAKES IN CUT

the amount of center cut plus the height of the observer's eye.

To the end of the tape is attached a string or wire equal to half the width of the road bed, in this case 10 ft. That makes it possible for actual tape readings to begin at the edge of the road bed so that that half width of road bed is automatically subtracted from any calcula-

tions. In Fig. 1 the slope is assumed as a 1:1. Adding, therefore, the center cut to the height of the eye we have 13.5 ft. The observer stands with his heel at the center stake and takes the loose end of the 10-ft. wire, holding it over the stake. The rodman takes the tape down hill and holds the rod at various points, calling readings on the tape while the observer reads the rod with a hand level. When that point is reached where the tape reading plus the rod reading equals 13.5 ft. the slope stake is set. The process is repeated for the other side.

Should the cut be made on a steep side hill where the total rod readings cannot be taken from the center grade stake, the observer may choose a convenient rod reading such as 10 ft. He then moves on to the point occupied by the rodman, adding in this case 10 ft. to the original distance (center cut plus height of eye). The observer takes the tape at the point held by the rodman and the

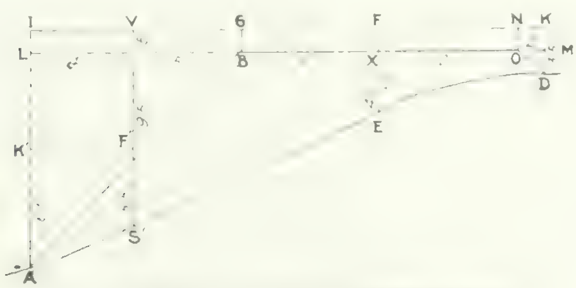


FIG. 2—SETTING SLOPES STAKES IN FILL

process is repeated until the center cut plus the height of eye equals the rod reading plus the tape reading.

When Grade is on Fill—Fig. 2 represents a case wherein a finished grade is entirely on an embankment. As the slope in embankments is usually 1.5:1, in order to simplify calculations, the tape can be turned over and divided into spaces of 1.5 ft. and these spaces subdivided into tenths. The calculations can then be treated as if the slope were actually 1:1.

In this case, referring to Fig. 2, the center fill is 4 ft. and the height of the eye 5.5 ft. Subtracting the center fill from the height of the eye leaves 1.5 ft. The observer then holds the loose end of the wire over the center stake and the rodman goes down the hill until the rod reads 9.5 and the tape reads 5. The observer then moves on to the point held by the rodman, adding 5.5 to his 1.5, making 7. The rodman moves on down the hill until the rod reads 6.5 and the tape reads 9. The sum of the two rod readings is 16 ft., from which is subtracted the tape reading 9, leaving 7. This is the proper point for the slope stake.

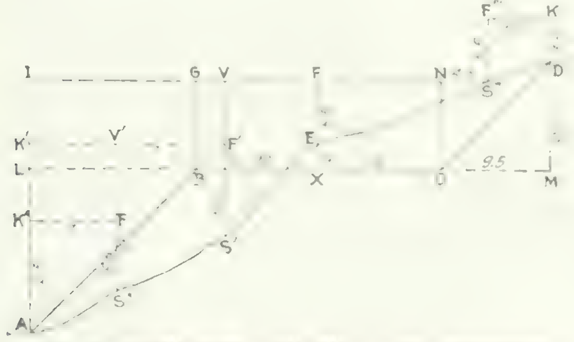


FIG. 3—BOTH CUT AND FILL ARE INVOLVED

FROM JOB AND OFFICE

Hints That Cut and Time

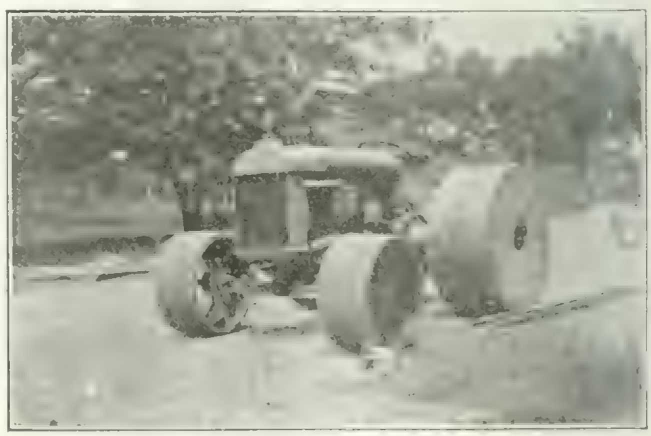
Both Cut and Fill—Case 3 represents a situation wherein the finished roadbed is in both cut and fill. Referring to the figure, the observer holds the end of the wire over the center grade stake, adding to the 2-ft. cut the height of eye, making 7.5 ft. The rodman goes down the hill to a point where a rod reading of 10 ft. is taken, the observer moving on to that point. The height of eye is added to the 7.5 ft. making 13 ft. The rodman continues down the hill to a second point where the rod reads 10 ft. and the tape reads 7. The observer then occupies that point and again adds his height of eye to the 13 ft., making 18.5 ft. The rodman continues down the hill to a third point where the rod reads 12.5 and the tape reads 14. All the rod readings (10, 10, and 12.5) are added, making 32.5. From this is subtracted the tape reading 14 ft., making 18.5. Hence this is the proper point for the slope stake.

There are various other cases than those cited herein, but the general procedure is clear and the engineer who finds this method of setting slope stakes to his liking can apply the general principles to any other cases.

Tractor Is Converted Into Road Roller

By Russell W. Hunt
Resident Engineer, Division of Highways, Vernon, Ill.

BY FILLING with cement the extension rims of the traction wheels of a Fordson tractor a very successful light roller for road work was produced by Mautz & Oren, Effingham, Ill., contractors. The cement filling made the tractor weigh about 5,000 lb., and gave double



CONVERTED FORDSON TRACTOR ROAD ROLLER

roller wheels with 20-in. treads. The front wheels have 14-in. treads.

The heavy steam and horse rollers which were generally used are very unhandy and cumbersome to use between forms. Oftentimes the roller is needed for only a short time, perhaps not over an hour during the whole shift, yet, in the case of the steam roller, steam must be kept up at all times. The improvised roller is ready at any time and with much less trouble does just as good work. It is very easy to handle, can do the same amount of work more quickly and takes up very little space, being left between the forms during operations. The weight of the roller was the only

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question in doubt when the roller was considered, but it has proved equal to the demands. It leaves a very smooth and firm subgrade and a much more even surface than the heavier rollers.

While the roller was made primarily to roll subgrade, it is very useful in many other ways. It pulls the turntable, hauls heavy loads of material and is often used to pull the plow.

Track Device Detects Loose Wheels

AT THE Stotesbury mine of the E. E. White Coal Co., Stotesbury, W. Va., an ingenious track device has been designed which detects wheels having too much play and which sounds an alarm when they are found. According to a recent issue of *Coal Age*, with this arrangement no one is required to give his time to inspection as the action of the device is automatic, and

DEVICE FOR DETECTING LOOSE WHEELS

what is more advantageous, each car is inspected every time it passes over the empty track at the tipple.

The inspection is foolproof, for every car that passes over the device is made to sound an alarm if the wheels under test do not continue within the limits of the track gage. One of the several men who work about the tipple will hear the alarm and the car is then run without delay onto the track leading to the shop. With the following description and the illustration shown it is possible for the blacksmith to fabricate the rail of which the device is composed.

Referring to the illustration, the entire length of the detecting track is no greater than that of the standard rail—that is, about 30 ft. This rail length is inserted on the empty or return track leading from the tipple so that the cars pass through it by gravity. To the left of the illustration of this device will be seen the 4-ft. latch rail *G*, fishplated loosely at one end, *A*, so that it may be thrown in line with either of the two rails, *B* or *C*, on the left. A detention spring, *D*, on the forward end of the latch holds it in line with the outer rail, *B*.

Imagine a standard pair of wheels, properly attached to an axle and truly in gage, passing through this track. Rail *C* is in gage with rail *E*, but the guide rail, *F*, attached to the latch rail, *G*, will not permit the passage of a left-hand wheel over rail *C* until the latch is swept from the normal position as shown to one in which rail *G* is in line with rail *C*. This is accomplished against the tension of the spring at *D*.

The right-hand wheel is pulled by the guide rail *F* (the gage of which with respect to *H* increases) toward rail *H* until the flange of the wheel comes into contact with it. In this position the flanges of the wheels on either side rub the two guide rails *F* and *H*, and only a small width of the tread on each wheel rides upon the rails *G* and *E*. But as the gage between *F* and *H* increases the latch rail and its guide are pulled into gage against the tension of the spring until the latch lines up with *C*, thus permitting the left wheel to pass over it and out to the point where the trip is made up.

If one of the wheels, being loose, is free to increase the gage between the wheels when passing through this track, the latch will not be thrown, and the wheels will ride upon rails *B* and *E* instead of *C* and *E*. On the ball of rail *B* are welded a number of vertical offsets or humps about one-half inch high. These make the car bump up and down when a wheel passes over them, and this is a signal to the men at the tipple that a defective car is passing over the track. At point *I* is located a small latch loosely fishplated so that wheels riding either on rails *B* or *C* may pass this point.

The entire length of the rail on the right-hand side is fishplated and secured to the ties in the ordinary manner and is paralleled by the inner guide rail, which is bolted to it and held at a distance of 2 in. from it by separating collars through which the bolts pass.

The double rail on the right acts as a raceway, holding the flanges of the right-hand wheels against the inner guide rail. The tension spring at *D* should be strong enough only to pull back the latch to the position shown, after a normal car has passed. A spring with a tension of about 30 lb. should do this work.

The blacksmithing job required is easy. And the cost complete is nominal. The saving made by detecting a loose wheel before it has time to cause a smashup at frogs and switches will repay the expenditure.

Estimating Floor Slabs

Engineering News-Record has been asked what, if any, is the standard practice in estimating that portion of the floor slab which rests in the wall. One prominent New York building contractor says it is part of the wall. Another says the slab. This journal would like comments on the point to see if a definite standard of practice can be arrived at.—Editor.

Making Curve Templets of Pressboard

By H. D. Hurley

Assistant Engineer, Massachusetts Department of Public Works, Boston, Mass.

MOST CIVIL engineering offices have a set of metal curve templets as a part of their regular equipment. Railroads usually use those of the even-degree type, and highway or general engineering offices the even-inch radius curves. A set of curves can be made quite easily by the individual engineer or draftsman, which will be found useful in small offices or in the field.

The material to use for this purpose is 0.015-in. pressboard. It is a tough durable paper of mottled reddish-brown color. In order to make these curves it will be

DETAILS OF CURVE BOX

necessary to have a metal set to use as a copy. Place the metal curve on the pressboard with the bevel up in order to insure a close edge contact. Scribe all around with a sharp knife, then remove the metal and finish the cut with shears. Cutting all through with the knife is apt to leave a burr.

The writer made a set of the railroad type curves of this paper consisting of a curve every 5 min. from 0 deg. 15 min. to 1 deg.; every 15 min. from 1 deg. 15 min. to 10 deg.; every 30 min. from 10 deg. 30 min. to 15 deg.; and every degree from 16 deg. to 28 deg.—a total of 69 curves.

A box can also be made for the curves with little effort.

Paving Breakers Wreck Reinforced Concrete Meter Vault

COMPRESSED - AIR - operated picks or chiseling machines, commonly used in breaking up pavement for street railway work and trenching, greatly hastened the demolition of a section of building wall and an adjacent Venturi meter vault of reinforced concrete at the Cleveland, Ohio, filtration works. The wall was 20 x 23 ft. and 2 ft. thick reinforced with ¾-in. rods on 8-in. centers. It was demolished in three days. The paving breakers not only broke up the concrete in pieces large enough to be handled by one man, but with the aid of a cutting chisel they also cut off the steel reinforcing side rods. These cutting chisels were similar to those used for asphalt except that the edge was concave so that it would not slip off the bar. Two men operate each machine.

The view shows the paving breakers at work on the side walls of the Venturi vault. These walls are 12 in. in thickness, 51 ft. long and 10 ft. high. They are reinforced in the same way as was the west wall of the building, and were removed in seven days. The

FROM JOB AND OFFICE

Hints That Cut Costs and Time

roof of the vault which was of the same dimensions and construction as the sides, was removed in 3½ days. This work it is stated would have taken many more men a much longer time to do if hand methods had been used, and would of course, have been much more expensive.


PNEUMATIC PICKS WRECK REINFORCED CONCRETE VAULT OF FILTRATION WORKS

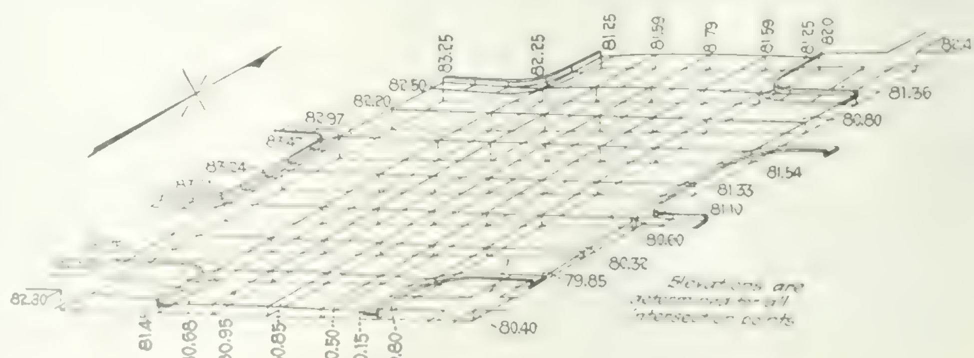
M. A. O'Brien, Secretary and Treasurer of the Lake Erie Construction Co., of Cleveland, Ohio, supplied this information. The work is in charge of Supt. William Maloney. The paving breakers were manufactured by the Ingersoll-Rand Co., New York.

Street-Intersection Grades Determined by Aid of Isometric Projection

By L. R. Douglass

of Douglass, Corey & Fiske, Engineers, Trinidad and Walsenburg, Colo.

DETERMINATION of elevations at street intersections is a problem over which many theories have been advanced, and to which much discussion has been given in the technical press. The difficulties of solving the problem satisfactorily are increased when intersecting grades are steep and elevations at the curb angles



VISUALIZING EXISTING AND FINISHED GRADES

FROM JOB AND OFFICE

For Contractor and Average Engineer

vary, rendering impracticable the use of the usual formulas.

This office, in working out street intersections in Trinidad, found the problem a difficult one in view of the fact that the city is situated in a mountainous section of the state, the topography being steep and hilly.

In developing a satisfactory method of working out these intersections it was necessary to visualize them. The method of platting on an isometric projection was therefore tried out. The idea was to plat the intersection so as to show both plan and profile at any point and as a whole. A convenient datum was selected which was passed under the 30-deg. isometric projection of the intersection, showing the exact relation between the existing elevations of the intersection and the proposed elevations of street, curb and gutters

Results by using the isometric projection method have proved highly satisfactory.

Assembling and Spacing Reinforcement in Pavement Slabs

SPECIAL methods to ensure the accurate positions of reinforcement in concrete pavement slabs are provided in the standard plans of the New Jersey State Highway Commission. Both pre-woven fabric and assembled-bar reinforcing sheets are employed.

If bar reinforcement is being used the arrangement indicated by Fig. 1 is employed for assembling the bars. This wooden frame is set on horses about 2 ft. above the ground so that a workman can step inside between the bars to make the wire ties and for other operations. Woven fabric is received in flat sheets of the proper size and ready to be put down.

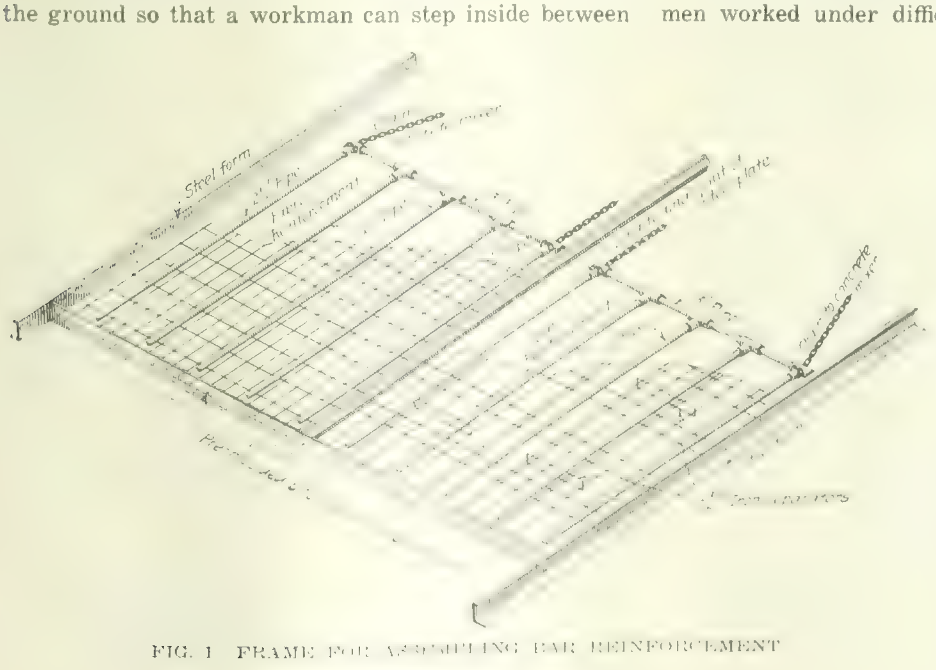


FIG. 1 FRAME FOR ASSEMBLING BAR REINFORCEMENT

When the sheets are assembled they are spread with the proper lap on the sheets previously placed, on the grids of pipe shown by Fig. 2. These pipe grids hold the sheet off the subgrade until the concrete is deposited. Then the grids are pulled ahead and another sheet of reinforcement is placed. When there are two layers of reinforcement they are assembled, as indicated, with spreaders to hold them the proper vertical distance apart.

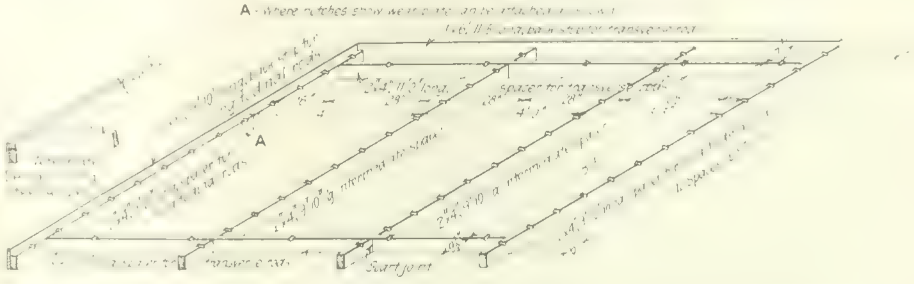


FIG. 2 PIPE GRID PULLED BY PAVER SPACES SLAB REINFORCEMENT

T. J. Wasser is state highway engineer of New Jersey with C. F. Bedwell as construction engineer.

Laying Asphalt by Artificial Light

Night work placing asphalt surfacing on the plank roadway of the Victoria Bridge, near Montreal, Canada, disclosed a number of difficulties due to artificial lighting. A $1\frac{3}{4}:2\frac{1}{2}:1\frac{3}{4}$-in. surfacing was required on a surface-worn plank roadway 6,400 ft. long and 14 ft. wide, and the only time the contractor had access to the bridge for construction operations was from 11 p.m. to 6 a.m. The ordinary bridge lighting was not sufficient, so it was found necessary to use high-candlepower, portable searchlights. Three rakers and an average of eleven shovelers were employed to spread the mixture. These men worked under difficulties, caused mainly by inefficient lighting and narrowness of the roadway. It was extremely difficult for the rakers to spread the material to the thickness required because of the many shadows which gave false impressions of variations in contour of the pavement. The roller engineer encountered some difficulties from this same cause, and found it very hard to operate the roller along the inner guard rail. Working six or seven hours facing the strong lights was a great strain on the eye and nerve. The bad condition of the plank flooring made raking difficult, for many splinters were lifted by the shovels and these made the mixture hard to handle

Electrolytic Corrosion of Steel Water Main at Akron, Ohio

SEVERE corrosion of about 1 out of 11 miles of the 36-in. steel force main of the water-works of Akron, Ohio, was found after considerable expert investigation to be due to mild stray electric current leaving the main to journey three miles by a low ground-resistance route to a power house. The case is reported in detail in the September *Journal* of the New England Water-Works Association by G. Gale Dixon, chief engineer, Akron Bureau of Water-Works Improvements, and Victor B. Phillips, of Crecelius & Phillips, Engineers, who investigated the electrolytic conditions for Akron. Additional information and opinion are contributed by F. A. Barbour, Boston, who was consulting engineer for the city when the pipe was laid. A number of other specialists were engaged in one or another phase of the investigation, one of the main objects of which was to throw light on the advisability of using steel for a parallel line of 48-in. main required by the City of Akron. Steel was finally used for the second line, except that 0.9 miles across the low-resistance ground was laid with cast iron before the exact cause of the corrosion had been determined and a nearly complete electric balance established. Lock-bar pipe was used for both of the steel pipe lines.

Mr. Dixon states in his paper that the first or 36-in. main was constructed in 1913-14 and put in operation in August, 1915. The pipe was actually distributed along the line between Nov. 21, 1912, and April 23, 1913. The pipe laying was started in May, 1913, and completed in July, 1914, "so all of the pipes were exposed to the weather of practically a full winter season, while a portion of it was on the ground during two winters, but this was not the portion of the pipe which was seriously damaged by corrosion."

In May, 1919, the pipe was uncovered at eight points in wet clay ground as a part of the studies for the parallel pipe line already mentioned. Mr. Dixon states that "in all cases the condition was found to be good; the coating in some spots was brittle and in others thin or easily removed, but no pitting was observed nor rust under loose coating." Equally good conditions were found at several other inspection tests not far distant.

Interior Condition—In November, 1919, on account of surface indications of leakage that had been observed for some time, an interior inspection of the pipe was made at a point in what was afterwards found to be the badly corroded area. Two holes entirely through the plate were found to be the source of leakage (previously attributed to ground water rather than to any defect in the pipe). The two holes were plugged from the inside and a 60-ft. length of pipe was uncovered, "showing a very severe condition of corrosion" both inside and outside the pipe, with three or four times as many pits above as below the horizontal line. Quoting now from Mr. Dixon's paper:

Inside, the original coating showed numerous blisters from from ½ to 1½ in. in diameter, which when punctured and removed disclosed bright steel with a slight roughness in the center; in other places tubercles were found covering shallow "saucer shaped" pits. On the exterior, the "cup shaped" pits usually contained at the bottom a small quantity of material resembling white lead paste, though in some cases a pale brownish color was observed.

In several places long shallow pittings apparently followed where the coating had been scratched by a pick or shovel in backfilling, and in another case near the end of a pipe a similar condition had followed abrasion due to the cable sling with which the pipe was handled.

Up to the early part of 1921 a total of nearly twenty holes had manifested themselves by leakage that had been plugged from the inside of the main.

The 60-ft. length of pipe line that had been bared, Mr. Dixon states, was "carefully cleaned, the deeper pits flushed up with metal by the oxy-acetylene flame, and the pipes were painted with 'Hermastic Primer' followed by 'Hermastic Enamel' applied hot. The trench was underdrained and backfilled with clean sand and gravel."

Altogether a number of different investigators were called in before the engagement of Crecelius and Phillips. Tests were made to determine the flow of electric current and also to throw light on the possibility of both soil and water conditions being responsible for the corrosion. Current flow tests were also made by Mr. Phillips in conjunction with the engineering force of the Northern Ohio Traction & Light Co. At one of these tests assistance with special instruments was rendered by E. R. Shepard of the U. S. Bureau of Standards. In April and May, 1921, the company just named, according to Mr. Dixon, established "electrical balance with the force main by re-bonding its tracks in the vicinity" of three of the company's sub-stations, installed a negative feeder at another point.

Conclusions—In the final report dated June 23, 1921, Crecelius and Phillips summarized their conclusions as follows:

1. That electrical conditions on the system of the Northern Ohio Traction & Light Co. are at this time so balanced as to eliminate the presence of current in serious quantities on the steel force main.
2. That there exist no geological formations that may serve as a natural battery with resultant galvanic currents.
3. That there be no danger from soil corrosion.
4. That there exist local galvanic currents due to presence of scale and also possibly to differences in the composition of the metal; and that the mains should be inspected from time to time to determine the seriousness of such local galvanic currents.
5. That periodic tests to determine current flow on force mains should be made in the future and that permanent test stations for such measurement may be installed to advantage.
6. That conditions are such as to permit the use of steel pipe without unusual danger (especially inasmuch as cast-iron pipe has already been laid in the dangerous area near Tallmadge).

In the paper by Mr. Phillips already mentioned, there is given the following explanation of why stray currents damaged this particular mile out of the 11 miles of the force main:

A study of the geology and topography of the country between Tallmadge and the Gorge substation disclosed the fact that there was an almost continuous low resistance path, due to creek beds and wet ground. The current was simply following this path.

Having established the fact that there was a measurable flow of current off the force main near Tallmadge directly across country to the Gorge substation, it was then necessary to determine the reason for the current taking this long, roundabout and comparatively high-resistance path. At least one contributing cause was found to have been in the rather long stretch of poorly bonded track between the High St. substation and the Gorge substation. Thus, a

certain part of the power originating in the Gorge substation positive feeders had to find its way back to the Gorge substation negative bus by another path than the high-resistance rail circuit. This increment of current then followed the tracks of the railway system into the High St. substation and thence through a bonded connection into the city water system and into the steel force main. It should be pointed out that the route followed by the railway, as well as the city of Akron, is all on high well-drained and consequently dry ground, so that there were no low-resistance ground paths by which this current might have taken a shorter route to the Gorge substation.

In his discussion of the two papers by Messrs. Dixon and Phillips, Mr. Barbour stated that "the experience described should not be interpreted as an argument against the use of steel pipe." Mr. Barbour also took up the question of the original coating of the pipe and its winter exposure as already mentioned. After giving some interesting general information on this matter of coating, Mr. Barbour stated positively that the corrosion of the Akron line was not due to "failure of the coating or to soil conditions or to local galvanic currents resulting from mill scale, or other causes of potential differences in the pipe," but was due entirely to "stray electric currents—the unusual condition being the great distance between the pipe line and the nearest electric railway tracks."

Thirteen-Ton Concrete Slab Moved To Repair Reservoir Floors

When Leaks Made Renewal Necessary 50 Slabs Were Rolled Aside While New Concrete Foundation Was Placed

A CONCRETE lined reservoir in Arizona developed leakage which could not be stopped by ordinary sealing processes because the escaping water had so undermined the foundation that the concrete footings seemed to have been affected; at least it was certain that mere surface sealing was ineffective because under water pressure the seal was broken by the movement of the concrete floor on its unstable base. The repair of the reservoir was started on the plan of breaking up the concrete and pouring a new paving on a new base. In doing this it was discovered that the concrete in the floor itself was in good condition. The original floor was laid in slabs 17 ft. square separated by ½-in. expansion joints filled with an asphaltic compound. It seemed a waste to break up these slabs for the sole purpose of getting at the foundation and the contractor decided to try to move them aside bodily and later return them to the reconstructed foundation. This plan was carried out and after a little practice was applied expeditiously over the entire reservoir floor. A total of 50 six-in. slabs, weighing about thirteen tons each, were moved without injury, the average move for a slab being about 18 ft.

The asphalt on the slabs and in the joints was first removed by burning as described in *Engineering News-Record* Oct. 27, 1921, p. 703. This made it possible for a crew of about twenty men, by prying against the adjoining slabs with crowbars, to raise a slab high enough to get jacks and blocks beneath it. After experience with the first few slabs it was found that the jacks could be supported on the concrete footings and runways of 8 x 12-in. timbers and rollers of 4-in. pipe, 14 to 16 ft. long, could then be used to move the slab to one side. When ready for rolling the slab was supported on four or five of the pipe rollers which turned between the timber runways below and a 6-in. timber placed on the under side of the slab to give the rollers a smooth bearing and distribute the load.

As the slabs were removed the foundation was seen to be in bad condition, having been "puddled" by the escaping water. From 3 to 5 cu. yd. of mud was removed from beneath each slab and this space refilled with concrete mixed by hand as needed on the floor of the reservoir. Eight to ten slabs were removed at a time and after placing the concrete it was left to set before replacing the slabs. After the slabs were put back in place a hole was cut through the center of each one and grout was poured in to give the slabs a uniform bearing on the foundation.

With the floor slabs leveled up and grouted the next step was to fill the joints with a soft mineral fiber pressed into position with a trowel. This soft compound was protected against water pressure by the

MOVING A 13-TON SLAB IN THE RESERVOIR FLOOR

Note the undermining of footing in the foreground. Jacks supported on these footings lifted the slabs which were then rolled aside until new foundations were placed

addition of three layers of fabric and finally sealed with a carbon gum. The last operation was to paint the entire inner surface of the reservoir with a black waterproof paint and cover this with a cement "lotion" which covered all traces of the black compound. The cost of this final cement finish, including its application, was about ½c. per sq.ft.

Although the repair of the reservoir as a whole was done in a series of several operations, the work on the floor involving the moving of the slabs bodily was done in the equivalent of about sixty days with a crew of from twenty-five to thirty men. The cost of doing the work in this way is estimated to have been about 50 per cent of the sum which would have been required to break up the old concrete and pour an entirely new floor.

The foregoing account of the work is based on information supplied by the Waterproof Paint Co. of Lankershim, Cal.

Determination of Rail Wear for Valuation Purposes

Cross-Sections Accurately Measured in Field—Rails Rated by Scientific Analysis of Observed Deterioration

By J. P. Newell
Consulting Engineer, Portland, Ore.

The difficulty of accurately measuring the wear of rails in the track has hitherto made the inspection of rails in valuation work almost entirely a matter of the judgment of the inspector. In the Grand Trunk arbitration, with 10,000 miles of track to be examined for actual purchase, a more definite method of procedure was desirable. It was made possible by the invention of a rail pantograph by S. W. Fairweather, office engineer of the government staff.

The Rail Pantograph.—The distinguishing feature of this instrument are a curved arm which can be rotated about its axis without changing the position of the tracing "point," and which carries a second arm mounted on an axis at right angles to the first and capable of being similarly rotated; and the substitution of a tiny wheel of hard steel for the usual sharp point. In other respects it is like an ordinary pantograph except that it is made of heavier material. It is mounted on a board about 18 in. square which can be clamped to the head of the rail to be measured. The curved arm enables the entire rail section to be reached at one setting, and the wheel runs smoothly over the surface, where a point would be continually catching. The rail section is traced on a card fastened to an upper corner of the board. The accuracy of the instrument is tested each time it is used, by the closure of the drawing, and means are provided for adjustment. The drawing is larger than the true section by the radius of the wheel at the point, $\frac{3}{64}$ in. The accompanying photographs show clearly the construction and method of use.

Each track-inspection party of the government staff had one of these "ouija boards," as they were promptly dubbed. Rail sections were taken at frequent intervals, taking both rails on curves, and notes made on the cards of the mile-post location, position in the track, size, date and brand of rail and track in which it was found. About 9,000 sections were measured, and the cards are on file at Ottawa.

A traffic study made in the course of the investigation calculated the gross tonnage of freight cars and locomotives in each direction over each track for a year. Similar figures for passenger traffic could be easily obtained, and close approximations of both for other years could be made. This, taken together with the rail sections, furnishes valuable material for a study of the effects of traffic on rail wear.

Field Methods—Deterioration of rail by wear manifests itself in one or more of six ways: (1) top wear, (2) side wear, (3) depression of the ends by wear and bending, (4) surface roughness, (5) surface bending, (6) kinking.

The first two were shown accurately by the measured sections. The third was measured by a four-foot steel straight-edge laid across the joint. A graduated wedge, applied at the end of the rail, measured the deflection in 64ths of an inch. The other three conditions were estimated by the inspectors, who were instructed to mark each by *O* for no perceptible wear, *A* for a small amount, *B* for a moderate amount, *C* for a bad condition, and *D* too bad to continue in use. These were recorded in the order given above. Thus if a rail card were marked *ABC*, it would indicate that the rail whose top and side wear were shown by the section on the card, and end wear by the number of 64ths of an inch depression, had a perceptible surface roughness, a moderate amount of surface bending and was kinked about as badly as could be permitted. A rail marked *D* must be scrapped or changed to an inferior service, regardless of the other markings. These letter gradings were made with regard to the service in which the rail was found. Thus a given marking for a rail in branch line track indicated a greater amount of wear than the same marks for a main line rail.

Standards for Rating Rail—In reducing the data collected by field engineers to numerical expressions of condition per cent, recourse was had to the standards for relay and scrap rail. It was considered that rail in service, found to be worn to the same extent as the average of rails bought and sold as relay was depreciated by the difference in price between new rail and relay; the same for scrap.

Prices of relay and scrap vary with local conditions but it was estimated that, considering the whole country served by the Grand Trunk, scrap rail would average one-third of the price of new rail and relay two-thirds. This means that one-half the wearing value is used up in main line service and the other in branch lines or side tracks. These ratios may be quite different under other conditions.

Deterioration of rail, if of considerable extent, always manifests itself in more than one way. Specifications for relay and scrap rail are made with this fact in mind. In order, however, to give a numerical value to each kind of wear, it must be considered alone, in which case the specifications would be somewhat relaxed. On the other hand, the specifications represent limits, and the average condition of either relay or scrap is a little better than these limits. These two conditions were considered as about balancing each other, and the limits given by the specifications for each kind of wear as permitted for relay or scrap were taken as representing the average for that kind of wear alone.

Combination of Ratings—The depreciation from several forms of wear existing together is obviously not the arithmetical sum of the percentages of depreciation which would be due to the various causes considered separately. A rail which is badly side-worn is less damaged by a given amount of end-bending than one which is otherwise perfect. It is therefore necessary to establish percentages of depreciation corresponding to combinations of wear in various forms. The procedure adopted was first to rate the rail for sectional and end wear combined, and then enter a second table with the depreciation thus obtained and find an additional amount to cover the three other forms of wear.

The specifications used were those of R. W. Hunt & Co. and the Canadian Pacific Ry. The method of making up the tables for a 100-lb. rail will be described. The maximum top wear permissible for No. 1 relay is $\frac{3}{16}$ in., which on the rail used by the Grand Trunk represents a loss of area of head of rail of 10 per cent.

This amount of wear therefore represents a depreciation of 50 per cent without other defects. The greatest loss of area by top wear found in service was 35 per cent. This percentage was taken as the maximum permissible, the corresponding depreciation being therefore 100 per cent.

The maxmum side wear for relay was taken at ¼ in. which equals 8 per cent of area of head. Side wear of 25 per cent on one side calls for scrapping as the bearing is then so far to the outside of the head that failure is likely to occur. Side and top wear rarely occur together to a marked degree. Where both were found, it was the rule to add one-quarter of the smaller to the larger and apply the rating accordingly.

For end wear a depression of ⅛ in. in 2 ft. was taken as the maximum for relay. The cost of cutting off rails plus the loss of length equals about 25 per cent of the wearing value; consequently depreciation from end wear is limited to 25 per cent in addition to that due to sectional wear, except that a shortened rail would always be depreciated 50 per cent. One-half inch depression has been taken as indicating 100 per cent depreciation, except as limited by cutting-off.

TABLE I—RATING TABLE FOR 100-LB RAIL

Per cent Depreciation for Sectional and End Wear

Per Cent Top Wear	Per Cent Side Wear	End Wear in Sixty-fourths of an Inch 0	2	4	6	8	10	12	14	16	18	20	26	32
0	0	0	13	25	37	50								
1		5	18	30	42	50	..							
	1	6	19	31	44	50	..							
2		10	23	35	47	50	..							
	2	13	25	38	50	.								
3		15	28	40	50	.								
	3	19	31	44	50									
4		20	33	45	50									
5	4	25	38	50	50									
6		30	43	51	53	55	55							
	5	31	44	51	53	56	56							
7		35	48	52	54	55	59	60						
	6	38	50	52	54	56	59	62	63					
8		40	51	53	55	57	60	63	65					
	7	44	52	54	56	58	60	63	66	69				
9		45	52	54	56	58	60	63	66	70				
10	8	50	53	56	57	58	60	63	67	70	73	[illegible]		
20		70	71	72	73	73	74	74	75	75	75	78	88	95
	15	72	73	74	75	75	75	76	76	77	77	78	89	97
35	25	100	100	100	100	100	100	100	100	100	100	100	100	100

Table of Sectional and End Wear—The controlling points in Table I have thus been established as follows:

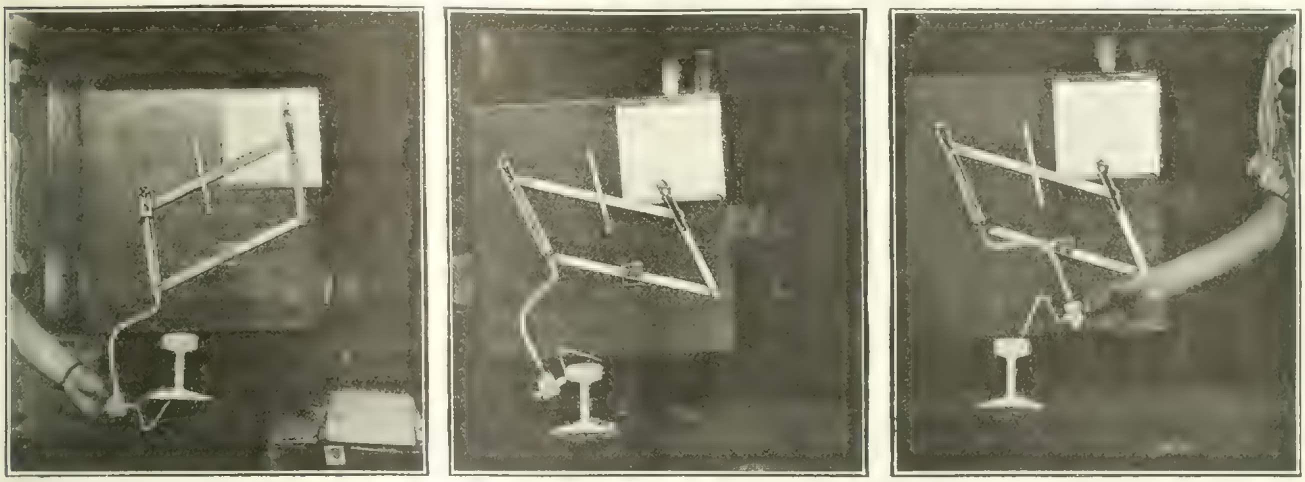
10 per cent top wear
8 per cent side wear
8/64 in. end wear
= 50 per cent depreciation.

and the following combinations were added:

2/64 in. end + 7.5 per cent top
or 6 per cent side
4/64 in. end + 5.0 per cent top
or 4 per cent side
6/64 in. end + 2.5 per cent top
or 2 per cent side
= 50 per cent depreciation.

35 per cent top wear
25 per cent side wear
32/64 in. end wear
= 100 per cent depreciation.

The remainder of the table is supplied by interpolation, bearing in mind that any form of wear has but little effect upon depreciation until it becomes equal to the other kinds of wear found with it. Tables were worked out for each per cent. In the one here presented this is done only as far as 10 per cent top wear.



PANTOGRAPH USED TO DETERMINE RAIL SECTIONS

These pictures show the pantograph in three different positions with reference to a rail section. The curved main and secondary arms permit movement of the hand-hold without changing the position of the tracing point, so that the entire section may be reached at one setting. The "point" consists of a tiny wheel of hard steel which prevents catching on the rail surface which might be caused by a sharp point.

The Grand Trunk has a 79-lb. rail with a deep narrow head and metal of a very high quality. On this account the controlling percentages were fixed as follows:

13 per cent top wear
8 per cent side wear
8/64 in. end wear
2/64 in. end + 10 per cent top
or 6 per cent side
4/64 in. end + 6.5 per cent top
or 4 per cent side
6/64 in. end + 3.0 per cent top
or 2 per cent side
= 50 per cent depreciation.

15 per cent top wear
20 per cent side wear
32/64 in. end wear
= 100 per cent depreciation.

Controlling points were fixed in a similar manner and tables made for each size of rail.

Effect of Other Depreciation—The effect of the remaining causes of depreciation decreases rapidly as sectional and end wear increase. As already pointed out, the ratings on account of these causes indicate a greater amount of depreciation the lower the grade of service in which the rail is found.

In fixing the controlling points in the table of additional depreciation due to surface roughness, surface bending and kinking, it was estimated that the loss of service value in the main line rail marked by the inspecting engineer *CCC*, but not otherwise deteriorated at all, is about three-quarters as much as that of relay rail, or 36 per cent. To main line rail depreciated to relay by end and sectional wear, *CCC* was considered to add only 10 per cent. If the rail were depreciated 100 per

cent from any cause, the same mark would add nothing to it. With these three points fixed, the remainder were interpolated in such manner that they decrease rapidly at first, with increase of sectional wear, and much more slowly after the latter reaches 50 per cent.

For important branch lines the same marking was taken as giving values of 42 per cent, 15 per cent and 0. For secondary branch lines 50 per cent, 20 per cent and 0; for siding rail, 60 per cent, 25 per cent and 0.

The *AAA* marking was taken as equal to one-sixth as much as *CCC*, but as reducing to 0 by the time sectional wear reaches 50 per cent. *BBB* was considered as equal to approximately one-half of *CCC*. The method of interpolation is sufficiently indicated by Table II

TABLE II—ADDITIONS TO RATING TABLE READINGS ON ACCOUNT OF SURFACE-ROUGHNESS, SURFACE-BENDING AND KINKING

Per Cent Section and End Wear	AAA OOB	OAB	AAB	OBB OOC	ABB OAC	AAC	BBB OBC	ABC	BBC OCC	ACC	BCC	CCC
	Main Line Rail											
0	6	8	10	12	14	16	18	20	24	26	30	36
10	4	5	7	8	10	11	13	14	17	19	22	26
20	3	4	5	6	7	9	10	11	13	14	16	20
30	2	3	4	5	6	7	8	9	10	11	13	16
40	1	2	3	3	4	5	6	6	8	9	10	13
50	0	1	1	2	3	3	4	5	6	7	8	10
60	0	0	1	2	2	3	3	4	5	5	6	8
70	0	0	1	1	2	2	3	3	4	4	5	6
80	0	0	1	1	1	2	2	3	3	3	4	4
90	0	0	0	0	1	1	1	1	1	2	2	2
100	0	0	0	0	0	0	[illegible]	0	1	1	[illegible]	0

which gives the additions for each marking to be made for each 10 per cent of depreciation from sectional or end wear. This table is used for any main line rail.

Use of Tables—The tables were used in this way: A tracing of the rail, with various percentages of wear shown on it, was applied to the drawing on each card, as turned in by the field forces, and the approximate loss of head by top or side wear, or both, noted. With this percentage and the end depression given on the card, the depreciation was found by Table I. This figure was then found in the first column of Table II, and the addition corresponding to the letter grading on the card found in the appropriate column.

For example: A rail card showed a section of 100-lb. rail which had a top wear of 6 per cent, no side wear, end wear $\frac{2}{64}$ in. grading *AAC*. Table I for 100-lb. rail, gives 43 per cent depreciation. Table II shows an addition of 4 per cent. Total depreciation 47 per cent.

Satisfactory results were obtained by this method of inspection on the Grand Trunk, but after the rejection by the board of arbitrators of the estimates of cost of reproduction offered by the company, it was thought best by counsel for the government to withhold evidence as to percentages of depreciation. The results were therefore not subjected to adverse criticism. In any case, differences of opinion would doubtless exist as to the relations between the values of new rail, relay and scrap, and the effects of different kinds and degrees of wear, but after these factors were fixed there should be but little variation in the application of the rules.

Great Britain's Highway Mileage

The total length of all highways in Great Britain, according to a statement by Sir Henry Maybury, director of roads, Ministry of Transport, in a recent address before the Institute of Transport, is computed as 177,306 miles. The results of the classification of roads show 22,160 miles of first-class and 14,419 miles of second-class roads.

Applying Efficiency to the Production of City Maps

Sectional Tracings, Embodying Primary Data, Printed in Duplicate—One Set Is Basis for Working Maps and Other for Special Uses

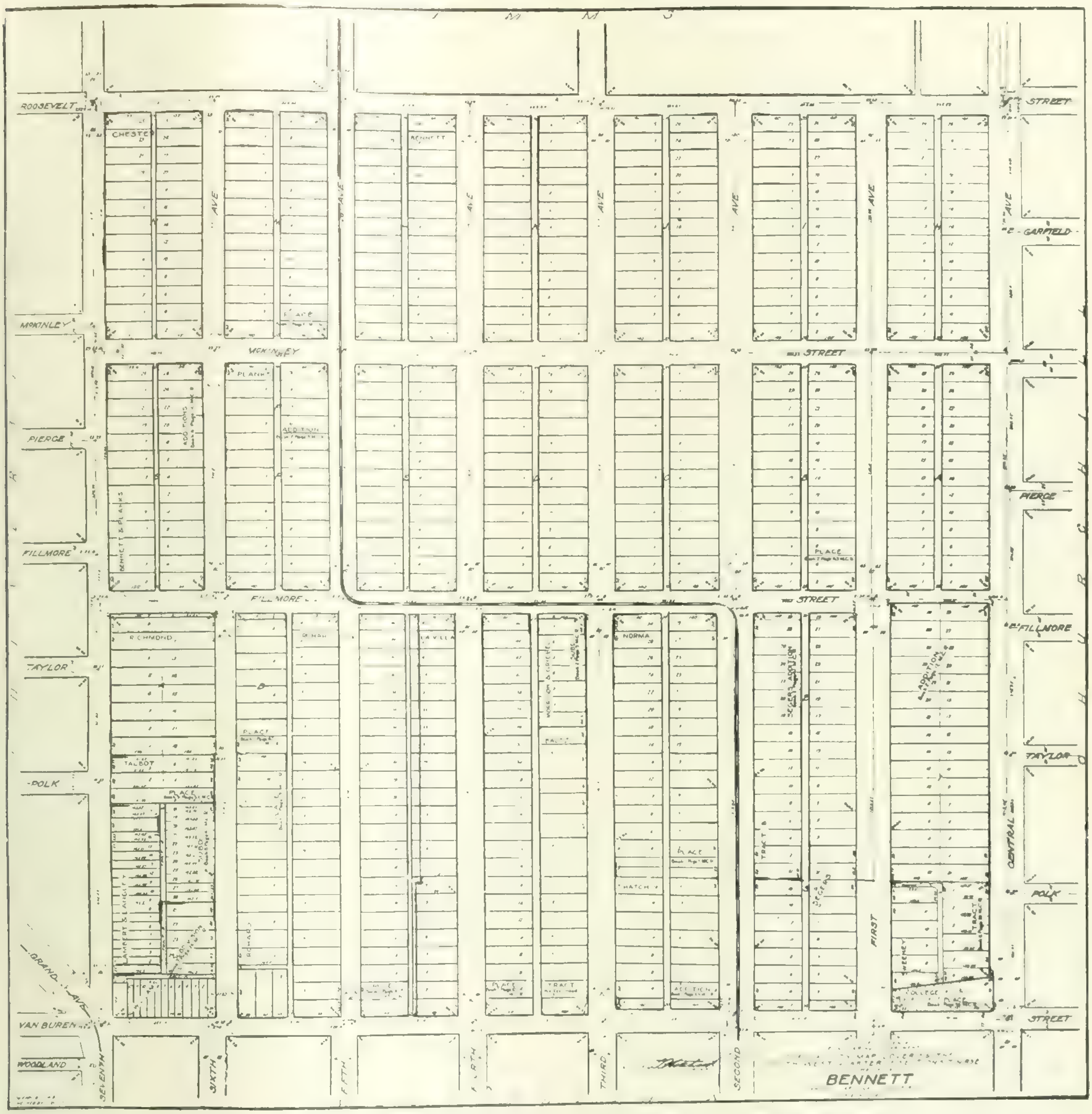
By S. M. Cotten
Civil Engineer, Phoenix, Arizona

THE ROUTINE work of the average city engineering department consists largely in the continual preparation of maps of the city or parts thereof. Such maps are required for a variety of uses; primarily, to show accurately the location of streets, land subdivisions, and other fixed characteristics; thereafter, to delineate assessment or improvement districts, to show the location of sewers, water mains and other public service installations, and to show special districts being studied for special purposes. The character of the work is such that maps of the same scale are suitable for all these purposes, but unless some system is devised to avoid it, the bulk of the work in the preparation of such maps will be but a repetition of similar effort previously expended.

Preparation of Sectional Tracings—The system now in use in the engineering department of the City of Phoenix has resulted in a great economy of time and money, and has made it possible to prepare acceptable office records inexpensively. The prerequisite to adoption of this system is a set of sectional maps of the city, on tracing cloth, uniform as to size and appearance, and carrying upon them all data of primary importance. The scale of the maps should be large enough to show clearly all information, both present and anticipated. The size of sheet selected will be determined somewhat by the natural subdivisions composing the city, but should be as large as possible, though not unwieldy. Since these maps are to be indirectly modified and reproduced to serve as the basis for special maps, care must be exercised to arrange street names and other lettering so that this will conflict as little as possible with the other purposes to which the map is to be put.

The City of Phoenix embraces an area of 5.16 square miles, and is situated in a region where the original subdivisions of record are the sections and quarter-sections established by government survey. Consequently, the quarter-section immediately suggested itself as the logical unit for the sectional maps, particularly in view of the fact that without exception the city has continuous and fairly uniform streets along all sections and quarter-section lines. A scale of 100 ft. to the inch was adopted. In order to have each map complete data pertaining to streets bounding the limits of each map were shown. The name and number of the abutting map sections were shown on the corresponding border of each map, so that it is possible to move from one map to those adjacent without any break in the continuity. Each quarter-section map was given an official designation. In view of the purposes to which these maps were to be put the street names were put only at the bottom and at the left of the sheet, whenever possible, and outside of the area of that particular quarter-section. Intersecting streets were shown for a distance of about two inches outside of the bounding streets.

Data Included on Tracings—In addition to street locations and names, these maps carried the following;



MAIN TRACING FROM WHICH SPECIAL USE DETAIL MAPS ARE MADE

On this map are included the following data: Subdivision name under which property is recorded, block and lot numbers, survey monuments, grade elevations of property corners at street intersections, and street-railway and railway tracks and rights-of-way. These tracings are large enough to allow matching up with adjacent ones.

1. The name of the subdivision under which the property is recorded, and a reference to the book and page of official record. This designation was so placed as to appear partly in the northwest and partly in the southeast corners of the subdivision, and the outlines of the subdivision were further indicated by a broad red ink line just inside the property line.

2. The name or number of blocks and lots, the recorded dimensions of the latter, and the width of streets and alleys. The figures showing the dimensions of lots were set back sufficiently from property lines so as not to interfere with the subdivisional boundary lines, if any, and the lot numbers were placed near, but not on, the rear line of the property. This left the lot clear for any other notations that might seem to be desirable

3. The city survey monuments, of which there is at least one at each street intersection, together with a number for each one. Each east and west street was given a number, likewise each north and south street, and these numbers apply to these streets from end to end of the city. Each street intersection has a number then which is the combination of these street numbers, always in a certain form, and the monuments take the numbers of the street intersections, with suitable alphabetical subscripts when an intersection has more than one monument. These monuments lie on a straight line for each street or portion thereof, and this "stone line" was shown, together with the rectangular offsets

from the same to the adjacent property lines: also, the distances from stone to stone as determined by city survey.

4. The grade elevations of property corners at street intersections and other points, as established by ordinance, and the elevations of the city monuments.

5. Street railway tracks and railroad tracks and rights-of-way.

The overall size of the maps is 31½ in. x 34 in. A 2½-in. binding border was provided at the left of the map, and a ½-in. border on the other sides.

The completed set consists of twenty-six maps. Three draftsmen were employed on this work at different times for a period of about six months. Each map was prepared complete by the draftsman to whom it was assigned, with the exception of the title. The work of these three men was ordinarily very dissimilar in appearance, but by adopting standard procedure respecting every detail of these maps, results were secured which were extremely uniform.

Before beginning the preparation of the sectional maps a traverse net for the city as a whole was plotted along all section and quarter-section lines, and the co-ordinates of control corners for each quarter-section were computed. The necessary data were on hand from previous surveys and general office records. The co-ordinates of control corners for each sectional map were so laid off that the side border lines lay in a due north and south direction, so that all maps are oriented with respect to the same north line when placed side by side. The plotting of the control corners by co-ordinates also insured a degree of accuracy and uniformity impossible to secure otherwise.

Preparation of and Use of Negatives—From these tracings were printed two sets of negatives. Prints from one set were used as the working maps for the office, and then filed for subsequent use; on the other set of negatives the stones, stone lines, grade and stone elevations, and stone distances were blocked out, using a payzant pen or brush and black drawing ink. These negatives give a print free from detail that would only be in the way for various plotting purposes. Such maps are suitable for use in various city departments.

Use of Prints—From the altered negatives was made a set of brown-line prints on thin paper of the best grade, from which very good blueprints or negatives are procurable. This set of maps was filed, is kept intact, and is used primarily in connection with the preparation of improvement or assessment-district diagrams. The boundaries of assessment districts are laid off on the thin brown-line prints in light-colored pencil lines, and a negative made of that portion of the map. A sheet slightly larger than the overall size of the finished diagram is cut from paper such as is used to wrap sensitized papers. An area is cut from this sheet such that the opening will just fit around that portion of the negative to be printed and the negative is attached to the mat by gummed stickers. The titles and legends which appear upon these diagrams being practically identical in all cases, negatives for them have been prepared in quantity, and are set into the mat just as in the case of the map portion above described.

From this mat-negative a thin brown-line print is made. On this print is lettered in black drawing ink, the required data, such as assessment numbers, areas of lots, outlines of the street improvement, and the omitted portions of the title and legend. We now have the equivalent of a tracing of the diagram, for the specific purposes in view without having had to draw a line or set down a figure so far as the map proper is concerned. We have used only a small fraction of the time which a tracing would have required, and the expense of the prints and material used is negligible. Furthermore, we know that the map features of the diagram conform absolutely to the official city map of that area, and that draftsmen's reproduction errors are eliminated.

From the completed brown-line print and additions, is made a negative, and from this as many blue-line prints as required. These final prints, while possibly lacking something of perfection, are good, clean-cut specimens and give no hint of their composite origin. One copy of these prints goes to the contractor for that improvement job, and is delivered by him to the bond house that purchases the bonds.

If the assessment district extends beyond the limits of one map, the condition is easily met. We have had them which embraced portions of six maps and have not found this to interfere with the efficient operation of the scheme of reproduction, or the arrangement of our diagrams.

The thin brown-line prints from the altered negatives of the sectional maps have proven to be of great value, and to effect pronounced economies in the preparation of office records. They serve practically as well as original tracings, and they are to be had on a few hours notice and at small expense. We have used them very successfully as the basis of a set of sewer maps. The sewer lines and all data incident thereto were put on in black drawing ink, and stand out well from the map background. The blue-prints made from these maps are as clean cut in definition as could be reasonably desired. It is anticipated that these thin brown-line maps will be used in the near future for preparing several sets of special function maps of the city, covering such services as water, gas, and electricity.

Field Party Books—An additional use for such a set of city maps may be suggested by the method we employed in making up the map books for the field parties. Heretofore it had been the custom to make these books of small sheets of egg-shell paper, and to a small scale. They were kept in ring binders which fitted the pocket, and so were very convenient. But, each sheet had to be a piece of individual work, was relatively expensive, and when worn out called for a duplication of the original effort to replace it. To eliminate these objections the following method was devised.

The letter size, 8½ in. x 11 in. was adopted as the standard for the field books, and a suitable ring binder as the cover. Two negatives were made of each sectional map and cut into twelve sheets so as to embrace the entire map, with a lap between the adjacent edges of the sheets. The white lines were blacked out for a distance of ½ in. or more from the edge of the sheets, so that the prints would have the appearance of finished an individual workmanship. The negative sheets were cut somewhat larger than the finished print size to provide for printing. The appearance of the prints was good and made into a book they have been very satisfactory. The negative sheets were filed.

High Standard Concrete Roads in North Carolina

Subgrade Checked by Templet—Concrete Mixed a Minute and a Half—Rolling and Belting Follow Machine Finishing

HEAVY reinforcement, a minute-and-a-half mix and an especially careful hand-finish put the new concrete road standards of North Carolina in the van of modern practice. In 1921, the first year of state construction, 16½ miles of concrete pavement were constructed. The present year will probably see this mileage multiplied by ten. Not all of this is of the reinforced section illustrated. With the plain section, however, the thickness is increased about an inch by flattening the bottom of the slab and crowning it to a thickness of 8 in. at the center from 6-in. edges. For a 16-ft. width, the plain slab runs about 2,151 cu.yd. per mile and the reinforced slab about 1,564 cu.yd. per mile. The relative sectional areas are 11 sq.ft. and 8 sq.ft.

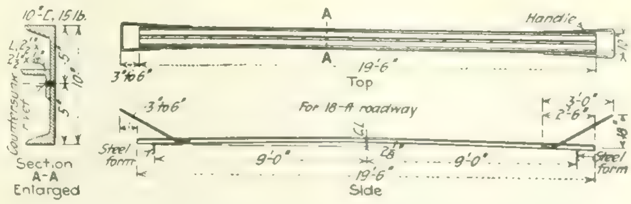


FIG. 2. STEEL SCREED FOR HAND FINISHING
This screed is required to weigh 18 lb. per foot whatever its length and not less than a total of 400 lb. however short. Note that the channel is given an excess crown of ⅛-in. to allow for crown slump in rolling, belting and setting.

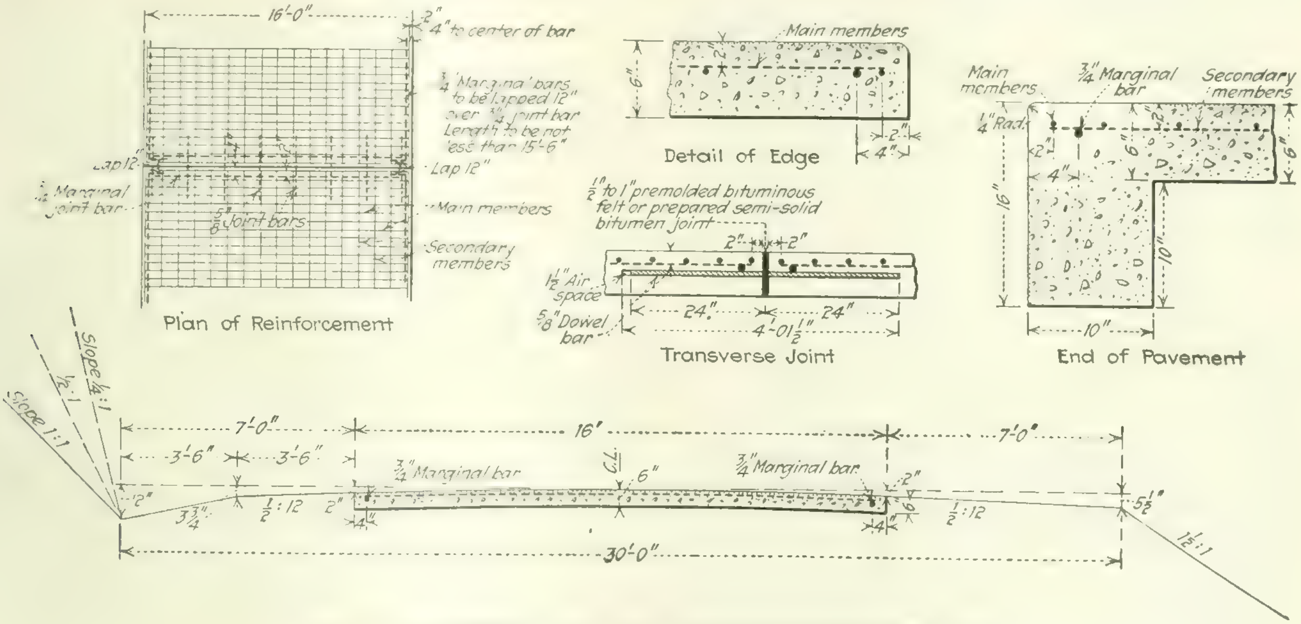


FIG. 1 PAVEMENT SLAB AND REINFORCEMENT DETAILS

An unusually heavy reinforcement is being employed and advantage of this is taken, as has been indicated, to reduce the volume of concrete nearly 600 cu.yd. per mile. Both manufactured galvanized steel fabric and fabricated sheets of plain steel bars are employed for main reinforcement. The effective areas and the spacing required in each case are:

	Mesh Fabric	Bar Mat
Main members area per foot, sq.in.	0.172	0.261
Main members spacing, in.	4 to 8	4 to 9
Secondary members, area, per foot, sq.in.	0.033	0.037
Secondary members, spacing, in.	16	16

Both styles of sheet reinforcement are supplemented by marginal bars at the edges and on both sides of all transverse joints. These are bent and lapped as indicated on the plan of reinforcement in Fig. 1. For the heaviest construction indicated the weight of reinforcement runs from 90 to 100 lb. per square. It is placed in flat sheets 2 in. below the surface on a bed of concrete struck off roughly by templet.

A secondary use of steel in the slab is as dowel bars to take shear at transverse joints. These are construction joints exclusively. Wherever the mixer is stopped exceeding 30 min. a joint, as shown by Fig. 1, is installed. The dowel bars are spaced 2 ft. apart, are tarred, painted or otherwise treated to destroy bond, and bond is actually destroyed on one side of the joint by pulling the bar 1½ in. when ready to continue the slab beyond the joint.

Preparation of the concrete mixture is rather closely controlled. The increased use of larger mixers, 21 and 28 cu.ft., both create the necessity and increase the possibility of better preparation of concrete. More precise measuring of material is required because with large mixers the batch containers are of large area and rough charging to mark, introduce variations of

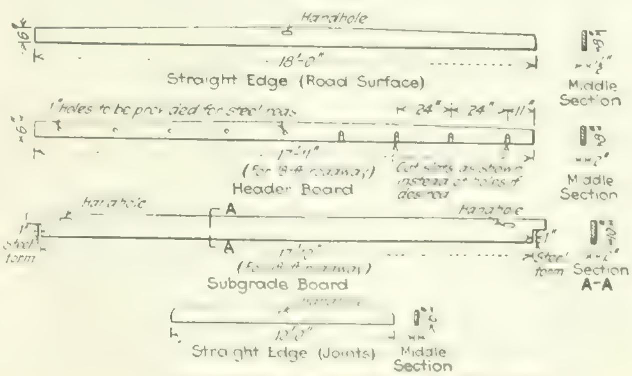


FIG. 3. TEMPLET, HEADER BOARDS AND STRAIGHT EDGES

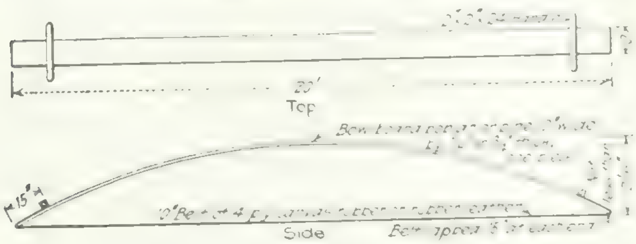


FIG. 4. BOW BELT FINISHER
Required length 2 ft. greater than pavement width.

considerable volume. On the other hand the large mixer is slower in charging and a longer mixing period is possible without increasing the total time of putting a batch through the mixer. A 1½-min. mix is required after all materials are in the drum. This exceptionally long mixing period is considered not to add materially to the cost of mixing and it is regarded as certainly adding strength to the concrete.

Concrete is placed on a moistened subgrade finished to templet. Either hand or machine finishing is permitted but in machine finishings rolling and belting by hand are required after the machine has completed its operations. The hand finishing methods are rather precisely stipulated as to both procedure and equipment. Figures 2 and 6 show the standard tools required for hand finishing. The number of templet operations will be noted; subgrade, road surface and smoothness of joints are all determined by templet. In particular the tamping templet, Fig. 2, will be noted for its width and weight. The floats, bow belt and roller are not unusual. Following the belting, burlap covers are spread on the surface and thoroughly wetted. Moisture for curing after set, when the burlap is removed, is provided in any of the familiar ways which the contractor may choose.

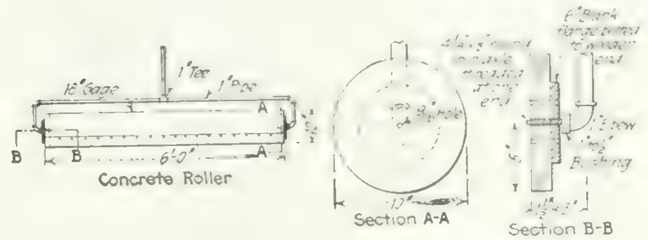


FIG. 5. ROLLER SHEET STEEL ON WOOD ENDS
Weight including handle from 72 to 90 lb.

The Health Value of City Zoning

In re-writing for the *National Real Estate Journal* of April 10, 1922, his address on "The Health Value of City Zoning" before the recent convention of the American Public Health Association, Charles B. Ball, Chief Sanitary Inspector, Department of Health, Chicago, summarized his discussion in the following five heads: "(1) Less discomfort from smoke, odors, noise, dust and flies, and therefore, to some extent greater vitality and better health. (2) Less crowding of public conveyances and so less contact infection. (3) Less darkness and better air circulation on the street surface, with fewer live pathogenic bacteria in street dust. (4) Less shadow on the dark side of buildings and in the spaces about buildings, which means more light and improved ventilation in rooms. (5) More cheerful outlook from the home and greater cheer within."

Specifications for a Federal Hydraulic Laboratory

By John R. Freeman
Consulting Engineer, Providence, R. I.

Part of the Presidential Address Before the Annual Convention of the American Society of Civil Engineers, Portsmouth, N. H., June 21, 1922.

IMMEDIATELY following my recent inspection of conditions on the lower Mississippi I had a conference with Senator Ransdell, of Louisiana, who for many years past has shown great interest in all pertaining to the improvement of river navigation. I told him about the hydraulic laboratory at the Dresden Engineering School, Germany, and the benefits that might come from a similar structure in America if used understandingly, hand in hand with observations on the river itself; so as to be sure that the eddies and swirls and effects of current in the model were accurately reproducing those of a much larger stream. In order to illustrate more clearly what I have in mind I am having an outline-drawing and details prepared from which to make up an estimate of cost.

The Tilting Tank—In a preliminary way (but subject to revision after conference with others interested) I am proposing a tilting tank for a model river about 250 ft. in length, 20 ft. in width and about 3 ft. in depth, with a broad wing giving a width of perhaps 50 ft. for laying out river bends. This tilting tank should be fixed at one end at a permanent elevation on a fulcrum or pivot and supported elsewhere by a series of jack screws about 25 ft. apart, actuated by worm wheels of varying pitch, proportional to the movement during inclination, so that all can be actuated from a single shaft and motor and the model tank quickly set at any desired gradient from horizontal to say, 3 per cent. After a run at one slope the inclination can be changed in a moment's time by these screws without otherwise disturbing the model. The same apparatus could be quickly adapted for tests on models of jetties for harbor entrances and for studies of shore protection.

Subjects of Study—Within this tank a rough foundation of any convenient material could be shaped up to represent a river channel say 5 to 10 ft. wide by 2.5 ft. deep, or smaller, with the base covered over with earthy material from the river in question. Or, sedimentary material of the kind carried by this particular river could be stirred into the waters as it enters the model channel, and the laws of deposition in eddies behind spur dikes or retards could be studied.

Also, one could study the law of re-distribution of sediments in the bed of a river during floods, by which, doubtless in many critical places during a flood, material is eroded from the pool near the concave shore and deposited along the bar, at the point of contraflexure. One could as well develop further information on the respective merits and disadvantages of straightening a channel that is full of big bends, which topic has been under dispute since Galileo's time. I am strongly inclined to believe that the prevailing authorities are still wrong.

A large amount of much-needed information could be had on the best radius of curvature for the end of spur-dikes placed in series for maintaining a straight-line channel. There can be no doubt that there is an optimum radius of curvature and that a dike, with its end curved downstream on a long radius, can be so formed as to lessen the irregularities of the sand waves in the channel bottom and lessen the tendency to undercut the end of the spur-dike or groin.

Obviously it is far cheaper to begin the development of the best form of groin in a small, cheap model than to build a groin of full size in the river. Moreover, the effect of changes in outline can be far more quickly studied as the experiments progress. One can perhaps cover as wide a range of experiments for finding which is the best form in six days on the model as he could cover in six months on the river.

But studies on the small model and upon the large river

must go on almost simultaneously. The distribution of velocities in eddies, and the capricious forms of sand-waves in river and in model must constantly be compared in order that the tests on the small model may not lead one astray.

Last but not least, is the matter of swirls and eddies and sundry obscure forms of vortex motion in the water, which some of us who have been observing water courses for many years believe are at the bottom of many of the problems of erosion and transportation of sediments. The swirls and eddies of the big river could be studied in parallel with studies in a laboratory of the dimensions proposed.

German Investigations—This tank in the German laboratory managed by Prof. Hubert Engel has been used for a variety of other experiments. For example, studies have been made relative to the shaping up of jetties at harbor entrances on a coastline where the great quantities of sand are swept along by the tidal currents, clogging the entrance to the harbor; and studies have been made of variants in the outline of these jetties, for lessening the deposits, or disposing of them so as to lessen their obstruction to navigation.

Other trials have been made in this laboratory upon the effect of various forms of bulkhead or sea-wall in resisting the action of waves and in obtaining a shape of vertical cross-section of the embankment or sea-wall that will leave the sand carried by waves and littoral currents in good shape. In order to simulate wave-wash on the shore a volume of water is held back by a gate at the upstream end of the tank, which gate is lifted, suddenly allowing a symmetrical wave to advance with uniform speed down the channel and impinge upon the model of sandy fore-shore and bulkhead.

Obviously, this tilting tank could be applied to a variety of other investigations, including an extension of the experiments for determining the laws of flow in drainage pipes, made a few years ago by the U. S. Department of Agriculture. The pipe or conduit to be experimented upon could be blocked up by supports from the bottom of the tilting tank and the water could be run through it at any desired slope, from 0 up to 3 per cent (or even more) by quickly resetting the screw supports. Such a series of experiments would give us much valuable new data on the discharge of partially-filled drains and sewers.

Canal for Stream-Flow Measurements—Alongside this tilting tank-canal I would propose building a parallel canal with concrete walls, say, 250 ft. long, 15 ft. wide, and 15 ft. deep, in which experiments could be made on the flow over models of dams and weirs of various forms, and in which other experiments could be made for determining new methods of precise measurement of velocity disturbed in currents. The current could be given a twist by inclined shear boards attached to the bottom or sides of the tank.

I have had proof that many supposedly accurate measurements by ordinary current meters made in streams having deeply disturbed currents were seriously in error, and the use of such an experimental channel would, I believe, be of great advantage to the hydrographic department of the U. S. Geological Survey and to many other institutions in educating its young men in the avoidance of errors in gaging.

At the end of the second proposed experimental channel provision should be made for some new weir experiments on a large scale, and at greater depths than any heretofore made.

There are numerous problems arising in hydraulic engineering practice, in water development, in municipal water supply, and in the work of the U. S. Geological Survey, the U. S. Reclamation Service, and the U. S. Department of Agriculture, for which such a piece of large-size apparatus of precision would be extremely useful and the results would rapidly repay its cost. When a set of tests has once been worked out understandingly and carefully, the data are unchanging and are within the actual range of experiment, good for all time, like the weir experiments of Francis made 60 years ago.

There never yet have been precise weir tests made with a depth greater than 2.4 ft.; but often we have to compute discharge over dam crests and sluiceways carrying depths of 10 and even 20 ft.

Because of certain preliminary experiments made by the late H. F. Mills at Lowell on a "Venturi flume," the speaker believes a very instructive series could be run on such a piece of apparatus in this new laboratory, which might develop considerable utility in irrigation, flood prevention, or municipal supply.

Hydraulic Jump Experiments—The laws of the so-called "hydraulic jump," which has lately come into prominence as an absorber of energy and thus a safety device for protecting the undermining of dams, could be much better worked out. Through the mathematical investigations of Kennison, reported to this society, we know that the time-honored formula is wrong and the speaker believes that a series of experiments with varying forms of pit and with various forms of deflectors, at the foot of the fall, would aid greatly in showing how best to absorb energy in the friction of eddy currents with maximum structural economy. The absorption of energy at the jump comes chiefly from the friction losses in the violent churning and swirling of the waters in the small open chamber immediately downstream from the jet.

Laboratory for Large-Scale Experiments—This would be essentially a laboratory for experiments on a big scale, leaving to the scores of small scale college laboratories the determinations and researches within their capacity. No college laboratory in America now has, or is likely to have, the capacity needed for experiments required as guides to the hydraulics of the Mississippi.

There are many ways in which such a laboratory can pay back its cost to the country at large, but first and foremost are the many great problems of river hydraulics and river training found along the Mississippi and its many tributaries and in widely separated parts of the United States.

The most difficult matter of all in connection with the establishment of such a laboratory is the finding of the right man for director, a man of inventive genius, born with the spirit of research, and skilled not alone in mathematics, in methods of precise measurement, and in setting traps for errors of observation, but also experienced by months of intimate contact and observation on natural water courses, particularly those carrying much sediment in their varying moods. Such men are extremely rare; only a few appear in a generation. The genius in this line, if found, can make this laboratory tenfold as productive as it would be under a good average scientist or college teacher.

Ten Years of Johns Hopkins Engineer School

In a statement to the governor and general assembly of the State of Maryland on the tenth anniversary of the establishment of the School of Engineering, Johns Hopkins University has reviewed the growth of the school. Beginning in 1912 with twenty-seven students, the enrolment now numbers 313. At the end of the present year the school will have graduated more than 200. Scholarships covering free tuition and text-books have been granted to 439 students from all counties of the state. Evening courses in engineering have been attended by 1,508 students and more than 100 lectures have been delivered by practising engineers. Many important researches have been conducted by the faculty, and professional advice and services have been rendered to seventy-nine industries of the city and state. During the war seven members of the faculty and sixty-two students entered military service and the work of the school was altered to conform to the requirements of the Students Army Training Corps. 1,502 students attended the School of Marine Engineering for the U. S. Shipping Board.

Extension of Fraser River Jetty to Improve Entrance

Problems Presented by Lower Reaches of Third Largest River on Pacific Coast and Efforts to Solve Them

With the extension of the Steveston jetty 3,000 ft. downstream, which is now under way, work has been resumed on the improvement of the entrance to the Fraser River. For about 30 years efforts have been directed toward making accessible for deep water navigation the lower reaches of this stream, ranking after the Columbia and the Colorado as the third largest on the Pacific coast. It is hoped that the works now in hand will provide a channel having a depth of from 28 to 30 ft. on a 12-ft. tide.

Characteristics of Stream—The Fraser River is 790 miles long and drains 91,700 sq.mi., all in British Columbia. Its maximum discharge at Hope, 100 miles above its mouth, since 1911 was in July, 1920, and amounted to 380,000 sec.-ft. During the freshet of 1894 the discharge probably amounted to 500,000 sec.-ft. The average maximum discharge is about 300,000 sec.-ft. and the average minimum between 1912 and 1920 was 17,000 sec.-ft., the lowest having been 12,000 sec.-ft. Tributaries that enter the river below Hope have altogether an average maximum discharge of about 56,000 sec.-ft. and an average minimum discharge of about 8,500 sec.-ft. Freshets, which may be expected any time during the months of May, June, and July, are caused mainly by melting snows in the interior of the watershed, over which there falls nearly every year sufficient snow to cause a large freshet if general and prolonged hot weather should prevail early in the season. Extreme low water may be experienced in any month between November and March.

Tidal Influence—The semi-daily tides in the Strait of Georgia, into which the Fraser River empties, are peculiar, the two high waters and the two low waters being unequal in range. Beginning with the higher of the two high waters, the "higher high water," the sequence is first a fall of moderate amount to "higher low water," then a rise of smaller amount to "lower high water," then a fall of considerable amount to "lower low water," followed by a rise through the extreme range of tides to "higher high water," which completes the cycle. The mean rise of tide at the mouth of the river is 12.5 ft. The maximum of the great flood tide is 15 ft., and of the great ebb tide 14 ft., but these maximums are rarely attained. The averages for the great declination tides which occur for a few days twice a month are 12 ft. for the ebb and 13 ft. for the flood. The height of the water surface at mean high tide at New Westminster is 1 ft. lower than at Sand Heads. At "lower high water" it is sometimes a few tenths of a foot lower. During the low water stage the tides affect the river as far as Chilliwack, 67 miles from the mouth, but the current is reversed by flood tide only as far as Fort Langley, 37 miles upstream.

Conditions Affecting Navigation—One of the greatest difficulties in controlling and maintaining the river rises from the fact that it exhibits the leading characteristic of streams that flow through alluvial deposits in that it meanders, eroding its banks on the outer sides of bends, and depositing on the inner sides. The bends, furthermore, move downstream.

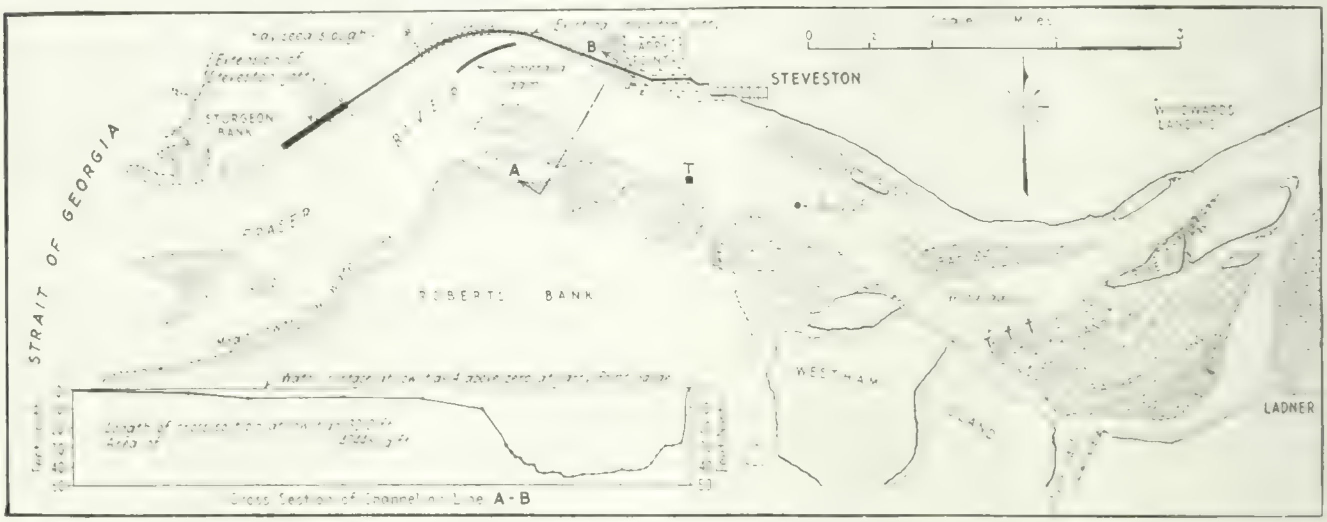


FIG. 1. LOWER REACHES OF FRASER RIVER

The maintenance problems of the lower Fraser River are confined to the sections here shown, the middle section from Woodwards Landing to Garry Point, and the seaward section from Garry Point to the mouth. The problem of the middle section is to protect the banks against erosion and that of the seaward section is to confine the flow to a single channel that will maintain its depth. The "submerged" dam here shown has been removed and a 3,000-ft. extension is now being added to the Steveston Jetty. The design of this extension is shown in Fig. 2.

The 22-mile reach from New Westminster to the mouth is the most important. This reach may be divided into three sections; the upper of 11 miles, extending from New Westminster to Woodwards Landing the middle section of 5½ miles extending from Woodwards Landing to Garry Point, and the seaward section of 5½ miles extending from Garry Point to the mouth.

The upper section, which is not shown on the accompanying map, Fig. 1, has but one main channel of fairly uniform width, flowing with gentle curves, having many straight stretches, and broken by few islands or bars. Except for about two miles on the south shore below New Westminister, this section of the river is bordered by delta lands which have been diked to exclude flood tidal waters. Throughout its length little difficulty is experienced in maintaining a depth of 18 ft. at low water.

Middle Section—The middle section is divided by many islands and bars which have brought about the formation of several outlet channels. Two of these may

be designated as main channels; the first, or new main channel, to the north of Bar A, and the former main channel between Bar A and Rose and Duck Islands. A third channel passes to the southward by Ladner and Canoe Pass. In the narrower section between Woodwards Landing and the head of Bar A, and along the south shore from the upper wing dam on Duck Island to buoy 25 just above Steveston, the channel is deep. The new north channel is fairly deep in its narrow reaches, but shoals at its lower end.

Changes in the position of the main channel interfere with the maintenance of the river not only because during a transition period the flow is divided between two shallow channels but also because they affect the course of the river below the point of change. The formation of the new main channel illustrates this. The south bank of this channel, against which the current is directed, is being rapidly eroded and the material carried downstream to form bars where the current slackens. A further result of this change is the direction of the current against the bank on the south side of the river below Steveston near platform *T*. This causes the formation of a new outlet channel, which, if it should be widened and deepened, may divert the main flow in the seaward section from its present course. All such places require careful watching in order that corrective measures may be taken in time.

Seaward Section—Throughout the length of the seaward section the banks are of sand, submerged at high tide but largely exposed at low water. Below the Steveston jetty, referred to hereafter, the river widens and divides into two channels separated by a bar. The main channel shifts its position and maintains no great depth of water there being in places less than 18 ft. at low water. Slack water is very marked in this lower reach and is considered to be one of the contributory causes of bars and shoals, its chief effect being to check the movement of material along the bottom. This slack water is accentuated due to the lack of a deep water channel which prevents the sea water from entering the river on the flood until the tide has reached a considerable height. The sea water enters at the bottom of the channel, while the river water covers the sand banks in the seaward part of the delta and is held back by the rise of tide, so that during the freshet and intermediate stages of the river the reversal of current on the flood tide is very much delayed or the river current is merely checked. The river even in its seaward part, has the characteristics of a river and not of an estuary. Hence, it is more important to maintain a single deep channel to facilitate the entrance of the flood tidal water than to provide a wide, open entrance.

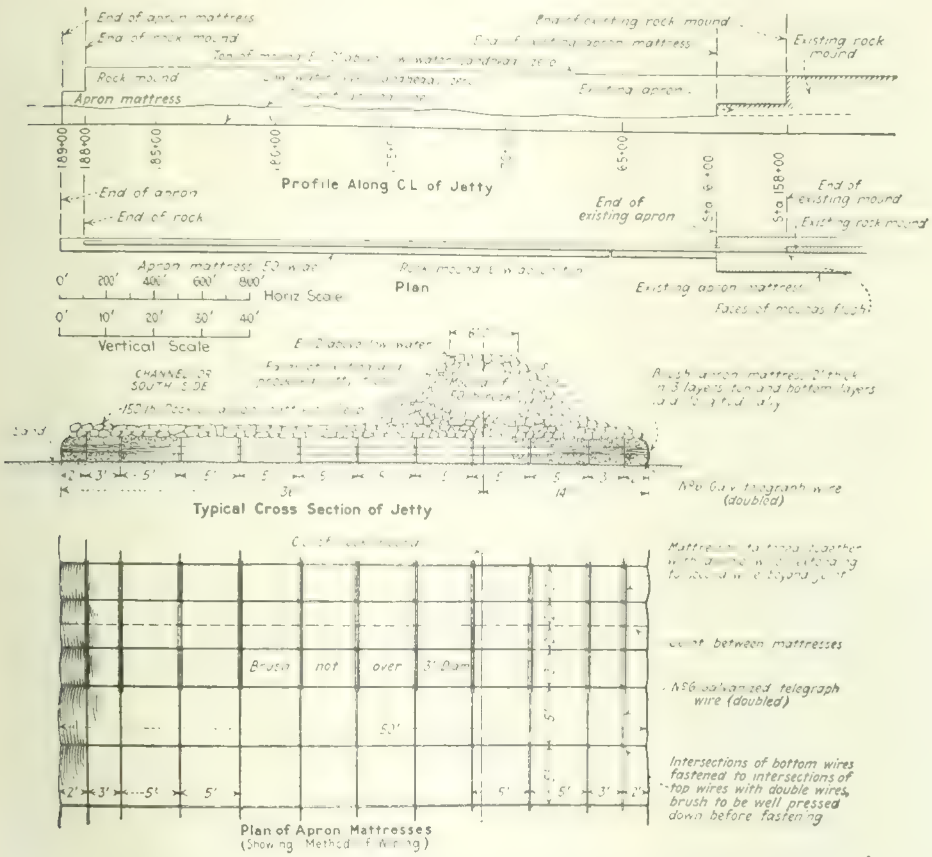


FIG. 2. DETAILS OF STEVESTON JETTY EXTENSION
Contract was let toward the end of 1921 for this work, which is now in progress.

Improvements were commenced in 1907 when the city of New Westminster obtained a report on the best method of improving the entrance from J. Francis LeBaron. He recommended the construction of parallel jetties or training walls, one-half mile apart, extending from firm land at Garry and Pelly Points to 30-ft. at low water in the Strait of Georgia. These were to have their crests at an elevation of 2 ft. above high water at the shore end, falling gradually to half-tide in a distance of a quarter-mile. The north jetty was to have been 25,700 ft. long and the south jetty 29,500 ft. Mr. LeBaron also recommended certain wing-dams, groins, and bank protection in the upper and middle sections. In view of the cost of carrying out these plans, he was asked for a supplemental report on the application of a single jetty, in reply to which he suggested the construction of a reaction jetty on the north side, extending from just below Steveston. This work was commenced in 1912 with the construction of 3,100 lin.ft. of single bulkhead and 3,800 lin.ft. of double bulkhead with brush mattresses and the necessary over dressing and filling of quarried rock. A second section of the jetty, embodying 7,100 ft. of rock mound on brush mattress, was begun in 1915.

In 1901 there had been built a wing dam, indicated on Fig. 1 as "submerged dam," intended to close off an outlet to the north known as "Hayseed Slough." This dam had not been removed and seemed to interfere with the effectiveness of the new jetty which, however, confined the main flow at low tide to a narrow deep channel from above Garry Point nearly to the dam. Diversity of opinion prevailed as to the line of future work so it

was decided in 1919 to undertake an intensive study of the river and to formulate a definite line of action before proceeding to further expenditure. A board of engineers, consisting of the assistant chief engineer and seven district engineers of the Department of Public Works, was convened and the co-operation of the Federal Department of Mines was obtained. Mr. W. A. Johnston of that department was assisted in his studies by the Water Power Branch of the Department of the Interior, the Hydrographic Surveys, the Department of the Naval Service, the Geodetic Survey, the Precise Leveling Surveys and Triangulations, the Tidal and Current Surveys, and the Geographical Survey.

Recent Improvements—As a result of these studies it was concluded that the old submerged dam blocked part of the channel and prevented deepening of the channel below it. The dam was removed, and the straightening of the channel and the maintenance of an increased and uniform depth appear to have justified the step. Since 1907 the Department of Public Works had maintained in this locality a Frühling type dredge, which, however, was able only to maintain the existing depth without increasing it. Since the removal of the submerged dam and the consequent proper application of the erosive force of the river, the necessity for maintaining this dredge has been diminished. It was considered advisable, also to resume construction of the Stevestor jetty for a distance of 3,000 ft. as designed by Mr. Le Baron. A contract for this was awarded toward the end of 1921, and the work is now in progress. Fig. 2 shows the general plan and details of this extension.

General Conclusions—With regard to the general situation the investigating committee reached the conclusion that the material carried in suspension by the river is not of great effect in shoaling the main channel except at the mouth, to which most of the suspended matter is carried. Bars are formed instead by the material moved along the bottom, which is of maximum volume when a shifting of the main channel is taking place. The problem of the middle section, therefore, is to prevent the shifting of the main channel.

In any scheme to effect permanent improvement the committee believes that effective bank protection must be an essential. This however, is complicated by the fact that the upper silty beds are more resistant to erosion than the underlying beds of sand. When erosion is active the underwater face tends to become nearly vertical with depth up to 80 ft. close in to the bank. This exposes the sandy lower strata which are washed away, thereby undermining the upper banks. Considerable sums have been expended in bank protection by the Department of Public Works but with indifferent success due to the difficulty of protecting the underwater faces of the bank.

The investigations indicate that until the river can be confined to its channel by protecting the banks on the outside of bends, protection works in the seaward section are likely to prove of little value. The problem of finding an effective means of bank protection that will be permanent and not prohibitive in cost applies, therefore, to both the middle and seaward sections.

The information in this article has been obtained largely from J. Francis LeBaron, consulting engineer, from K. M. Cameron, assistant chief engineer of the Department of Public Works, through the courtesy of A. St. Laurent, chief engineer of the Department, and from Memoir No. 125 of the Canada Department of Mines on the "Sedimentation of the Fraser River Delta," by W. A. Johnston. In this memoir are contained complete technical data concerning the river, its geology, tidal characteristics, climatic conditions on the water sheds, currents induced by variation in density, wind, and tide, sediment transported, and other characteristics.

Research as Important as Instruction in University Work

AT THE annual meeting of the Western Society of Engineers, C. R. Richards, for several years dean and director of the College of Engineering, University of Illinois, and now president of Lehigh University, laid down the principle that scientific research should be given a standing equal to that of instruction in the aims of the modern university. What follows is an abstract of President Richards' expression on the subject.

Research and Instruction—It should be the purpose of real universities to place scientific research and the advancement of knowledge in a position of equal importance with the work of instruction. The tremendous development of technical education during the past fifty years, with the constantly increasing number of technically educated men in industrial life, has increased the need for more exact information concerning the scientific basis of industrial activities, and demands that those responsible for the advancement of these activities utilize more effectively the results of technological research. Whatever may be the future of technological research in the universities as compared with that in private laboratories, the fact remains that educational institutions have blazed the way and have made the importance of such research fully apparent.

Until recently, comparatively few of the engineering industries have appreciated the value of scientific research. Now, most of them are alive to its importance and many of them have undertaken its promotion by one means or another. It is difficult to determine when a corporation or an association of concerns having a community of interests, can justify the organization of an independent research laboratory. The great expense of operation, the difficulty of securing men competent to do research work, and in many cases the failure to recognize the nature of the problems to be solved, are likely to bring many of these commercial laboratories, as well as research in general, into disrepute. A commercial organization which is forced to show suitable profits to its stockholders may have difficulty in properly evaluating the work of its own laboratories.

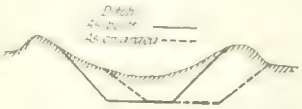
It is probable that the solution of the problems of most industries can best and most economically be undertaken through association with the universities and technical schools. Emphasis should be given to the fact that ordinarily such co-operative arrangements are entered into with no expectation of profit and that a well-equipped institution has scientific facilities both in apparatus and men which cannot readily be duplicated in any private laboratory. Thus, in the field of engineering research as conducted in a modern university the scientific workers have advantages through association with the professors in physics, chemistry, bacteriology and other branches of pure science which may have a direct bearing upon engineering investigations in progress. Many leaders of industry have looked upon men engaged in academic pursuits with some contempt, but this attitude is rapidly changing. In an ever-increasing degree the industries of the country are looking to the technical schools for assistance, and are co-operating with them to their own advantage as well as to the advantage and advancement of education and knowledge.

Enlarging Old Drainage Ditches in Missouri

Widen Ditch by New Side Cut, as Unstable Subsoil Causes Slips in Deepening—Draglines Preferred to Dredges

IN ENLARGING and clearing out about 32 miles of ditches in drainage districts Nos. 12 and 14 of Scott County, Mo., trouble was experienced from sliding soil which made it necessary to provide the increased flow capacity by widening instead of deepening. These ditches have a bottom width of 10 to 20 ft. and a depth of 5 to 12 ft. As excavated originally the slopes were left at about 1 on 1, but they had gradually settled and became approximately 1 on 2.

It was planned to carry out this work by removing the sediment and slipped material and to excavate the bottom to 4 or 6 ft. below the original grade line, leaving the slopes undisturbed. The idea in this was that the banks or slopes of the ditches seemed to have become stabilized through duration of time, and that by taking all the excavation from the bottom of the ditch the banks or sides could be prevented from sliding and caving. It was found, however, in the construction of the work, that the subsoil is underlaid with quicksand or sand of a more or less saturated nature, so that when the earth was removed from the bottom of the ditches the only means of support of the slopes or banks was removed. When an excavation of 4 to 6 ft. was made in the bottom of the ditches the sand would begin to run in to the center of the ditch from underneath the berm or waste banks, with the result that the entire slope and bank of the ditch would gradually settle into the ditch. Under this condition, after any one section of the work was completed the bottom of the ditch was comparatively little lower than when construction started.



SECTION OF CLEARED AND WIDENED DITCH

To secure permanent results it has been found expedient to use a point near the center of the ditch for the outside edge of one of the slopes, as shown in the accompanying section. Particular care was taken not to get near the bank of the ditch. All excavation was made on one side, entirely removing one berm and waste bank, and by making a flat slope (about 1 on 2 or 2½) on this side, it has been found that the banks cave very little. This method increases the yardage of the work considerably beyond what was originally contemplated, but results in a ditch which stands up fairly well. The cost of the work is of course increased in the amount of the increased yardage of excavation, but it is felt that the extra expense is a good investment, for it is the only method found for maintaining the ditch in proper condition. Another case of widening drainage ditches and providing flat slopes, also in Missouri, was noted in *Engineering News-Record* of Aug. 11, 1921, p. 227.

Dragline excavators are being used in the Scott County work and are giving satisfactory results. Starting at the outlet end of the ditch, they give immediate relief to the adjacent lands for the reason that they dig upstream rather than downstream, as is necessarily done with the floating type of dredging machinery. Moreover, it is considered that there would have been considerably more trouble with floating dredges in this particular work, or the reason that dams would have to be maintained to hold sufficient water for the dredges to operate. When the ditch was completed to its outlet or past the dam, the water would go out with a rush, and as the banks of the ditch would be thoroughly saturated with water standing against them for a comparatively long time they would be liable to cave more severely than they do under the present plan. This condition might not be true in certain other kinds of soil. In fact it is considered evident that every contract or problem in such work needs its own design and that no standard can be determined in advance for all classes of construction work in drainage or land reclamation.

This improvement is being made under the direction of C. E. Swank, Charleston, Mo., chief engineer for the drainage districts in question. The W. E. Callahan Construction Co., Dallas, Tex., has the contract, and the cost will be about $175,000. Work was commenced in the fall of 1921 and is expected to be completed by December, 1922.

Corrugated Culvert Pipe Jacked Through Embankment

By P. F. Jones

Chief Engineer, Modesto Irrigation District, Modesto, Cal.

CONFRONTED last winter with the problem of carrying the south branch of the Davis-O'Connor Drain underneath paved highway and the main line tracks of the Southern Pacific R.R. at Salida, Cal., a corrugated culvert pipe was used like a tunnel shield. A siphon was necessary, with its bottom grade 9 ft. below the surface of the ground. It was wholly impracticable to interrupt traffic to excavate and, even if it had not been, the expense would have been very heavy. It was therefore determined to jack a corrugated pipe through the fills.

JACKING CULVERT-PIPE THROUGH AN EMBANKMENT

A siphon which carries water under railroad tracks must, of course, be water-tight. Corrugated pipe can readily be made tight by close riveting and soldering and this is the method usually employed. But it was

decided that in this instance soldering was not practicable on account of the likelihood of the solder being loosened by the jacking operations. The final decision was to install a concrete pipe, in 2 ft. lengths, inside the corrugated culvert. This could readily be made watertight by means of cemented joints; and the corrugated pipe would act as a jacket and afford ample protection against the jars and strains of traffic.

Armco corrugated No. 19 gage was purchased. This was delivered in three 30 ft. sections, one 24 ft. section and two 16 ft. sections. The joints were expanded, joined and riveted in the trench. Only two sections of the pipe had to be jacked—one of 30 ft. under the railroad tracks and one of 24 ft. jacked under the highway paving. The remainder of the pipe was laid in an open trench.

The equipment used was an ordinary screw jack; timber backing to take the thrust of the jack; a bilge pump to keep the trench drained, and a rope and box for removing earth from inside the pipe as it went forward. This box was 16 x 16 x 14 in. The soil was removed by hand, a workman operating inside the pipe. Owing to the confined space, laborers would change off approximately every hour.

The installation occupied four men for twelve days actual working time. The sections under the highway and railroad were jacked forward at the rate of 1 ft per hour. The soil encountered was quicksand for approximately 30 per cent of the distance, and clay pan for the remainder. Water stood 3 ft. above the bottom of the trench, requiring the use of the bilge pump. The driving end of the culvert was not protected in any way; and its condition at the end of the job was perfect.

The total cost of the siphon, including labor, pipe, supplies, etc., was $1,243. It seems that this form of installation might be employed to advantage in many locations. Not only water pipes but those for gas or oil may readily be carried under railroad embankments in this manner. Costly and more or less dangerous operations are avoided and the whole operation is carried on without interruption to traffic.

Steamship Dock and Warehouse at Milwaukee, Wis.

Concrete Structure with 440-Ft. Dock—Waterproof Basement—Ramps with Inclined Floor—Conveyors Assist Trucking

An EXAMPLE of modern steamship terminal facilities at ports on the Great Lakes is a new dock and warehouse of reinforced-concrete construction built at Milwaukee, Wis., for the Milwaukee Terminal Co. This four-story structure 440 x 122 ft., with 440 ft. frontage on the Milwaukee River and on Erie St., adjacent to the Broadway bridge, has its first floor designed for use as a steamer wharf and freight shed. The basement is for freight storage and the upper floors are for warehouse and light manufacturing purposes. A view of the river elevation is shown in Fig. 1.

FIG. 1. DOCK AND WAREHOUSE ON THE MILWAUKEE RIVER

Along the river front of the building is a 3-ft. dock wall having its top 7 ft. above the water level. But this wall is not level with the floor of the building, being intended mainly for use in mooring steamers. As shown by the typical section, Fig. 2, the basement floor is 4 ft. 9 in. above the water and 2 ft. 3 in. below the dock wall. The first floor is 3 ft. 6 in. above the street level, so that it is convenient for handling goods to and from wagons as at a freighthouse.

Passenger facilities arranged across one end of the first floor include ticket office and waiting rooms, with a stairway leading down to the dock wall, from which a gangway is laid to the steamer deck. Freight movement is facilitated by five concrete inclines or ramps from the first floor to the dock wall. These ramps are 15 ft. wide and in the middle of each one is a motor-driven conveyor or traveling platform on which the truckers ride with their hand trucks. A similar ramp leads up from the basement to the dock wall.

Concrete footings on wood piles in a heavy clay formation constitute the foundation. The dock wall is built on two rows of round piling with a line of triple-lap wood sheeting behind the first row, as shown in Fig. 3. This timber bulkhead is held in position by tie-rods at-

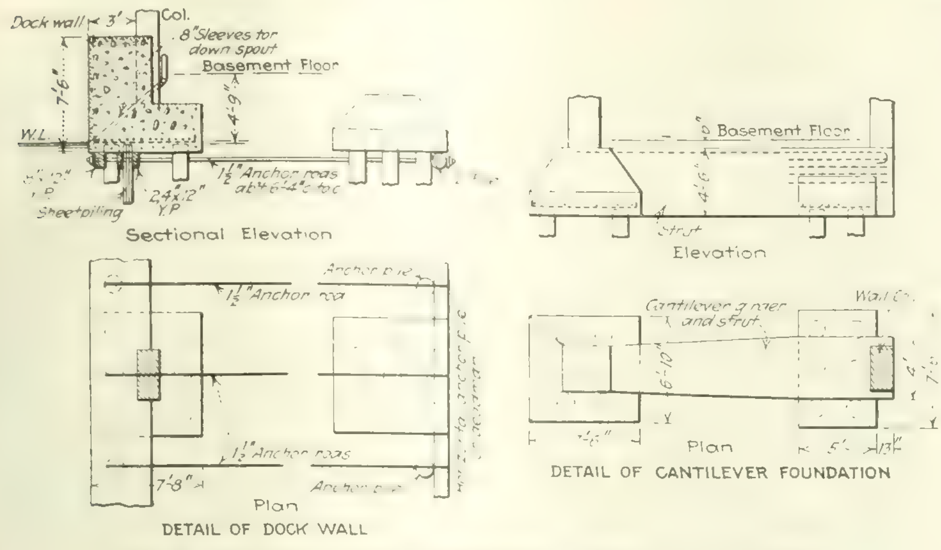


FIG. DOCK WALL AND CANTILEVER FOUNDATION GIRDERS

tached to horizontal deadmen placed behind anchor piles in the rear of the first interior row of footings. At the north end of the building, where the footings are kept within the property line, the wall columns are carried by cantilever girders extending over two rows of footings, as shown. These cantilevers also form struts to resist lateral thrust.

A dry basement was essential for freight storage. To secure watertight construction, a cinder fill was placed between the clay and the concrete floor and an integral waterproofing compound was added to the concrete for the basement floor and dock wall. The result is reported to be entirely satisfactory.

Flat-slab floor and roof construction is used, supported by circular columns forming panels 21 x 21 ft. The first floor is designed for a live-load of 250 lb. per square foot and the others are designed for a 200-lb. load. Cement finish is applied to the floor slabs, except that wood paving is used on the first floor. Brick curtain walls have a large area of steel sash with wire glass. On the street side of the first floor are a number of freight doorways 12 ft. wide and 10 ft. high, fitted with rolling steel doors. Similar doors are used at the openings along the dock wall. Three 8-ton freight elevators are provided. Sprinkler fire protection equipment is served by a 40,000-gal. capacity steel tank and tower situated above the roof.

This marine terminal and warehouse was designed by Albert S. Hecht, architect, with Lieberman & Hein as structural engineers. It was built by the Thompson-Starrett Co. All these are Chicago firms.

Milwaukee County to Build Main Sewer System

Formation of a Metropolitan Sewerage Commission for Milwaukee County, Wis., late in 1921, for the area outside of the city of Milwaukee, linked up the political areas which are one topographically. Outside districts can now be handled in conjunction with the extensive improvements of the Milwaukee Sewerage Commission in cleaning up the drainage areas of the Milwaukee River and its tributaries. Both bodies are state commissions and the plans are being worked out to handle county sewage by intercepters connecting with the city system. For the year 1922, $1,300,000 in bonds has been authorized by the county board of supervisors for the Metropolitan Sewerage Commission. The budget planned includes two main intercepters; one for Whitefish Bay and Sherwood and the other for a section north of the city and North Milwaukee, which is to be connected with the city's West Side intercepter.

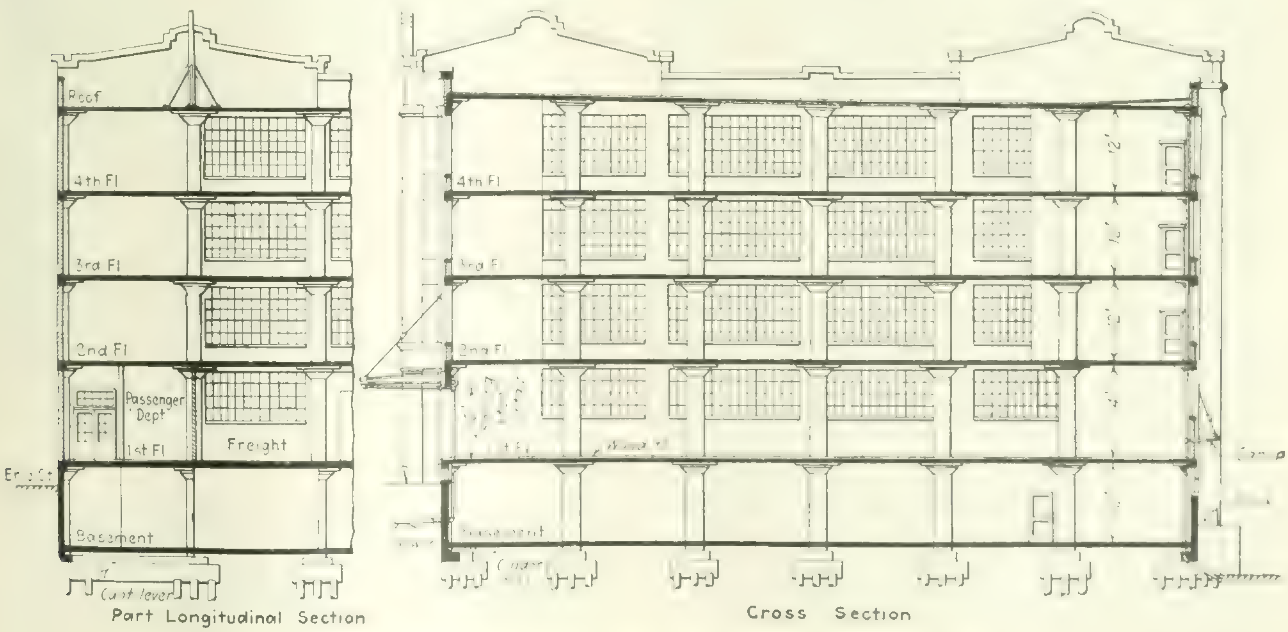


FIG. 2. CROSS SECTION OF DOCK AND WAREHOUSE BUILDING

Large Activated-Sludge Plant for Chicago Sanitary District

To Serve 800,000 Population in 1930—Bar Screens, Grit Chamber, Fine Screens, Dorr Thickeners—Sludge Lagoons for First Use

AN ACTIVATED-SLUDGE plant with sludge disposal by pumping to lagoon was recommended on Feb. 27 for the north-side sewage-works project of the Sanitary District of Chicago by a commission of engineers consisting of Harrison P. Eddy, Boston, George W. Fuller, New York City, and T. Chalkley Hatton, Milwaukee, Wis. The plan was approved by the Board of Trustees of the Sanitary District on May 18 and orders to prepare detailed plans and specifications in accordance with the report of the engineers were issued to Albert W. Dilling, chief engineer of the district. This will be the third and much the largest activated-sludge plant built by the Chicago Sanitary District, two others now being near completion, known as the Calumet and Des Plaines, (see *Engineering News-Record*, Dec. 9, 1920, p. 1134, and June 9, 1921, p. 986). For the present only part of the Calumet plant will make use of the activated-sludge process. The area tributary to the north-side works extends from Glencoe on the north to Fullerton Ave. at the south. The estimates assume a population of 800,000 in 1930 and an average sewage flow of 175 m.g.d.—mostly from confined sewers receiving but little industrial waste. The 1920 population was about 600,000. The effluent will reach the main drainage channel via the North Shore Channel and the North Branch of the Chicago River. The proposed site for the works is 177 acres of land owned by the district in Niles Township, just west of the North Shore Channel.

Cost estimates (see table) were made for (1) coarse screens, grit chambers, Imhoff tanks, fine screens, trickling filters and humus tanks, with sludge beds and final sludge disposal by barging the sludge to fill low ground near the Main Drainage Channel west of the city; (2) activated-sludge works, with coarse screens, grit chamber, fine screens, aeration tanks, Dorr thickeners in the settling tanks, dewatering plant to convert the sludge into 10 per cent moisture commercial fertilizer base at the works, with no credit for the dried sludge on account of uncertainties as to dewatering and marketing it; (3) activated-sludge works as in (2) but with the liquid sludge pumped to lagoons on land owned by the district near the Main Drainage Channel west of the city. At this site a central sludge dewatering and drying plant to serve several other sewage-works could be built if warranted in the future. Consideration was given, but without making cost estimates, to fine screening, sedimentation, chemical precipitation, "direct-oxidation" (lime-electrolytic), sand filtration and contact beds.

The Imhoff-tank sprinkling-filter project was dismissed because it was thought that an activated-sludge plant would be freer from objectionable conditions, even after allowing for (1) 1,500 acres of extra land (gross area 1,700 acres) to isolate the sprinkling filters by means of a strip of land one-half mile wide, and (2) for 70 acres of sprinkling filters so one-seventh of the area might be periodically flooded and out of use in summer to prevent the small-fly nuisance.

The Imhoff tanks provide for 2¾ hours detention and 2.3 cu.ft. per capita of sludge storage. The trickling filters are of broken stone 6½ ft. deep and are designed to receive sewage at the rate of 3 m.g.d. per acre or 0.462 m.g.d. per acre-foot of stone. This gives a gross loading of 11,430 persons per acre or 1,750 per acre-foot of stone. Allowing for 10 of the 70 acres out of service for flooding during the fly-breeding season, the net loading rate is 13,330 persons per acre and 2,050 per acre-foot. The humus tanks are of the one-story hopper-bottom type, with an average detention period above the hoppers of one hour. For the digestion of the humus-tank sludge, an Imhoff type of tank is provided. Sludge-drying beds of a net area of 14 acres are included, or 0.75 sq.ft. per capita. The filter isolation area of some 1,500 acres area adds $2,250,000 to the cost of this project, land in each case being figured at $1,500 per acre. The isolation area requires a short extra length of sewer construction, compared with the activated-sludge estimate.

COMPARATIVE ESTIMATES OF COST OF NORTH-SIDE SEWAGE WORKS

CHICAGO SANITARY DISTRICT

Based on 175 m.g.d. average and 263 m.g.d. maximum sewage flow or 220 and 330 g.d. per capita.

	First Cost*	Capital Charges†	Renewals and Repairs	Power, Labor & Supplies	Total Annual Cost
(1) Imhoff tanks-trickling filters	$16,433,500‡	$1,105,020	$152,982	$510 440	$1,778,442
Per m.g.d	93,900 (p.m.g	17 46	2 40	8 00	27 86
(2) Activated sludge, with dewatering.	14,502,713**	983,716	266,456	946,277	2,196,449
Per m.g.d.......	82,872 (p.m.g.)	15.40	4.16	14.81	34.38
(3) Activated sludge, with lagooning..	13,203,321††	895,579	205,451	630,660	1,731,690
	75,447 (p.m.g.)	14.02	3.22	9.87	27.11

* Common to all three projects are coarse screens, pumping plants (with 57-ft. lift for (1) and 53-ft. lift for (2) and (3); grit chambers and fine screens. In (1) the fine screens are placed between the Imhoff tanks and trickling filters and are much less expensive than the 8 Rex screens, each 7 x 53 ft., at $30,000 each to be placed between the grit chambers and aerating tanks in (2) amd (3). In each case 15 per cent is allowed for engineering and contingencies.

† Interest at 5 per cent and annual charge of 1 783 per cent to redeem bonds in 30 years on 4 per cent sinking fund basis.

‡ Includes heavy allowances on account of "isolation strip" ½ mile wide around plant to prevent complaints of odors from spraying sewage on trickling filters. This strip adds about 1,500 acres to the 187 acres otherwise allowed for site for this project and for projects (2) and (3); or at $1,500 an acre, a total of $2,250,000 extra for land. Besides this, $272,000 net is added for extra sewer construction. Project (1) also includes $500,000 for sludge barges, etc.

** The total first cost of the dewatering plant is $2,190,635, divided as follows: 50 Berrigan presses, including pumps, pipe, etc., $750,000; 6 rotary dryers, $300,000; conveyors, grinders, shakers, bagging equipment, etc., $62,000; buildings, $714,200; coal and ash handling equipment, $78,700; engineering, etc., $285,735.

†† First cost of sludge disposal by pumping and lagooning totals $891,250, thus divided: sludge force pump, $5,750; 12-in. cast-iron force main about 18 miles long, $655,500; lagoons $230,000. Estimates of first capital and pumping costs for 16-, 12-, 10- and 8-in. pipe lines showed that the 12-in. was considerably the cheapest.

(All foot notes compiled from the many detailed tables and the text of the report.—EDITOR.)

In the activated-sludge estimates the aeration tanks are 15 ft. deep and have a capacity 20 per cent in excess of that required for six hours detention at the average rate of flow; or in other words, provision is made for a 20 per cent sludge return. The air rate is 1¼ cu.ft. per gallon. Filtros plates on a 4 to 1 ratio are provided for. The settling tanks are 15 ft. deep, with 1 sq.ft. of surface per 1,600 gal. of sewage in 24 hours at the maximum rate of flow, but with no allowance for sludge deposits.

The sludge dewatering estimates assume a final 10 per cent of moisture. They include sulphuric acid treatment, Berrigan presses, rotary dryers (washing the dryer gases to remove dust) grinders, sieves, conveyors and final bagging. It is estimated that each 1,000,000 gal. of sewage would produce 1,000 lb. of dried sludge.

A Review of Recent Accidents in New York Subways

Delays Due to Excess Runoff from Streets, Broken Water Mains, and Short Circuits in Trains and Power Houses

By Robert Ridgway
Chief Engineer, New York Transit Commission

In order that engineers may have authoritative technical information concerning the series of accidents that have recently befallen the New York rapid transit subways, Mr. Ridgway has prepared, at our request, the following statement as to the scope of the difficulties and their causes, so far as it has been possible to determine them.—Editor.

Beginning about a month ago, a series of accidents occurred in connection with rapid-transit operation in New York, in some cases causing partial or complete suspension on a line or system, with consequent delay and inconvenience to passengers. Such a series of delays, occurring at so frequent intervals, and being detailed and dilated upon by the daily press, may cause some apprehension in the minds of the traveling public as to the efficiency and safety of the rapid-transit systems upon which they are dependent. It is proposed, therefore, to consider in some detail the nature and causes of these several accidents. They may be grouped into two general classes: those caused by water and those by fire.

Delays Caused by Water—Considering the first class, on July 1, train service on the Interborough subway on Seventh Ave. was delayed near Houston St. by water to a height of about 12 in. above the tracks, which caused a suspension of through operation on that line from about noon to 2:20 p.m. On the same day traffic was interrupted in the Eastern Parkway (Brooklyn) line of the Interborough subway between New York and Troy Aves., from 12:56 to 2:30 p.m., by water over the subway tracks. On the same day also service on the Fourth Ave. subway line of the New York Municipal Ry. Corp., in Brooklyn was interrupted because of the collection of water over the tracks of the subway near Union St.; and a similar suspension of traffic occurred on the Brighton Beach line because of water over the tracks near Newkirk Ave.

These several suspensions of traffic all were due to the excessive rainfall of that day, which was reported to have exceeded $1\frac{1}{2}$ in. in two hours and more than 1 in. in twenty-five minutes. So excessive a rainfall overtaxed the catchbasins and sewers to the extent that at certain locations the water on the street surface rose above the level of the curbs. At Union St., Brooklyn, the water on the surface is stated to have stood two feet above the street surface.

In the cases of Seventh Ave. near West Houston St., Eastern Parkway, between New York and Troy Aves., and Fourth Ave. near Union St., the water rising above the curbs was diverted into the subway through the openings and gratings provided in sidewalks and parkways for ventilating the subway trainways, and thence along the tracks to the lowest points adjacent. At each of the locations mentioned drainage sumps, equipped with automatic pumps, were provided at the time the subway was constructed. The capacities of the pumps were based upon ample allowance for the flow likely to reach them from outside seepage and from sources within the structure but not upon so excessive an inflow from the street surface as was caused by the storm water rising above the street curbs. The pumps are arranged to work automatically, and did so; but they were unable to cope with the large inflow.

The tracks of the Brighton Beach line, at Newkirk Ave. were flooded by the obstruction of a cross drain which was under pressure during the flood. The water flowed off by gravity when the pressure was released.

On the evening of July 18, the Seventh Ave. line of the Interborough Co. was again flooded near Houston St., at the same point and from the same cause as on July 1, causing a suspension of through operation from 7:57 to 10:30 p.m. The rainfall again flooded the streets and entered the subway through the gratings in the sidewalk in the block north of Houston St. Investigation of the conditions in the vicinity would seem to indicate that a contributing cause was the temporary condition of the sewers due to the reconstruction of a large sewer in Clarkson St., which had been made necessary by its insufficient capacity.

On July 26, service on the Lexington Ave. line of the Interborough Co. was slightly delayed in the early morning by water entering the subway near 26th St. through the west wall of the subway. This flood was due to the breaking of a 36-in. water main running east and west on the north side of 26th St. The water rose to the top of the rails only and did not stop traffic.

On July 29 a 12-in. water main broke at the southwest corner of Flatbush and Fourth Aves., Brooklyn. The resulting flood did not interfere with subway operation. Near the point where this main broke there was a duct manhole which was damaged and in process of reconstruction when, on Aug. 4, another break occurred in a 16-in. main near that point. The water from this break found its way through the holes of the duct line and discharged into a duct manhole located inside the subway near Atlantic Ave. station. A 4-in. brick curtain wall separating the tracks from the splicing chamber was not of sufficient strength to resist the water pressure. When it failed the water flowed to the tracks to a depth of 20 in., causing a suspension of traffic on the Interborough lines east of Atlantic Ave. station from 8:50 p.m. to 12:30 a.m. The pumps provided at the sump nearby worked automatically and removed the water as soon as the inflow was controlled.

In the case of each delay or suspension of operation mentioned thus far, the reason for the delay or suspension originated entirely outside the subway structure and from causes beyond the control of the operating companies. There is nothing indicating laxity on the part of the operating companies, either in the matter of prevention of the occurrence or resumption of operation. The permanent equipment provided for the removal of water was adequate for the contemplated needs, and worked automatically as intended. Auxiliary emergency pumping equipment on cars was brought in and operated when it proved of advantage to do so. The water in each case entered the subway through necessary openings provided for proper ventilation or for other purposes. Heavier rainfalls of longer duration have occurred without affecting subway operation at these points and it is not clear why the runoff

through the streets and sewers was not so efficient as it had been in the past. The delays of this class did not cause any danger whatever to the traveling public.

Delays Caused by Fire.—Considering the second cause of delays and suspension of traffic we find two cases. On July 6 a short circuit occurred on the switchboard or panel box of the fifth car of a northbound Jerome Ave. express train in the Lexington Ave. subway of the Interborough Co. near 60th St., which required the shutting off of power and suspension of traffic between Grand Central and 77th St. stations from 11:13 a.m. to 1:03 p.m. Because of the consequences that followed, this accident is the most important of those yet mentioned. The short circuit set fire to the insulation contained within the panel box and the paint and varnish of the vestibule of the car adjacent, generating a large amount of smoke and fumes. The draft of air from the ventilation of the subway carried the smoke toward the north and, as the train had been brought to a stop, most of the passengers from the train walked south, along the footwalk provided for that purpose on each side of the tracks, to the emergency exit at 59th St. The passengers from a southbound train stopped by the shutting off of power in the affected section just north of the one with the short circuit, also walked south through the smoke to the exits at 62nd and 59th Sts.

It is probable that 150 passengers were aboard the train on which the short circuit occurred, and that from fifty to seventy persons were more or less affected by excitement, smoke and fumes, and by the unusual exertion of climbing 60 ft. of stairway, the express tracks at this point being at quite a depth beneath the street. There were no fatalities. All, with the exception of some of the trainmen who remained to care for the train, went to the street above. Some received assistance up the steps, nine were reported to have fainted or lost consciousness after reaching the street, and sixty-seven were sent to the hospitals for treatment. All but thirteen of these were discharged on the day of admission. In all, 112 persons received medical treatment. It was at first thought that the condition of those treated might be due to the use of pyrene fire extinguishers. The record of the case of each patient treated indicates that this was not a fact, and that, except in the cases of four or five of those treated, in which the pyrene fumes appear to have aggravated the smoke effects, the symptoms could all be accounted for by the known effects that result from the burning of insulating materials, rubber, varnish and paint. It is apparent, therefore, that most of the passengers were suffering from panic, and the remainder, with the exceptions noted, wholly from smoke and fumes. The trainmen who remained with their trains were not affected.

The panel board of the car in which the short circuit occurred is a small switchboard on which is installed the electrical apparatus, such as switches, relays and fuses, by means of which the current for motors, lights, heaters and air compressors is controlled. These instruments are mounted on a slab of slate and are covered by a steel door lined with asbestos. All of the wires connecting with the instruments on the panel board are rubber-insulated and are carried to the panel in iron conduits, the insulation of the wires being the only inflammable material on or near the panel board. It is difficult to understand how such a destructive arc originated, and there is no precedent to guide in this case. It is reported that in the seventeen years since the beginning of subway operation, no other accident of this nature has occurred. The routine of the operating company requires that the entire equipment of each car be inspected after each 1,000 miles operated. This particular car was last inspected on July 3, 1922, since which date it had been operated only 323 miles.

Determination of the precise cause of the short circuit has been made difficult as the result of the destruction produced by so intense an arc. The occurrence has been carefully investigated and steps are being taken to avoid a recurrence.

On July 25 there was a complete suspension of traffic on the lines of the Brooklyn Rapid Transit Co. as a result of a fire in the Williamsburg power station of that company. The fire occurred at the rush hour of the day and consequently caused greater inconvenience to the traveling public than all the others mentioned. Trains and surface cars were stalled at various points over the system, beginning at about 5:15 p.m., and full service was not resumed until about 8:55 p.m. This fire also was due to a short circuit and originated on an oil-switch connected with a generator, the switch being so badly damaged that the exact cause could not be determined. The intensity of the arc that was formed caused fire at other points and to combat the flames it was necessary to shut off all power. Except for the delay and inconvenience caused the traveling public, the latter would probably have been unaware of the occurrence of the fire. It had no bearing on the question of safety to passengers, except that of possible panic, as a result of trains being stalled indefinitely in the tubes at a time when the Lexington Ave. fire was still fresh in the public mind. The absence of panic under the unusual and trying conditions speaks well for the mental balance of the passengers.

Summary—In the foregoing review of the various delays to rapid transit traffic and their causes, two facts are apparent. First: Without a single exception the accidents were of a most unusual nature and therefore difficult to provide against. The delays from flood were due either to the failure of the street and sewer drainage system to carry off the excessive rainfalls, or to the bursting of water mains. Consequently, when the water rose above the level of the curbs, it found its way to the subway through the stairways, ventilation and other openings provided for various purposes. When the trainways are so flooded it is not reasonable to expect that the water can be removed immediately by pumping into the streets or sewers at a time when the latter may already be choked and flowing under a head. Second: In but one of the cases mentioned was there any real exposure of the passengers to danger, and in that case it appears that the danger was, at least in part, within their own control; for it is certain that more of the passengers suffered from panic than from any injurious effects resulting from the fire itself. Such accidents as the Lexington Ave. fire reflect credit upon the manner with which the train crews and employees of the operating companies have taken care of the directions for safeguarding the passengers in such emergencies. In comparison with the car mileage operated it may be stated that since the year 1917 and including the present year the occurrence of short circuits has been gradually reduced in number.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

A Simple Remedy

Sir—In an editorial in your issue of Aug. 10 you say, "Something more than the ordinary processes of law is required to guarantee punishment for building collapse."

The remedy is obvious: Let the engineers be licensed; then the buildings cannot possibly collapse.

West New Brighton, N. Y. FREDERIC W. JAMES.
Aug. 11.

Engineers and the Eighteenth Amendment

Sir—On page 172 of your issue of Aug. 3 in a reference to the eighteenth amendment, you say that engineers as such might reasonably have expected to have little interest in the eighteenth amendment and that to them the alcoholic content of a beverage would seem to be a matter of the slightest consequence.

A standard clause in construction contracts, especially in railway construction contracts, relates to the prohibition of alcoholic beverages on or about construction work. Intoxication is an inadmissible element in engineering design and in construction. No sane person would by choice or preference entrust engineering design or supervision to intoxicated engineers or execution of the work to intoxicated workmen. Engineers individually and as a class have or should have as much interest in the eighteenth amendment as any other person or class.

J. L. CAMPBELL,
Chief Engineer, El Paso & Southwestern System.

El Paso, Tex.
Aug. 11.

Favor Lug Brick With Asphalt Filler

Sir—Readers of *Engineering News-Record* may be interested in having their attention directed to certain features in a paper by Prof. Arthur H. Blanchard entitled "Developments in Methods of Constructing Brick Pavements," presented before the Eighth Annual Michigan Conference on Highway Engineering held at Ann Arbor, and to discuss his conclusions as herein set forth. The paper describes the various phases in the history of development of brick pavement, beginning with brick laid upon sand foundation and sand filler, and concluding with the modern type of brick pavement which is brick laid upon Portland cement concrete foundation, sand bed and asphalt filler. It also recognizes the economic development resulting from the action of the Secretary of Commerce of the United States in calling a conference of the manufacturers and engineers regarding simplification of variety and standards for paving brick.

In the discussion of brick pavements only two important characteristics of an ideal pavement were considered, namely, imperviousness and durability. Part of the paper refers to the merit of various types of paving brick. This reference is based on the author's field studies of existing brick pavements and experiments under his direction with the co-operation of the director of the Michigan State Highway Laboratory and engineers of the Ohio Paving Brick Manufacturers' Association.

Professor Blanchard's conclusions and recommendations are as follows:

"Bituminous cements, possessing the desired characteristics, should be universally used for the filler."

"The use of plain wire-cut brick is accompanied with great risk relative to securing well filled joints. Conservative practice dictates that only lug brick should be employed."

The writer submitted Professor Blanchard's paper, together with a questionnaire, to about 400 municipal and highway engineers. The questionnaire sought the engineers' opinion regarding lug and lugless type of brick for asphalt filler. Of 103 engineers who answered the questionnaire 89 per cent favored the use of brick with lugs for asphalt filler. A tabulation, by states, of the opinions set forth in answers to the questionnaire is presented herewith:

State	Favorable to Lug Type	Favorable to Lugless Type	Indefinite or Uncertain	Total
Pennsylvania	12	3	1	16
Ohio	33	3		36
Indiana	13		2	15
Illinois	10			10
Missouri	5	1		6
Iowa	12	1		13
Kansas	7			7
Total	92	8	3	103

JAMES C. TRAVILLA,
Consulting Engineer,
Dunn Wire-Cut Lug Brick Co.

Conneaut, Ohio,
July 20, 1922.

Economics of Selecting Industrial Sites

Sir—In reference to Mr. Cresswell's letter in *Engineering News-Record*, June 8, 1922, p. 969, on "The High Cost of Tardy Engineering," there are other than purely construction costs which should be considered in determining the suitability of any site for an industrial or utility plant. These factors are not generally spoken of as engineering factors but as they are most certainly economic they come within the province of the engineer and should be called by him to the attention of the executive on whom rests the final decision, definitely, and in their proper relationship.

Freight transportation facilities are generally well studied out but those for passengers—meaning by this the facilities for handling the labor to and from the plant—are rarely given any attention. In the neighborhood of large cities especially, where there may be competition for labor, this is important. If the workmen have to spend an extra half hour, or pay an extra fare, twice a day dissatisfaction will soon develop, showing itself in an increased labor turnover. The resulting loss of efficiency possibly will more than offset the physical or commercial advantages.

Other phases of the labor problem may present themselves. If the social surroundings of the community do not meet the demands of the class of employees needed for the work, the result will be either an uneconomical turnover, or the substitution of a different class or race of workmen not naturally adapted to the particular industry. Native Americans, for example, require good schools and a fair chance of self-government and will not be satisfied to remain in a community of Poles or Italians whose standards of living, amusements and public welfare are so radically different. Where the number of operatives is small, relative to the surrounding population, such effect on turnover and operation may be great but will diminish as the number increases sufficient to form a community of its own.

Tax questions are important and should be put in their proper relation to the other factors. The writer has in mind a certain factory which was moved from a city of relatively high tax rate to an adjoining town with a lower rate, in order to save on this item. But the lower rate, though applied to a much larger area and showing a large saving in comparison with similar area in the city, was more than offset by unsatisfactory transportation facilities.

Care is required to make the proper adjustment of all the factors involved in a choice of location. Their relative values vary with different industries and with different cases in each industry. Thorough study must be made, therefore, to determine, first, the value that each factor should have *for that particular case*, and second, the value of that factor in each location under consideration. If, and when, this is done the final decision can be made on a basis of correct knowledge and the chances of mistake reduced to a minimum.

L. J. CARMALT.

New Haven, Conn., June 29.

NEWS OF THE WEEK

New York, August 24, 1922

Cabinet Members Give Views on Hydraulic Laboratory

Secretaries of Interior and Commerce Favor Its Establishment—Weeks Opposes the Plan

Washington Correspondence

Establishment of a national hydraulic laboratory is favored strongly by the Secretary of the Interior and by the Secretary of Commerce, but the Secretary of War believes "in view of the necessity for economy in federal expenditures that this is not the time for establishing a laboratory."

The opinions of the three cabinet officers concerned most with hydraulic matters were sought by Senator Ransdell, the chairman of a sub-committee of the Senate Committee on Commerce, who will conduct hearings in the near future on a bill proposing the appropriation of $200,000 for the establishment of this laboratory.

Secretary Fall, in his reply, points out that the Interior Department for many years has recognized the necessity and the value of scientific research in river hydraulics.

In suggesting that the laboratory be conducted by the Geological Survey, Secretary Fall makes this point: "Not only is it necessary for the organization intrusted with this investigation to have had broad field experience, but it is equally essential that the fact-finding agency be separated from the executive agency. In this department, that relation between the Geological Survey, an investigative bureau, and the Reclamation Service, a construction service, has proved the practical and effective division of the work."

Views of Hoover and Weeks

Secretary Hoover concurs in a report made by the Bureau of Standards on the bill, in which it is stated that "the waste due to floods makes this distinctly a national problem. Without question the solution of this tremendous waste problem rests on fundamental data concerning the flow of water, the wearing of structural and natural material, the transportation of material and water, and chemical and physical deposition."

Secretary Weeks says that he desires particularly "to emphasize that the hydraulic laboratory proposed would have no value whatever in solving flood-control and that the government would not be justified in incurring the expense of a laboratory for the investigation of flood problems," since "the reservoir control of the Mississippi flood problem is not practicable" and since "the art of dam construction is so far advanced in this country that a national hydraulic laboratory is not necessary to advance that science, and is certainly unnecessary to determine the proper design of levees. I may go so far as to say I would regard it as a misapplication of government funds to establish a laboratory for flood problem study."

To Hear Clay Products Rate Case

Freight rates on hollow building-tile and clay products from Brazil and related points in Indiana to Chicago will be the subject of a hearing at Chicago on Sept. 7 before Examiner Hillyer of the Interstate Commerce Commission.

Maps Prepared on Colorado River Irrigation Project

Maps for the Colorado River irrigation project which were completed by C. C. Holder of the Topographic Section, Geological Survey, have been received at Ballinger, Texas, for approval of the irrigation committee before further work on the project is launched. Mr. Holder spent nearly eight months making the survey, working under the direction of the government, and has been at Washington for the last four months making the maps of the proposed 200,000-acre district. Mr. Holder's preliminary report shows the project to be entirely feasible and the next move will be the creation of an irrigation district for the issuance of $10,000,000 worth of bonds.

San Francisco to Vote on School Building Bond Issue

The supervisors of the city and county of San Francisco will submit to the voters at a special election a $12,000,000 bond issue for the construction of thirty-five new school buildings and the acquisition of additional lands for school purposes. In addition, the supervisors are pledged to place a 15-cent tax in the yearly tax-rate to meet the needs of the school department for maintenance, repairs and upkeep of the existing school buildings and to construct three new schools each year to meet the normal needs due to the increase in the number of school children.

At the same election the voters will decide the issuance of $2,000,000 in bonds to finance construction of relief home buildings.

Bids Wanted Soon for Spavinaw Water Project, Tulsa, Okla.

Contractors wishing to bid on the new water supply for Tulsa, Okla., known as the Spavinaw project, are invited by the Water Commission of Tulsa to look over the ground. Final plans and specifications are about completed and bids will be received the latter part of September. The work includes a masonry and earth dam 50 ft. high; 28 miles of 60- and 25 miles of 54-in. pipe; 7,000 ft. of 78-in. tunnel; a 350-m.g. storage and a 10-m.g. high-pressure reservoir; and about 7 miles of cast-iron or steel force mains. Bonds to the amount of $6,800,000 for the work have been voted. The engineers are Trammel & Holway, Tulsa, and the consulting engineer is Dabney H. Maury of Chicago.

MacDonald Returns From Western Trip

Finds Pacific Coast States Have Attacked Highway Problems With Vigor and Effect

Washington Correspondence

Despite sparsity of population, difficult construction, long distances, and large proportions of land not now productive the Western states have attacked their highway problems vigorously and effectively, according to Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, who just has returned to Washington after an extended trip through the West. So that he might gain a better idea of the highway system that is being built up in the West, Mr. MacDonald covered 5,000 miles of the trip in motor cars. He is particularly impressed with the high standards of engineering being followed in the construction of western roads. This applies to the secondary as well as to the primary roads. He notes, however, that the states which have made most progress in the carrying out of their highway programs are those in which there has been stability in the personnel of the state highway commission and its staff.

Mr. MacDonald found very pronounced objection in the West to the limitation in the per mileage expenditure carried in the present highway law. In order to make the roads safe, where heavy grades and difficult construtuion must be undertaken, it is necessary to resort to higher standards of construction. The limitation in the bill discourages the more economical and the safest course. He also encountered a very general feeling that the rate of appropriation provided in the existing act does not allow for adequate progress in road building.

One observation which Mr. MacDonald made while on his trip, and which he thinks could be applied throughout the country in the interest of safety, is the practice of sanding asphalt surfaces on hills and at points where skidding of motor vehicles is likely to occur. This simple expedient, he found, practically obviated this danger and makes possible the safe use of mountain highways when the surface of the road is wet.

Texas Highway Association Holds Convention

Centralization of road-building activities under state control tending towards more efficient prosecution of a comprehensive campaign to bring Texas "out of the mud" was stressed during the recent convention of the Texas Highway Association, held in Galveston, Aug. 3 and 4. About 400 delegates from all over the state were present, representing business men, city and county governments, and state institutions.

Industrial Films Available to Engineering Societies

Engineering News-Record has from time to time received requests for information as to where moving picture films depicting various engineering and industrial processes may be secured free of cost. From various sources this journal has prepared a list which is deemed of sufficient interest to warrant publication. Though the films can be secured rent free, the cost of transporting them must be borne by the organization desiring them, and some guarantee must be given that the films will be returned in good order.

Following is the list and the information as to how they can be secured:

"Manufacture of Gas From The Coal Pile to the Meter," obtained through the American Gas Association, 128 East 15th Street, New York City; "Bombing Tests at Langley Field," Lieut. Geo. W. Haskins, McCook Field, Dayton, Ohio; "Combining Earth's Scattered Treasures to Produce Light," National Lamp Works, Nela Park, Cleveland, Ohio—attention of W. M. Johnson, Engineering Department; "The Story of Petroleum," Bureau of Mines, Washington, D. C.; "Processes Employed in Mining, Crushing, Handling and Transporting Trap Rock," Clarence A. Munson, New Haven Trap Rock Co., 67 Church St., New Haven, Conn. "Testing and Training for Mine Rescue Work," U. S. Bureau of Mines, Washington, D. C.; "Multiplying Man Power," J. Maxwell Carrer, care of Chas. A. Schieren Co., 30 Ferry Street, New York, N. Y.; "Hog Island Ship Yards," American Society of Mechanical Engineers, 29 W. 39th St., New York; "Coal is King," Diamond Power Specialty Co., Detroit, Mich.; "The Construction of a 60,000-hp. Hydro-Electric Plant," Stone & Webster, Boston, Mass.; "The Story of Ingot Iron," Bureau of Mines, Washington, D. C.; "Manufacture of Pipe," Charles Fitzgerald, White Oil Corp.; "Steam Railroad Electrification," S. T. Dodd, Railway & Traction Engineering Department, General Electric Co., Buffalo, N. Y.; "Production of Lead," John R. McGregor, Asst. Gen. Store Manager of the Eagle Pecher Lead Co., Bridgeport, Conn.; "Hydro Power Developments in Connecticut," A. J. Campbell, Connecticut Light & Power Co., Waterbury, Conn.; "Manufacture of Air Compressors, Drills and Coal Cutters," Sullivan Machinery Co., Chicago; "Manufacture of Genuine Wrought Iron Pipe," A. M. Byers Co., N. Y. C.; "The Cordage Industry," and "The Story of Sulphur," Bureau of Mines, Washington, D. C.; "A Dollar Saved Is a Dollar Earned," (pipe-covering industry), Bureau of Mines, Pittsburgh, Pa.; "Making Telephones in Tokio," Western Electric Co., New York; "Alpha Cement Manufacturing and Use," the Alpha Portland Cement Co., New York City; and "Soap Making," Kirkman & Sons, Brooklyn, N. Y.

In addition the following pictures are available through the General Electric Co., Schenectady, New York. The order should be given by film number.

Film 9, "Panama Canal"; Film 17, "The King of the Rails"; Film 23, "The Electric Giant"; Film 25, "The Island of Sugar"; Film 27, "The Queen of the Waves"; Film 28, "The Land of Cotton"; Film 29, "The Sugar Trail"; Film 30, "Big Deeds"; and Film 31, "Revelations by X-Ray."

Water Power to Be Subject of Am. Soc. C. E. Fall Meeting

The water-power problem will be the theme of the technical discussions at the fall meeting of the American Society of Civil Engineers, to be held Oct. 4-9 in San Francisco, according to a preliminary announcement from the office of the secretary.

For the first two days of the meeting members will get together largely to hear and discuss technical papers and to participate in local excursions. Durin the week-end of Oct. 6-9 there will be an excursion to the Don Pedro and Hetch Hetchy dams and the Yosemite Valley.

Special excursion rates will be in effect from the Atlantic Coast and Chicago. The round-trip railroad excursion rate without excess fare will be: From Boston, $147.66; New York, $138.32; Chicago, $86. The price of a lower berth in a Pullman for one way is: From Boston, $33.76; New York. $32.63, and Chicago $23.63.

The committee on local arrangements is composed of A. H. Markwart, chairman, and H. D. Dewell, Ely C. Hutchinson, Thomas H. Means, and F. H. Tibbets.

Paving and Street Railway Engineers to Confer

The Engineers' Club of Philadelphia, in co-operation with members of the American Society of Civil Engineers, the American Electric Railway Engineering Association, the American Society for Municipal Improvement, the Society of Municipal Engineers, the Federal Highway Council and the Motor Truck Association of America, has arranged an all-day conference, Oct. 9, for a general discussion on the design and construction of streets for street railway traffic. Announcement of the meeting is being sent to chief engineers of cities and of street railway companies throughout the country. Though the meeting is sponsored by a local organization, it is desired by that organization that the discussions take on a national aspect.

Inasmuch as the general subject is so important, it is considered best by the committee to limit the meeting to the consideration of the general subject alone and not take up other city paving questions.

As ramifications of the general subject will be taken up the location of utilities in the street, design of street-railway structures, paving and drainage of street for street-railway traffic, what the responsibilities of the railway company as to installation and maintenance paving costs should be, and the expense to which paving is affected by street railway tracks.

The committee in charge of the meeting is composed of the following men: C. M. Pinckney, New York City; Col. R. Keith Compton, consulting engineer, Baltimore Paving Commission; Major F. S. Besson, assistant to the engineer commissioner, Washington, D. C.; R. C. Cram, Brooklyn Rapid Transit Co., Brooklyn, N. Y.; E. J. McIlraith, Philadelphia Rapid Transit Co.; Julius Adler, deputy chief, Philadelphia Bureau of Highways; John Meigs, consulting engineer, Philadelphia; and Charles E. Billin, secretary, Engineers' Club of Philadelphia.

Preliminary Power Permit Held Not Binding

Attorney-General Holds it Establishes Priority Only—License May Impose New Conditions

Washington Correspondence

A formal opinion by Attorney-General Daugherty practically denudes the preliminary water-power permit, granted under the provisions of the Federal Water Power Bill, of its value. In his opinion conditions can be inserted in the license which were not indicated in the preliminary permit, and a license may be refused even though the permittee has complied with all the provisions laid down in the preliminary permit.

The Attorney-General's opinion is based upon the letter of the bill which prescribes that the sole purpose of the preliminary permit is to establish priority of application for a license. Any application for actual power development must therefore be considered on its merits and in the light of the conditions then existing.

Act May be Amended

Since large expenditures frequently are necessary to make the preliminary investigations, it is believed that this interpretation of the law will discourage expenditures for that purpose and lay a further obstacle in the path of water power development. It is very generally believed that this was not the intent of the law and steps will be taken at once, it is believed, to secure an amendment to the act which will make the preliminary permit sufficiently binding to justify applicants in incurring the expense necessary for the preliminary investigation.

The opinion is of particular importance at this time in that it relieves the Federal Power Commission from any obligation to issue a license on the Girand application covering a power site at Diamond Creek on the Colorado River.

Ontario Will Reserve Abitibi Power for Future Use

As a result of several recent conferences with the parties interested in power development in Northern Ontario, it is stated that the Ontario government has decided to reserve the Long Sault rapids on the Abitibi River representing 60,000 hp. of electric energy for future disposition. The Hollinger Consolidated has made application for the Three Carrying Places rapids where 40,000 hp. can be developed. The Timiskaming & Northern Ontario Ry. has waived its rights to any power for electrification on the Abitibi between Iroquois Falls and Tin Can Portage, and will develop a power on the Frederichouse River for the electrification of a portion of the line near Cochrane.

It is also understood that the T. & N. O. Ry. will seek further reservations of power between New Post, its present objective in the extension toward James Bay, and its final terminus at tide water. These reservations will provide two lots of 15,000 hp. each. Further conferences are being held to arrange for the control of the flow of the Abitibi River.

See No Gain for Public in Strike Settlement

Washington Looks Upon Cleveland Agreement as Truce—Expect All Operators to Sign

(Washington Correspondence)

A truce, with the contestants retaining their arms and preparing for a resumption of hostilities on a larger scale, describes the situation in the coal industry. It is an opinion in Washington almost unanimously held that all the operators eventually will accept the Cleveland agreement. So far as government officials are concerned, they will have little patience with any other course. Their position is that the public's need of coal is more important at this time than any issue involved in the strike. The viewpoint of government officials and members of the Congressional bodies is important not so much from any law the government can invoke as from the fact that they are assured complete publicity for their opinions on this subject and in that way can crystallize public opinion.

If the entire Central Competitive Field can get under way within ten days, it is believed that the situation can be tided over so that industry can be kept going. It is realized that the country's coal reserves are about gone. Widespread stoppage of industry will show itself soon unless capacity production is attained quickly. The ability of the country to produce coal is well known, therefore hoarding would soon cease. Such reserves as remain will be used up first with the knowledge that better prices are more likely to be obtained the longer purchases can be deferred.

The non-union fields are in a position to produce a record tonnage. Not only have many new mines been opened but it is predicted that all non-union operators will be paying the 1920 wage scale before Labor Day. All of this is on the assumption that normal transportation facilities will be available.

Results of Struggle

The result of the struggle is regarded as something of a draw. The strength of the union has been clearly demonstrated. The mine workers have successfully resisted a reduction in their pay. The check-off will continue and working conditions remain unchanged. The operators at least have broken up the Central Competitive Field. The prospects are that the union will lose some of the weakly-organized districts. No one of the fundamental ills of the coal industry has been remedied. Every issue involved in this strike must be fought out again. A truce has been declared but it is a make-shift.

The public is more concerned with the net effect of the strike. There has been a great industrial set-back. There has been widespread unemployment. The nation's fuel bill for 1922 will be $300,000,000 more than it was in 1921. One-half of one per cent of the population has taken advantage of its position to dominate the supply of a necessity. The interests of 99.5 per cent of the population have been affected adversely. There has been no humbling of the organization responsible. No industrial disciplining has resulted.

One of the big factors influencing operators to get back to work is the fear that they will lose markets permanently to the non-union districts which have a better coal. Reports to Washington indicate that many industries now that they have had a taste of high-grade coal, intend to use it permanently. Other companies fear the loss of business, gained at great cost, in the Northwest. They do not want to see Illinois get the business which represents a large outlay to them. There are other operators who think they can take in enough money in the next six months to make it attractive to take chances on the future. Some expect to sell all their coal for the high dollar as long as the market lasts and then go out of the business. Those with such ideas in mind will be interested in a recent statement by Fuel Distributor Spencer that agreements as to maximum prices will be sought immediately in those districts which return to work. He did say that it is possible that no control over prices would be attempted if the entire union area should resume operations. He called attention to the prompt flattening out of the market following the settlement of the 1920 strike.

There is some speculation as to the number of coal miners who may have gone into other industries during the strike. Some think they may stay with their new line of work and that there may not be such a superfluity of coal miners in the future. The majority opinion, however, seems to be that coal mining at the 1920 rate of pay is so attractive, when all other circumstances in connection with the work are considered, as to insure the return to the business of every man who has ever engaged in it and a considerable number of men from other industries where the wage scale is lower and where working conditions are more strict.

Grand Trunk President Resigns, Pending Reorganization

It is officially announced that Howard G. Kelley has resigned as a member of the board of directors of the Grand Trunk Ry. and so automatically ceases to be president of the road. His resignation has been in the hands of the government for some time in view of the impending reorganization, and its acceptance is stated to be due to the fact that his contract with the Grand Trunk expires Aug. 31. Pending the organization of the Canadian National Railways board the government has appointed Major Graham Bell, C. M. G., deputy minister of railways, to fill the vacancy on the board created by Mr. Kelley's resignation. W. D. Robb has been appointed vice-president and general manager.

League to Combat Oil Pollution of Coast Waters Formed

The National Coast Anti-Pollution League was formed at Atlantic City, N. J., as one of the results of a two-day conference of representatives of seaboard cities. Gifford Pinchot, state forester of Pennsylvania and gubernatorial candidate, was elected president, and Sedley H. Phinney, Trenton, N. J., secretary of the league.

The Engineer in Public Life

JOHN F. COLEMAN

Political work with the League for Good Government and service in connection with the Eye, Ear, Nose & Throat Hospital, a charitable institution, have been among the public activities of John F. Coleman, consulting engineer, of New Orleans. Mr. Coleman was born in 1866, is a founder and past-president of the Louisiana Engineering Society, and a past vice-president, American Society of Civil Engineers. His professional work has related largely to railroads and river and harbor improvements. Just before going into private practice he served as principal assistant city engineer of New Orleans, from 1896 to 1901.

He has been active in the work of the local Association of Commerce and also in the development of the port of New Orleans, having been sent abroad recently as representative for the Dock Board to investigate methods of operation of canals, inland waterways and port facilities in Europe from the business point of view.

Mr. Coleman's political activities have included the presidency of the Fair Election League and the vice-presidency of the Democratic Good Government League, in which capacity he had charge of a campaign for political betterment. As a member of the Board of Trustees for the Eye, Ear, Nose and Throat Hospital he has taken a prominent part in campaigns to raise funds for a new structure for this institution and is now chairman of its building committee. He is also a member of the New Orleans Association of Commerce.

Tariff Bill Permits Creation of Free-Port Zones

Washington Correspondence

Establishment of foreign trade zones at a number of American ports practically is assured by the action of the Senate Aug. 16 in adopting, with practically no opposition, an amendment to the tariff bill which would authorize the creation of such zones. The plan for the so-called free ports has been denounced by ultra-protectionists as a free-trade scheme. To meet some of the objections voiced against the proposal the Senate committee eliminated from the original amendment the authority to establish manufacturing enterprises within the free zone. It will be possible, however, to store, exhibit, break-up, repack, assemble, distribute, sort, refine, grade, clean, mix and otherwise manipulate foreign or domestic merchandise in an area where no compliance with the laws and regulations governing the entry of merchandise will be required. By making this possible it is thought substantial advantage will accrue to American shipping.

Safety Institute Has Extensive Accident Prevention Program

Preliminary plans have been made for a campaign of accident prevention to be carried out in October and thereafter under the auspices of the New York Public Safety Committee, of which Judge Elbert H. Gary is the chairman. The committee intends to extend the general program which has been followed during "Safety Week" throughout an entire year.

The committee invites general participation in this continuous program which is to contain three features. The first feature is safety teaching in the public and parochial schools. It has been shown that practically half of all that has been done to prevent public accidents can be done through the schools. The second feature is a school for automobile drivers which will be conducted in as many separate classes in the five boroughs of New York as may be required to serve the needs. In each class a course covering three months will be given and will be repeated at short intervals. The aims of this course will be to instruct drivers in the care and management of a car and also to develop a sympathy among drivers for the efforts of the police to control traffic.

Finally, an accident statistics bureau will be established as a department of the Safety Institute and its function will be to assemble and interpret the facts. Official approval of this project has been secured from commissioners of the departments concerned.

Proposes Regular Bus Service for New York Transit

Four plans whereby buses may be used to supplement the transit facilities of New York City were proposed by D. L. Turner, consulting engineer to the New York Transit Commission, speaking before the National Automobile Chamber of Commerce. The first of these is to provide a regular through-route service toward business in the morning and toward home at night for special groups of customers living in the same locality. The second is to provide crosstown routes on the streets having stations on the north and south rapid transit lines in order that the traffic may be distributed across town from such stations. The third is to handle some of the short-haul traffic in congested centers in place of the surface car lines now used. The fourth is to serve outlying districts at the ends of existing rapid transit lines.

Bus lines running between the termini of several rapid transit lines would hasten the settlement of regions that might otherwise remain undeveloped for a long time owing to lack of transit facilities. This in turn would tend to advance the date at which new rapid transit lines would be justified. Mr. Turner considered this fourth application as being the most important.

Ciani, not Cram

In the group photograph of engineer reserve officers at Camp Dix published on page 290 of the issue of Aug. 17, the name of Capt. A. J. Ciani was printed in error as Capt. A. J. Cram.

U. S. Roads Bureau Endeavors to Expedite Material Shipments

The Interstate Commerce Commission has been acquainted with all details of the situation with regard to the movement of road-building materials. Arrangements have been made for close co-operation with the Bureau of Public Roads and every effort will be made to expedite the movement of these materials. Even at best, however, it is admitted that there will not be enough open-top cars to go around from this time forward. Under the priority orders issued by the Interstate Commerce Commission, coal mines have the first call on open-top equipment. The volume of coal which it will be necessary to move in order to replenish the country's empty bins, is so great that the surplus of open-top cars will be small. So far as can be foreseen at the Bureau of Public Roads there is certain to be serious interference with highway construction.

Thomas H. MacDonald, Chief of the Bureau of Public Roads, calls attention to the fact that shortage of coal already has caused a reduction in the cement output with the result that a considerable number of projects already have been forced to suspend work.

The use of cement, he points out, is not confined to surfacing. Transportation officials frequently lose sight of the fact that it is essential for the bridges, culverts and the base for many types of roads. The public is penalized, Mr. MacDonald states, not only by the delay in using the road, but because contractors who suffer losses as a result of their inability to secure materials are inclined to bid higher on their next contract so as to make up those losses.

Notes on Wisconsin Highway Building and Operation

For the quarter ending June 30 A. R. Hirst, state highway engineer of Wisconsin, in his report to J. G. D. Mack, state engineer, states that 55 paving mixers were in operation and 65 will probably be in service before the end of the season. About 4 miles per day of concrete road were being built.

For experimental purpose 10 miles of paving will have a longitudinal joint. Obeservations indicate that 9-ft. pavements are free from longitudinal cracks. F. M. Balsley, chief inspector, has devised a machine for marking a dividing line separating travel in opposite directions.

The highway service map is distributed this year to 160 paid subscribers. Instead of the blue print used last year the map is printed in black on white paper with construction and detour information in red and green over prints which are corrected each week.

On the experimental wide gravel road maintained last year with a motor grader experiments with tar and calcium chloride are being made.

Signs 10 ft. wide and 12 ft. high showing a map of the state and the trunk highway system in the colors and conventions used in the official pocket highway map have been installed at all trunk highway entrances to the state.

German Firm to Resume Business Though Property Was Sold

A decision of importance and interest was handed down on July 26 by Judge Augustus N. Hand of the U. S. District Court for the Southern District of New York in a case involving the right of a German corporation to continue its business in the United States where its American property had been seized and sold by the Alien Property Custodian during the war. In the suit in question the purchaser of the American property and good will of Orenstein & Koppel A. G. of Berlin (formerly known as Orenstein—Arthur Koppel Co.), including its plant located at Koppel, near Pittsburgh, Pa., attempted by injunction to prevent the German corporation from again doing business.

In addition to its plant at Koppel, Pa., the Orenstein & Koppel A. G. had numerous plants in Germany and in other countries for the manufacture of industrial railway equipment, being among the largest concerns in the world of this kind. After the war, the German corporation opened an office in New York in the name of L. E. Hellmann at 50 Church St. Eric Joseph, who before the war was in charge of the entire American business, is now in charge of the New York office and was a defendant in the suit.

Judge Hand held that the sale by the Alien Property Custodian to the complainant of the American good will of the German corporation did not terminate or affect the right of the German corporation to do business in the United States in its own name and to solicit business among its former customers.

It was further held that the attempt of the complainant company to prevent the German corporation from doing business here in its own name, because the deed from the Alien Property Custodian of the tangible assets also purported to convey the good will of the corporation, was something which was neither covered in terms by the war legislation of Congress nor justified under any sound legal theory.

This is the first case decided by the courts involving the right of a German company, whose American property was sold by the Alien Property Custodian, to resume business in the United States.

Amarillo Considers Irrigation District Survey

The Board of City Development of Amarillo, Texas, has been asked to have a preliminary survey made of that portion of the Canadian River and its valley adjacent to the city for the purpose of determining the possibility and scope of a large irrigation project, including power and a water supply.

Civil Service Examination

UNITED STATES

For the civil service examinations listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local branch of the Civil Service Commission.

For vacancies in the Bureau of Standards: Junior engineer, junior physicist, and junior technologist, $1,200 to $1,500 per year. Examinations to be held Nov. 22.

War Material Distributed

The U. S. Bureau of Public Roads has reported that on July 1 there had been delivered to various states for use in road construction surplus war material valued at $139,773,986. The material, which consists of various supplies and equipment for which the department has no further need, has been distributed on the same basis as monetary federal aid. In value of material delivered, Texas and New York lead with nearly $8,000,000 worth; and all but five of the smallest states have received material valued at more than $1,000,000. The material includes 24,752 trucks and 4,573 automobiles.

Engineering Societies

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal, Que.; Professional Meeting, Winnipeg, Man., Sept. [illegible]

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, San Francisco, Oct. 4-9.

The Kansas Section of the American Society of Civil Engineers has elected the following officers to replace two members who have left the section: Vice-president, Con M. Buck, division engineer, A. T. & S. F. Ry., Topeka, Kansas, replacing C. C. Williams; and secretary-treasurer, F. W. Epps, bridge engineer, State Highway Commission, Topeka, Kansas, replacing Frank Altman.

Personal Notes

EDGAR WINTON has been appointed county surveyor of Merced County, Calif., succeeding A. E. Cowell, resigned.

H. E. COLLINS, of Rogers, Brown & Co., pig-iron dealers, Boston, has severed his connection with the company, and will become associated with the Harry M. Hope Engineering Corp., consulting and designing engineers, Boston, on September 1.

A. J. STEPHENS for the past fourteen years manager of the Vallejo, Calif., plant and business operations of the Pacific Gas and Electric Co., has tendered his resignation, effective September 8.

WALTER MOORE, JR., formerly manager of the Southern California Chapter of the Associated General Contractors with headquarters at Los Angeles, resigned August 1 to accept the position of sales manager of the Union Rock Co., Los Angeles.

WALTER WARD, project manager, King Hill Project, U. S. Reclamation Service, has charge of the construction of the Black Canyon dam on the Payette River near Emmett Idaho. This work, involving an expenditure of $1,000,000, was recently started. It is the intention to finish the dam in time for use in 1924. Mr. Ward is succeeded at King Hill by A. M. Rawn, one of his assistant engineers.

EARL H. EBY, who has been a district engineer with the South Dakota Highway Commission stationed at Brookings, has been promoted to the position of construction engineer. His headquarters will be at Pierre.

T. S. SCOTT of Kingston, Ont., has been appointed city engineer of Niagara Falls, Ont., succeeding J. C. GARDNER. Mr. Scott was appointed out of a list of thirty applicants.

CHARLES F. FISHER, for the last two years and more engineer of City Planning Commission of Akron, Ohio, resigned that position effective Aug. 1 and is now at Providence, R. I., directing studies for the zoning of that city under Robert Whitten, of Cleveland, Ohio, who has been engaged by the city of Providence for the purpose indicated. Before going to Akron Mr. Fisher was street-extension engineer at Portland, Ore., and secretary of the Portland City Planning Commission.

F. H. SCHRADER, formerly resident engineer with the South Dakota Highway Commission, and stationed at Hot Springs, has been made a district engineer and will be stationed at Brookings.

J. B. MCREA, hydraulic engineer, Ottawa, has been appointed to conduct an investigation into the differences between the Ontario Hydro Electric Power Commission and the Dominion authorities, regarding the lease of power by the Commission at Romney Falls, Ont.

DON L. JACKSON, resident engineer for James Stewart & Co., Inc. of New York, for the past two years at Guthrie, Okla., has accepted the position of chief engineer for Eads & McCune, architects, of Chickasha, Okla.

R. W. KINNALLY, formerly resident engineer of the South Dakota Highway Commission, stationed at Huron, has resigned to become associated with the contracting firm of W. J. Cole at Huron.

J. M. PADGETT, until recently a foreman with the Weller Construction Co., road builders of Washington, D. C., has joined the staff of the Pottsville Construction Co., Grampian, Pa.

M. C. HINDERLIDER, consulting and supervising engineer, Denver, Colo., has been commissioned by the Greeley Poudre Irrigation District to make the necessary investigations for and prepare plans and estimates of cost for a high dam to be located on the Cache la Poudre river in Colorado. Mr. Hinderlider is a graduate of Purdue University. His first engineering experience was in Colorado in public land surveying. He was later engineer with the Board of Public Works of Denver, and from 1902 to 1908 engineer in charge of hydraulic work at the Rocky Mountain Division of the U. S. Reclamation Service. He was the engineer in charge of construction of the Hydro-electric Power Plant at Shoshone Falls, Idaho, and for the Central Colorado Power Co. in 1908 and 1909. Since 1909 he has been engaged in private practice.

JAMES C. BOYD, formerly connected with Westinghouse Church Kerr & Co. as first vice-president, has opened a consulting engineering office in Portland, Me., where he will specialize in railroad, power and general industrial development work. Mr. Boyd began his engineering experience in 1891, after three years at the Massachusetts Institute of Technology and survey work with the Bangor & Aroostook Railroad in Maine. Later, he was with the Boston Elevated Railway, first as assistant engineer and then as division engineer in charge of design, surveys and construction on the Charleston subway and part of the Atlantic Avenue Division. From 1901 to 1902 he was in charge of maintenance, structure, tracks and building of the Boston Elevated and the following year he was engineer in charge of new construction and of bridges and buildings of the Boston & Albany Railroad. For 18 years, Mr. Boyd was associated with Westinghouse Church Kerr & Co., New York City, and then resigned in 1920, to enter private practice. However, he became later associated with E. Corey & Co., of Portland, Me. He now announces that he is free again to act in a consulting capacity.

B. L. WARNER, formerly a resident engineer for the South Dakota Highway Commission, and stationed at Winner, has resigned and has accepted a similar position with the Illinois Highway Commission.

GEORGE Y. SKINNER and Associates, Inc., Civil Engineers and City Surveyors, with offices at New York City and Flushing, N. Y., announce a resumption in the general practice of civil engineering, surveying and real estate development, with additional facilities and personnel.

Obituary

JAMES KENNEDY, engineer, editor and author, died recently in New York City, aged 72 years. Mr. Kennedy was born in Scotland, receiving his primary education in Dundee, as well as learning the machinist trade there before coming to America in 1868. After his arrival here, he worked at locomotive construction and repairing on some of the principal American railroads, carrying on his studies at night. At one time, he had charge of a department in the locomotive shops of the New York Elevated Railroad. In 1883, he superintended the construction of the first steam locomotive built at that company's works. Mr. Kennedy became associate editor of *Railway and Locomotive Engineering* in 1905, and its managing editor five years later.

At the time of his death, he was editor of the publication and president of the Angus Sinclair Publishing Co. Several volumes of his poetry were published, among them being collected poems, songs and lyrical character sketches published in 1883; The Deeside Lass and Other Poems in 1888, and Scottish and American poems in 1899.

EARL POTTER MASON, production engineer and director of the Anti-Corrosion Engineering Corp., Inc., New York City, died recently at his home in Summit, N. J., aged 46 years. Mr. Mason was a graduate of the Massachusetts Institute of Technology. Previous to his connection with the Anti-Corrosion Company he was with the United States Shipping Board. During the war he was a commander in the navy and was in charge of all Shipping Board repairs. Previous to that position he had occupied executive positions with the Grinnell Company of Providence, R. I. He also engaged in the contracting business in that city for some time. He was a member of the A.S.M.E.

SAMUEL KINGSLEY PROBASCO, a son of Samuel R. Probasco, former chief engineer of New York City, and himself an engineering graduate of the University of Pennsylvania, died recently in New York City. Though an engineering graduate, Mr. Probasco studied law soon after his graduation and for the past twenty years he had been connected with the Brooklyn office of the New York City Corporation Counsel. Mr. Probasco was born in Burlington, N. J. and was 52 years old at the time of his death.

S. L. F. DEYO, former chief engineer of the Interborough Metropolitan Co., and of the Rapid Transit Subway Construction Co., New York City, and for several years both assistant engineer and division engineer of the New York, New Haven and Hartford R.R., died Aug. 18 at his summer home in Norfolk, Conn., aged 70 years. Mr. Deyo was a graduate of Union College. His engineering work in New York City was mainly in connection with the Park Avenue improvements of the New York Central R.R., and the construction of the first New York subway. He was also engaged for a time on the surveys and the construction of the South Pennsylvania R.R. He was, during his connection with the subway construction company chief engineer of the Interborough Rapid Transit Co. He was a member of the American Society of Civil Engineers of which he was a director in 1898-1900, and vice-president in 1904-1905. He was also a member of the Engineers' Club, New York City.

EDWIN CHAMBERLAIN, assistant engineer with the Philadelphia and Reading Ry. Co., died Aug. 15, aged 68 years. He was educated in the public schools of Philadelphia and prepared at the Lackawanna School, Scranton, Pa., for entrance to the Scientific Department of Lafayette College, Easton, Pa., entering the class of 1880. In the fall of 1880 he went to Reading, Pa., in the capacity of clerk to Edwin F. Smith, chief Engineer of P. & R. canals, waiting an opportunity to be placed in the engineering department. In 1881 he was made inspector of water powers. In January, 1882, he was transferred to the office of W. Lorenz, chief engineer of the P. & R. Co. and placed under direct charge of C. W. Buchholz, then assistant chief engineer. In March, 1883 he was made division road master at Reading and afterward division engineer and served in this capacity until 1886, when he was transferred to the Philadelphia Division, where he remained until January, 1887, when he was transferred to the chief engineer's office. After engaging in various work for six years he was elected city engineer of Reading, Pa., and served from 1894 to 1897. In 1897 and 1898 he was engaged in the enlargement and improvement of the water supply of the City of Binghamton, N. Y. He again entered railroad work in 1899. From 1906 to his death he was engaged on the elimination of grade crossings in Philadelphia.

BUSINESS NOTES

S. R. RUSIACKAS, until recently a student at Lafayette College, has been made an inspector of steel work with the Bethlehem Steel Bridge Corp., Harrisburg, Pa.

CARL J. LOFSTEDT has severed his connection with the Atlas Portland Cement Co., in Northhampton, Pa., by which company he was employed as a designer, and has joined the Palmer-Bee Mfg. Co., Detroit, Mich., manufacturer of conveying machinery.

THE HARDWARE MANUFACTURERS INSTITUTE has moved its offices from Memphis, Tenn., to Chicago. Its new address is 1026 S. Wabash Ave.

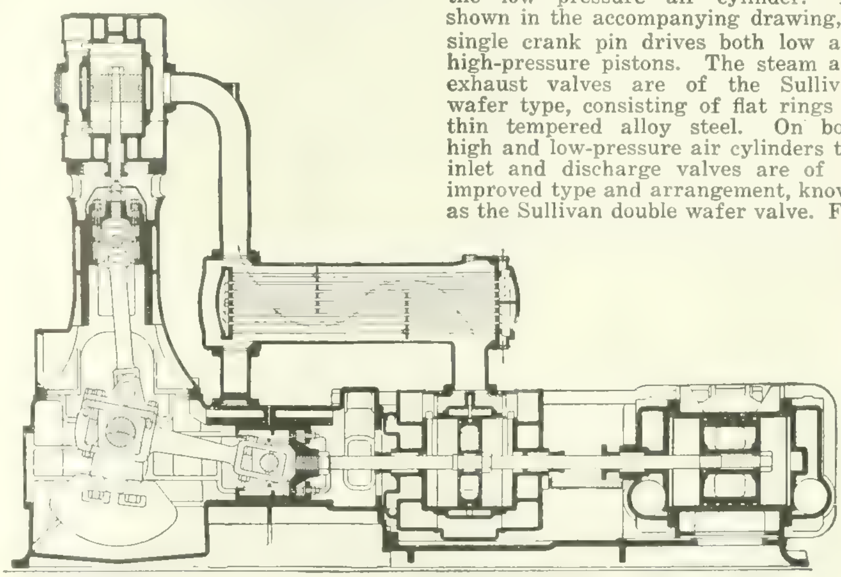
GEORGE E. TITCOMB, of the Mc-Myler Interstate Co., New York City, has just returned from a five months' tour of Europe, inspecting port facilities and installations.

THE BUILDING MATERIAL EXHIBIT, Chicago, announces the establishment of a bureau of service which provides for engineers and architects conference rooms, a library of catalogues and specifications and service in making appointments for out-of-town architects and engineers with material men and others.

EQUIPMENT AND MATERIALS

Angle Compound Steam Driven Air Compressor

A new steam-driven, angle compound air compressor is announced by the Sullivan Machinery Co., Chicago. It consists of a two-stage compressor having its low-pressure cylinder in a horizontal plane and its high-pressure cylinder in a vertical plane. Power is furnished by a single high-duty steam cylinder in rear of and tandem with the low pressure air cylinder. As shown in the accompanying drawing, a single crank pin drives both low and high-pressure pistons. The steam and exhaust valves are of the Sullivan wafer type, consisting of flat rings of thin tempered alloy steel. On both high and low-pressure air cylinders the inlet and discharge valves are of an improved type and arrangement, known as the Sullivan double wafer valve. For removing the heat of compression in the air from the low-pressure cylinder an intercooler is provided, consisting of a cylindrical cast-iron shell containing a nest of copper or aluminum tubes through which cooling water circulates.



Heretofore, the company points out, its angle compound design of compressor has been belt-driven or direct-connected. The new compressor, however, is operated by a single four-valve direct-flow steam cylinder connected in tandem with the low-pressure or horizontal cylinder of the angle compound unit. The capacity range of the machine is from 1,000 to 3,500 cu.ft. of free air per minute.

Out-of-the-Ordinary Trade Publications

Centrifugal Pumps—THE PENNSYLVANIA PUMP & COMPRESSOR CO., Easton, Pa., has issued a 16-page bulletin descriptive of the company's line of double-suction, single-stage centrifugal pumps. The pamphlet contains much useful engineering data.

Line Material for Mines—THE WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., East Pittsburgh, Pa., has issued a 64-page illustrated catalog devoted principally to equipment for overhead line construction in mines, including bracket arms, suspensions, insulators, trolley wire splicers. Information is given also on mine safety switches, strain insulators, solderless connectors, mine locomotives and headlights.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Prices Not Necessarily on the Toboggan

W. B. Bennett Calls Attention to Differences Between Conditions Today and After Former Wars.

William B. Bennett, consulting engineer, the United Railways of St. Louis, writes that statements as to what the "new normal" price level is to be are at best nothing more than speculative opinions. "Our theoretical economists," he says, "give us learned discussions as to what may be expected, based upon their interpretations of the teachings of the past, but all studiously refrain from making positive predictions for the future.

"I have given the subject of price trends considerable study during recent years in connection with the preparation and presentation of valuation estimates, but I have not settled in my own mind the extent to which the conditions existing subsequent to the War of 1812 (Napoleonic Wars) and the Civil War are present today; therefore, I am not willing to agree with those who take the position that prices have 'hit the toboggan slide.' I am mindful of the fact that the halt in the downward trend is not without precedent in the previous post-war periods. The history of prices in this country shows that subsequent to the rapid decline in prices immediately following the War of 1812 and the Rebellion, there was a temporary check in the price decline, lasting from two to three years, after which there was a recurrence of the rapid falling off to a pre-war level. But I feel that there are influences existent at this time which render conditions entirely dissimilar to those for periods with which many are wont to make comparison. Chief among these may be mentioned the gold supply and effective Governmental control of the monetary system.

"On the question as to whether or not there is to be a 'new normal' my opinion is that there will be. What this will be with respect to the pre-war level nobody knows. Some commodities, such as copper, apparently receded too far and now appear to be coming to rest at a level considerably above the low figure of a year ago. Certain other commodities, as for instance sand, gravel and crushed stone, continued to decline after the halt in the price drop of many other commodities, but these now seem to have come to rest. The trend of wages of labor has been steadily upward for over a hundred years and while we may perhaps expect some further reductions in wage rates these are not likely to go below the trend line as observed for the period prior to the World War and projected through the high price period to the present time. In other words, labor rates will not go back to the 1913 or pre-war level.

"The year 1913 still furnishes a good base level and should in my opinion be retained for some time. It permits of direct comparisons that will be most helpful in the presentation of valuation estimates to courts and commissions."

Finance Briefs

Stocks firm almost without exception and tending upward with new high records established. Dealings light, only 500,000 shares per day. The significant fact is that few of the higher grade stocks have been pressed for sale and that buyers had to bid sharply. At the same time, there can be no healthy market until the labor difficulties are settled.

Bond market inactive and unsettled; new offerings fewer than in any week in a year and a half. Municipals quiet because practically all bought up. Bankers urge new issues of public bonds, with little response.

Money plentiful. The business slowdown due to strikes has only increased the reservoir of money seeking use. Call funds, 3@4 per cent. Time loans, 4½ per cent for four months. *The Annalist* says, "Evidences are to be seen on many sides that the low point of the year has been reached."

Price Trend Is Upward

Warning that the "ups" of the market balanced the "downs" was first voiced by *Engineering News-Record* on May 11, p. 809. The situation was elaborated and interpreted in the light of the Cost and Volume Index Number in the June 8 issue, p. 976. All that was forecasted has practically come to pass. Construction cost is 4 per cent above the May figure. The Cost Index Number is now 173 against 164, on May 4.

Mills supplying the basic building materials have fallen off in production, due entirely to the fuel and car shortages. Dealers' stocks in the various distributing centers have been able thus far to meet the heavy demands. Before very long, however, the mill shortage may be reflected in a serious lowering of warehouse stocks. Even with the strikes settled amicably in the near future, it is probable that a sufficient number of cars cannot be put into service quickly enough to prevent slow mill shipments during the Fall and Winter months. Furthermore, the institution of a priority scale, until the car shortage is overcome, would give preference to materials other than construction.

With no perceptible let up in construction proposals and with danger of a material demand in excess of supply, further price rises may be looked for.

	New York		Chicago		San Francisco	
	May 4	Aug. 3	May 4	Aug. 3	May 4	Aug. 3
Steel shapes, per 100 lb. at warehouse	[illegible]	2.83	2.48	2.68	3.10	3.10
Cement, f.o.b., without bags, per bbl	2.00	2.10	1.97	2.05	2.73	2.71
Lumber, 3 x 12 12 x 12, 20 ft. f.o.b. per M. ft. b.m.	43.00	46@47 (spruce)	40.00	47.00 (pine)	26.00	31.00 (fir)
Common brick, f.o.b. per M	17.00	20.00	11.00	11.00	15.00	15.00
Lime, common lump, per bbl	2.75@3.18 (280 lb. net)	2.75@3.14 (280 lb. net)	1.40 (180 lb. net)	1.40 (180 lb. net)	1.75 (180 lb. net)	1.75 (180 lb. net)
Carpenters, per hr	1.12	1.12½	1.00	1.00	1.00	[illegible]
Common laborers, per hr.	44@60	44@60	72½	.72½	47½@50	47[illegible]

Public Work Contracted For in 1921 and 1920

Less in 1921 than Municipal Bond Sales Indicated—Some Reasons

A correspondent asks why no more local public work was contracted for in 1921 than in 1920, when double the amount of municipal bonds were sold.

Statistics kept by *Engineering News-Record* do not classify buildings, and therefore it is impossible from these records to show the amount of public building placed under contract. It is possible, however, to give the value of road, bridge, sewer and water-works contracts. It must be understood that the following figures do not include water-works projects costing less than $15,000 nor bridge or road work under $25,000.

	1920	1921
Streets and roads	$265,423,000	$315,351,000
Bridges	35,214,000	27,331,000
Sewers	36,067,000	39,385,000
Water-works..........	30,772,000	40,603,000
	$367,476,000	$422,670,000

It would seem from these figures, therefore, that more public work was contracted for in 1921 than in 1920 unless public buildings fell off in 1921. It is quite likely that this was the fact, inasmuch as general commercial building did drop from $581,000,000 in 1920 to $568,000,000 in 1921, according to our figures.

Some of the facts of the case, therefore, are that more water-works, sewers, and road work were contracted for in 1921 than in 1920, this of course from a money standpoint. Costs in 1920 were at peak and nobody contracted for anything that could be postponed. High construction cost, however, did not dampen the avidity with which tax-exempt bonds were absorbed. It was a sunny year for municipalities in need of money and much hay was made. Contracts could be placed later when costs were more attractive.

Furthermore, of the $1,200,000,000 sales, $400,000,000 were made in the last quarter of 1921. This will also explain why the 1921 volume of contracts was not much larger than it was.

Our correspondent also offers some explanations of his own which are in line with the facts:

(1) The law customarily requires municipal bonds to be sold before contracts are executed. The plans may not be made until bonds are sold. Therefore, many months may elapse between the sale of bonds and the execution of of the contracts. Bonds sold in summer and fall of 1921 may not result in work during 1921.

(2) Bonds are sold in a lump for an undertaking which requires several years to complete. The proceeds lie on deposit until used.

(3) The result of the bond sales in 1921 may not be fully apparent until 1922.

(4) The percentage of state bonds for highway construction compared to city bonds may have been unusually large in 1921. The effect of state financing may not be felt until the subsequent open season, or during several open seasons.

(5) The percentage of public bonds sold for soldiers' bonus and non-productive purposes may have been unusually large in 1921.

Steel Wages Up 20 Per Cent

A 20 per cent increase in wages of common labor was announced by the U. S. Steel Corporation on Aug. 22 to take effect Sept. 1. The 150,000 men concerned will receive 35c. per hour. Judge Gary also stated that other rates would be equitably adjusted. A similar course will be followed by the independents. In 1915 the rate for common labor was $2 for a 10-hr. day; on Feb. 1, 1920, the wage was $5.06; now $3.60.

Lumber Movement Suddenly Expands

Following several weeks of decline the lumber movement revived surprisingly during the week ending Aug. 12, according to a summary of telegraphic returns from 379 mills reporting to the National Lumber Manufacturers' Association.

Recovering from the effects of forest fires during the last two months, the West Coast Lumbermens' Association increased production by about 13,000,000 ft. over the preceding week. At the same time car shortage, due to the strike, reduced shipments by about 16,000,000 ft. On the other hand the Southern Pine Association showed slight gains in production and shipments and an increase of about 14,000,000 ft. in orders. The net result was an increase for the whole country of 18,608,684 ft. in production, a drop of 11,691,542 ft. in shipments and a gain of 19,133,993 ft. in orders. The cut was 97 per cent of normal, orders 96, shipments 81. It is significant that shipments, taking the country as a whole, declined while orders and output gained appreciably. Demand and supply are in a prosperous balance, but delivery is difficult. Hence the rising market.

For the first time in the history of the American lumber industry the export trade of the Pacific Northwest exceeded that of the Southern pine region, during the first six months of the current year. In that period Washington, Oregon, and British Columbia shipped 624,367,409 ft. of lumber over seas as against 315,192,637 ft. of Southern pine; the fir movement having been 98 per cent greater than pitch pine exports.

Japan is the heaviest buyer of Pacific Northwestern lumber, with a gain of 319 per cent in purchases for the first half of this year, compared with the corresponding period in 1921. Total Japanese purchases were 381,019,667 ft. California water shipments increased 102½ per cent; total was 703,578,501 ft. as against 347,901,289.

Labor Cheaper on Federal-Aid Projects

Wage schedules, applying on thirty-nine different kinds of labor used in Federal Aid road work in June show a lower average hourly rate than the rates on all classes of construction as quoted monthly in *Engineering News-Record*. In the case of common labor, however, the Federal Aid (F.A.) rates in the various district are generally rather higher than the regular rates quoted in specific cities in those districts. For example, 38c. is given as the F. A. rate in New England, whereas 55c. was the official rate in Boston last June. The Middle Atlantic F. A. rate was 33c., compared with rates of 44@60c. in New York and 30c. in Baltimore. South Atlantic F. A. rate, 22c., against 20c. in Atlanta. West South Central rate, 27c., Dallas, 25c.; E. S. Central, 21c., New Orleans, 30c.; Mountain, 37c., Denver 35@50c.; Pacific, 46c., San Francisco and Seattle 47½ @60c.

JUNE FEDERAL AID LABOR REPORT—AVERAGE HOURLY PAY BY GEOGRAPHIC DIVISIONS

Kind of Labor	New England			Middle Atlantic			East North Central			West North Central			South Atlantic			East South Central			West South Central			Mountain			Pacific		
	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural
Foremen																											
Miscellaneous.....										50													52		63	75	
Superintendents.....	1.19	1.25	75	1 08	1 05		90	92	60	93	1 03	95	.82	82		81	84	.79	.74	1.02	84	98	99	1 00	1 11	1.23	
Foremen............	74	75	80	68	66	68	61	67	60	63	64	.61	45	.55	60	.51	52	.53	.51	60	59	.69	68	79	72	88	86
Subforemen........	63	61	.69	.57	.55	52	50	56	61	.50	50	.50	.36	41	.37	.41	42	.43	43	49	.31	.61	.58	.62	.67	85	65
Operators																											
Miscellaneous.....				54	53			42		52	.46						42			63		.62	.55	.52	.68	56	60
Auto drivers ..				40	42			39	.35		.37	.30		.36	19	.35	31			46			.50		62	73	56
Truck drivers	.52	.51	.57	43	42	43	.35	.42	.32	.36	35	38	.41	.37	31	30	35	43		.31	32	.53	.51	.55	65	.69	67
Roller engineers	68	61		54	57		52	52		.52	.52		.44	43	.54	.40	41			.44		.60	.63		.79	.72	
Machine drillers ...	30	40		45	50					.65	.45			.37			31		.45	.56		53			51	62	
Mixer operators ..		59			64	60		55	45		60	.41	60	.57	30		54	.32		.58		.62	65	45		90	.75
Steam shovel operators	1 09	1 07		85	74		73	72		.76	66		.80	.80		.78	53	.50	.60	99		1 00	80		1.10	1.05	
Tractor operators	45	45		41	40		43	40	.45	55	48	37	.33	.35		.28	33	30		.35		.62	57		75	.76	
Jackhammers.....	35	30		57	47		30			35	42		.40	.30		.37	28			58		.59		..	.61	55	
Crane operators.....	.				71			65	75	54	65	40	.50	.67	.		52		.40	.60			59		.75	94	
Enginemen ..	.42	55	50	50	51		.51	45		.57	.50	.41	.40	.60	.37	.28	.36	.45	.45	47	.75	75	.53	.47	.72	.67	.62
Skilled Labor																											
Miscellaneous.....				55	46	50		66	50	51	51	34	.25	.28	.25	.39	.26			41	65	.59	45	50	56	.60	
Blacksmiths.....	.67	.67	.51	.57	.55		.45	61		50	.54		.44	.43	.	.39	.38		41	47	30	.57	.56	.69	.65	.73	
Bridgemen.........			.85									51						.50			58			40			
Carpenters	.80	.80	70	50	59	50		70	66	.45		.44		.37				.42		46	50	.50	50	.76	.68	66	.65
Bridge carpenters.....		1 15	1.02			62			54		40	.48						.50	50		.56	.75		.79			.71
Drillers	57	45		45	44		50	60		60			.50	.34		.28	.25		.30	30		.52	.46	.47	.53	.62	
Firemen.........	.67	55	35	46	43	47	62	40	25	.37	36	.39	.41	.36	.23	.42	30	.30		35			.48	.40	.76	72	
Finishers....		.50	.57	.35	46	40		51	35	30	44			.25				.20		32	.33		.68	70	.68	.78	
Concrete finishers.....		47			48	49		.41		.40	52	51		.32			.38	.33			.35		.49	.62		.85	
Masons	.55					1 12					.75	60		.32				.78						1 00	.75		75
Mechanics ..	.58	60		64	61		29	42	35	54	63	60	37	32			52			84		72	53		90	83	
Powdermen... ..		.39	60	63	47					.52		.43		.35		.32	.33	30	.30	43		.65	.43		58	.69	
Commissary Labor																											
Miscellaneous.......	.				45					.30			.25	20			.30				.10	55	.24		.38	.58	31
Cooks...........	.47	.37		89	.70		58	58		.39	48	.33	.30	.27		.23	.25	.24	.27	.22	.37	48	33	32	.53	.53	54
Assistant cooks......	.33				39			30		24	.33		.25	.18			.18	.15		.20		.32	.21		39	.44	40
Cooks' help......		.35		81	37			29		26	25		.20	22		.10				.13		.50		.63		34	
Flunkeys	...				.20					.23	.21	.30	25	.12		.16	.08	20	20	.12		.37	.28	.31	30	29	
Waiters	...																					.40	37		.25	.25	
Common Labor																											
Miscellaneous.......				.90	90			50		.42			.41			.							.52		.35	.43	38
Common labor......	.37	.38	38	33	33	33	30	30	30	28	32	30	.22	20	22	.21	20	21	.26	24	.27	40	.35	.37	.47	.50	46
Teamsters...........	.38	.40	42	.32	.60		31	29		28	26	.29	.16	22		.20	.19	.20	.25	21	27	39	.37	.37	.38	.48	27
Teams																											
Teams..	.50			.73	60	75	37	42	25	.28	24	.32	.36	30		27	.30	.25	27	29	30	31	.31	.28	20	.43	.18
Teams incl. teamsters..	.72		82	67	70	72	55	55	58	52	49	48	50	.50	.62	48	41	.47	48	44	47	47	.51	57	60	50	
2 Horse teams	.67									44 ..												75					

Note—Rates in dollars and fractions of dollars

Some Unit Prices on Contracts Awarded Last Week

Accepted bid prices on pipe, excavation and street contracts, awarded last week in various parts of the country and selected at random from *Construction News* are presented in the table.

Pipe bids cover cast-iron, reinforced-concrete and steel. Unit prices on earth excavation are taken from ditch, levee and State highway awards. Bituminous and waterbound macadam and vitrified brick blocks comprise the paving prices, while curbing bids are for both bluestone and concrete.

Pipe:	
8,000 ft., 20-in. rein.-con., at trench, East Orange, N. J., per ft.	$3.20
8,000 ft., 6-in. c.i., Harlem, Mont., per ft.	5.335
10,200 ft., Class C., 1,800 ft. Class D., 20-in., c.i. pipe, Birmingham, Ala., per ton.	48.40
8,400 ft., 24-in. steel water-pipe, New Westminster, B. C., per ft.	3.687
Earth Excavation:	
[illegible] cu.yd., drainage, Boonville, Ind., per cu.yd.	.09
92,263 cu.yd., ditch, Olivia, Minn., per cu.yd.	[illegible]
[illegible] cu.yd., levee, New Orleans, La., per cu.yd.	[illegible]
65,000 cu.yd., levee, New Orleans, La., per cu.yd.	.39
9,660 cu.yd., State Highway, Michigan, per cu.yd.	.50
Rock Excavation:	
110 cu.yd., rock, Akron, Ohio, per cu.yd.	3.50
Paving:	
12,300 sq.yd., 3-in., bituminous macadam, Akron, Ohio, per sq.yd.	.93
12,300 sq.yd., 7-in., waterbound macadam foundation course, Akron, Ohio, per sq.yd.	1.00
8,533 sq.yd., vitr. brick block paving, Winona, Minn., per sq.yd.	1.99
Curbing:	
1,650 lin.ft. stone curb, Akron, Ohio, per lin.ft.	1.25
[illegible] lin.ft., 8-in., concrete curb, Akron, Ohio, per lin.ft.	.20
28,350 lin.ft. concrete curb, Waukon, Ia., per lin.ft.	[illegible]

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 3, the next, on September 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	+$2.93	$3.65	+$4.20	+$2.92½	$2.95	$3.70	$3.10	$3.75	$3.75
Structural rivets, 100 lb.	+3.85	4.35	+6.00	3.35	3.52½	4.80	4.25	3.75	6.50
Reinforcing bars, ¾ in. up, 100 lb.	+2.83	3.50	3.50	+2.82½	2.85	3.67½	2.55	3.60	2.90
Steel pipe, black, 2½ to 6 in. lap, discount	60%	61.15%	45%	59½%	61.9-5%	+43%	46.6%	50%	30.00
Cast-iron pipe, 6 in. and over, ton	53.30	49.00	51.50	45.20	52.00	57.00	51.00	53.00	50.00
Concreting Material:									
Cement without bags, bbl.	2.60	2.50	2.25	2.05	2.39	2.85	2.71	2.90	2.78
Gravel, ¾ in., cu.yd.	1.75	1.85	2.25	12.00	1.50	1.75	2.25	1.00	1.50
Sand, cu.yd.	1.00	1.15	2.25	12.00	1.00	0.75	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	1.65	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	51.00@52.00	40.00	+40.00	47.00	40.00	50.00	31.00	23.00	50.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl.	2.75@3.14½	1.80	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	11.00	+10.90	11.00	17@18	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	+.1101	.086	+.087	....	.11	.09
Hollow partition tile, 4x12x12, per block	.1112	.0776	.115	+.0808	....	+.087	.108	.11	.09
Linseed oil, raw, 5 bbl. lots, gal.	.91	.97	+1.13	+.99	1.03	−1.12	1.04	.86	1.12
Common Labor:									
Common labor, union, hour	.60	.35	....	.80	.....	.50@.55	[illegible]	.50@.60	...
Common labor, non-union, hour	.44@.60	.30	.25	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock, common lump lime, in 280 lb. bbl. net and hydrated lime f.o.b. cars, tile "on trucks", linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50 lb. bags, common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180 lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at [illegible] cents). Bag charge is 80c. per bbl. Discount of [illegible] per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Continued scarcity of coal and coke, resulting in increased production costs and further reduction in output, is forcing prices higher at the warehouses following each mill rise, however slight. Structural shapes quoted at New York warehouses at $2.93 as against $2.83; rivets at $3.85 advanced from $3.60, and reinforcing bars at $2.83 as compared with $2.73 per 100 lb., one week ago. Chicago warehouses quoting shapes at $2.92½ as against $2.80 and bars at $2.82½ as compared with $2.70 per 100 lb., last week. Mill price of structurals and reinforcing bars, $1.80@$2 per 100 lb., f.o.b. Pittsburgh. Bars quoted at $2, however, on small tonnages for quick deliveries. Wrought steel pipe discounts down 3 points in Denver warehouses following the general advance in pipe. Pittsburgh basing card of the leading interest, however, shows no changes as yet.

Fuel scarcity effecting hollow tile to the extent of slight price advances in both Chicago and Denver. Prices tending upward in New York. Brick, sewer pipe and other clay products retaining greater price stability than hollow tile in face of the fuel situation.

Raw linseed oil up 2c. in Chicago and 6c. in Dallas; down 6c. per gal. (5 bbl. lots) in Denver.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

Volume 89 — NEW YORK, AUGUST 31, 1922 — Number 9

Dramatic Elements

LAST week we commented on the President's duty of making dramatic the issues in strikes affecting the national welfare. Sometimes, though, the strikers do their own dramatizing. If they had had a movie scenario writer as strike director they could have devised no incident better suited to rouse the public than the abandonment of trains on the desert. The public "got" the situation. But it did not applaud. It roared its disapproval. Some minor "stunts" are being staged by the director. Some tracks have been dynamited, some buildings destroyed, some men maimed, some killed. The action is effective. It intimidates a few but rouses the many.

A Fifty Per Cent Rating

ANY time the engineer may harbor the notion that the business world has great respect for his scientific methods and accuracy, he might ponder the following quotation extracted from an address by an official of the Department of Commerce to an organization of business men. He is discussing the much-heralded report on Waste in Industry, which has been regarded as an outstanding contribution of American engineering science to the business community. "This report," says the speaker, "shows that on the average these six industries are being operated with a waste of 40 per cent. Forty per cent of the capital, material, labor, mental effort just thrown away with nothing to show for it! *Of course, it's an engineer's report and some of you may want to discount the technical man's findings, but surely you will admit these engineers are at least half right* and that would mean a waste of 20 per cent—$1 out of every $5 destroyed." The italics are ours. Comment is needless.

A Rare Tribute

FEW engineers ever have received or ever will receive a tribute comparable with that accorded to Herbert Hoover by Ex-Governor Cox of Ohio, Democratic candidate for President in the last election. In a summary of the European situation published in *The New York Times*, Governor Cox says: "Our government * * * should designate Herbert Hoover, now a member of the Cabinet, to serve in the reparations task. He holds the confidence of Europe. Peoples and governments trust him. He can analyze the economic situation of Germany. His decision as to what Germany can pay beyond much question of doubt would be accepted by France—and that means by all the parties interested. I believe every Chancellery in Europe would welcome his coming. The mere announcement of his selection would stabilize things. With reparations adjusted, Germany and France—both in need of large loans—would be given credit, and Austria, too. Then would come the dawn of a new day. Mr. Hoover is not of my political party, but any one in as close touch with Continental conditions as I have been is thoroughly stripped of every partisan thought."

The Royal Road?

THOSE who favor state licensing as a means to establish more securely the professional standing of engineers—"to make it a *real* profession," as one advocate has said—may be encouraged to learn that advertising men are thinking along similar lines. In the Advertising Club of Pittsburgh a movement is afoot to urge a state code making it "obligatory on the part of every man or woman in Pennsylvania entering the profession of advertising to pass a board examination if he or she is to become an A.C. or Advertising Counsellor." Those who pass the examination would be entitled legally to sign the initials, "A.C." after their names. The purpose of such a measure has not transpired, but we doubt not that, ostensibly at least, it is intended for the protection of the public. Would it tend also to the same degree as with engineering, to make a *real* profession of advertising?

A Stampede Unlikely

FAILURE has attended the efforts of the train-service brotherhood leaders to mediate between the railroad executives and the striking shopmen. Most of the executives stood pat on their earlier decision with regard to seniority. So did the shopmen. A minority of the executives whose roads had taken on but few new men, proposed a plan that would have met the seniority issue; but the leaders of the shopmen would not consider separate agreements. Thus does one issue succeed another as a barrier to peace. Meanwhile the roads carry on, declaring that they expect to meet every demand for equipment. The President is very unwilling to have the government undertake either railroading or coal-mining except under stress of direct emergency. This reluctance is an encouraging indication that we are not to be swept on a wave of agitation into the gulf of government ownership. We hope that the President will make this so clear and unmistakable that hope of using the strike to throw either mines or railroads into government hands will be abandoned by any who may now cherish it.

New Promise in Air Flight

A GERMAN student has managed to remain over three hours in the air in a motorless sailplane or glider. Perhaps, after all, the treaty provisions which forbade the construction of high-powered airplanes in Germany and which caused such a piteous outcry from the vanquished will react to their benefit. Little is known, even yet, of the laws governing mechanical flight but we seem to have progressed since the days of the

war when the principle effort was to develop engines of higher and higher power. Designers knew then that the more power they could crowd into a plane the faster it would fly and they had no time to devote to scientific research or to plane refinements. As a result we had single-seaters propelled by motors of 300 hp. and upwards, economic monstrosities. Apparently we are about to go forward from the point where the Wright brothers left off. They were principally concerned with discovering means of control and they were successful. The present-day gliding tests begin with a very fair knowledge of the control factor and aim at further advances in the knowledge of the laws of sustained flight. Germany is off to a good start. It is not too much to say that we are on the threshold of a revolution in the science of flying. The German demonstrations seem to open up unlimited opportunities for reducing the power required to propel heavier than air machines.

The Mission of the University

WHAT should be the aim and function of the University? This question is raised by the statement of Dean Eugene Davenport, of the College of Agriculture, University of Illinois, reported elsewhere in this issue, and by that of President Richards of Lehigh University, reported on page 320 of last week's issue of this journal. Dean Davenport declares that the objective of education has been shifted from the man to the activity, with a corresponding shift of emphasis from instruction to research. President Richards believes that it should be the purpose of real universities to place scientific research and the advancement of knowledge in a position of equal importance with the work of instruction.

No one will question the value of scientific research, intelligently conducted. No one can doubt the value of experiment stations and research laboratories, conducted either privately for the benefit of an industry, or by the state for the benefit of its citizens. Few, moreover, will question the benefit to a professor, or an instructor, of a certain participation in research work. Few, therefore, will doubt the advantage of having research carried on as university work, provided it can be done without prejudice to the essential work of the university, which we conceive to be the education of those who seek instruction from its faculty.

We speak, of course, from the viewpoint of the engineering schools, which just at this time are taking serious thought to their efficiency in ministering to the needs of the community. But their concern has not arisen because of a dearth of scientific research or a failure to contribute to the fund of engineering knowledge. Quite to the contrary, the complaint of industry is addressed to the preparation of technical graduates. The uneasiness of the profession concerns its personal capacity to assume broader responsibilities of citizenship, and the care of organized engineering educators is to clarify their objectives and overhaul their methods for the training and education of their students.

On every hand today the demand is for better-trained men, and this does not mean men with more information or even greater technical skill. It means men of broader vision, of more fundamental knowledge, of more alert perception, of more earnest purpose, of greater industry, and of more human instincts. These, with the exception of the second, are qualities of character, which are developed not by book, or precept, or yardstick, but by contact with instructors of profound human sympathies, who will "teach the student rather than the subject." The faculty, therefore—at any rate that of the engineering school—should be selected with this end in view, if the schools are going to rise to the opportunity that is before them and give to the community more efficient engineers, wiser citizens, broader men.

Now and then we meet a professor, or instructor, who can do this work, and who is a competent research worker besides. But the combination is rare. Our judgment is that commercial research is so important and so necessary that it should be conducted with every needful facility by specially selected and specially trained staffs. To attempt this work with a staff charged also with the duty of training and inspiring the usual body of engineering students would do justice neither to the research nor to the community that is awaiting the manhood it expects from its university.

From a proposal to establish and strengthen research staffs at our universities there should be no dissent, provided the universities have the resources with which to carry on both research work and instruction. Neither will anyone question the value to the teaching faculty of a certain amount of original research, designed to stimulate and strengthen their teaching ability and kept strictly subservient to that purpose. But if, as is intimated by Dean Davenport, the emphasis is to be shifted from the training of the man to the ascertainment of knowledge intended for commercial application, those who are interested in the education of our youth should begin to seek other means than the university for the development of our manhood. But we are reluctant to believe that this opinion is shared by any considerable body of those who are responsible for the conduct of our engineering colleges.

Licensing Still an Issue

THE comment that has followed upon the publication in *Engineering News-Record* for July 6, of a discussion on the licensing question indicates that the profession still holds diverse opinions concerning it. The extracts published in this issue are representative of the three prevailing views: (1) That we should work for licensing; (2) that we should oppose it; (3) that we are getting it anyway so let us make the best of it.

Those who favor it subscribe to the principle that it must be justified by the needs of public safety and submit that it is so justified. They contend, however, that the profession has a right to consider and to accept whatever advantage may inure to it as a by-product of licensing, and that the development of higher standards in the profession will avert the danger of licensed engineers undertaking work for which they are incompetent.

Those who oppose licensing contend, in the main, that it is not required to protect the public and that it is, therefore, unjustifiable. Some charge much of the licensing promotion to selfish motives—largely the desire to restrict competition and to close the profession.

The attitude of the neutrals is best reflected, perhaps, by the comment of one of them that we should "guide the law-makers, so that the resulting legislation will do the least possible harm and, if possible, some good."

Most interesting of all, perhaps, is the evidence that

the opponents of licensing are organizing for the repeal of some of the laws. News has reached us recently of such action in two states. Information is not available as to whether similar measures are contemplated to forestall the enactment of laws where none now exist. Unquestionably, organized effort has had much to do with the enactment of most of the licensing laws and if their opponents adopt the same tactics the whole question will be more thoroughly aired than could otherwise be the case.

Denver's Water Problem

DENVER has another water-works report by consulting engineers. It is different from any of the long series made in the past. For the first time the impelling motive back of the employment of experts was not for or against private stockholder interests. The people of Denver own the plant now and the instructions to the consultants were to lay out a comprehensive program for the best interests of the city. In all previous history of the system reports and investigations of the many able engineers consulted had been made largely in support of legal contentions or for condemnation or rate-making purposes, without the interests of the water users having been represented by engineers free from leaning toward one or another side of a controversy.

While the report, which is abstracted elsewhere in this issue, deals somewhat with the past it is for the sake of giving a better understanding of the present engineering situation. Rightly, a plea is made to seal the historical pages of dissention. If enough voters can be educated to this viewpoint to put through a bond issue for the first steps in a far-reaching comprehensive program Denver may be spared the threatened water famine and become one of the large cities of the country. Water limits the size of the city, and particularly its expansion to embrace outlying districts which for the present need water chiefly for irrigation but ultimately, with plenty of water, would become urban areas. As William Mulholland told the Los Angeles city council when it was considering the Owens River $30,000,000 project, "If you do not go after this water you will not need it."

Startling as is the proposal in the report of the Board of Engineering Review to distribute all of Denver's water through Marston Lake, it is no more so than the idea of the city controlling and regulating all of the water that flows down the South Platte, both for municipal supply and for irrigation. As there are few people in Denver who do not realize that something must be done to get more water, the feasible and comprehensive program outlined should receive majority support.

The unit control of irrigation supply as well as domestic water for the Denver region is the logical thing to do from the engineering, management and financial standpoints. All that is needed is to bring this home to the electorate. Fortunately, Denver has a small percentage of illiterate voters. If the various civic organizations take up the task, aided, of course, by the societies of engineers, a serious campaign of education should meet with success. The irrigators need the continuity of service which unified administration promises, for, as the report indicates, irrigation near Denver is not satisfactory. Denver needs a prosperous back-country. It must have more water within its boundaries or suffer for its lack.

Legal vs. Technical Opinion

IT IS commonly assumed that where a professional question of engineering comes before the courts, the legal decision rendered is also the best judgment of the technical aspects of the case. Cases occur frequently which bring this assumption strongly into question. Two recent ones are presented by the Ferris wheel collapse at Clason Point, N. Y., and the Knickerbocker Theatre indictment in Washington, in both of which cases the men brought into court were released. In the former case (p. 248, Aug. 10) the magistrate before whom the charge was examined took the view that an extraordinary gale was responsible for the failure. In the Knickerbocker case five defendants had been indicted, the architect, the building inspector and three contractors or contractor's employees, but the justice dismissed the indictment (p. 162, July 27), holding that it should have charged specific acts of omission or commission; for example, in what respect the plans and specifications prepared by the architect were negligently prepared and in what respect he failed to exercise the general direction and supervision of work.

To the technical mind, neither decision can be satisfactory as an interpretation of the engineering facts. In the Ferris wheel case the collapse occurred during a wind of 80 or 90 miles per hour, which exerts just about the pressure for which all structures are supposed to be designed. In other words, the wheel failed under a load that was not excessive or calamitous, and there is good reason for believing that at no time in its existence was the wheel adequately anchored to resist such wind pressure with due margin of safety. From an engineering standpoint, then, the case stands quite differently from the magistrate's legal interpretation, and it is patent that the accident demands technical investigation with a view to preventing its repetition.

In the Knickerbocker case the fact has been abundantly brought out that the building was dangerously defective in a number of ways and that the collapse resulted from one or more of its defects. The charge of negligence in design, execution and supervision is therefore so specific that no one could claim it unfair to be required to defend himself against it. Certainly it is specific as concerns the architect; his building collapsed, and the law on this point goes back at least as far as Hammurabi. The decision of the justice is, for the time being, equivalent to throwing the cases out of court and releasing the defendants as not responsible, and unless the ingenuity of the public prosecutor enables him to find indictments of more satisfactory precision, it amounts to a denial that any of the defendants are answerable.

The view of the lawyer and the view of the engineer are clearly not identical in these cases—and probably in many others. Nor is legal investigation of matters involving engineering questions an adequate safeguard to the public. Such roughly fashioned machinery for independent engineering investigation of important accidents as was brought into action to study the Knickerbocker collapse, resulting in the two reports which we published on pp. 532-38, March 30, should be applied also in future. Above all the young engineer should take warning that, as he builds up his sense of good and bad practice and of professional obligations and responsibilities, he will find sounder guidance in the engineering than in the legal view.

Caribou Tunnel Driven Under Heavy Inflow of Water

Unwatering Problems Paramount—200 Million Gal. Per Month Pumped From Shaft B—Water Pressure Prevented Use of Air Locks

By W. D. Shannon

General Superintendent, Stone & Webster, Inc., San Francisco, Cal.

THE construction program for Tunnel No. 1 on the Caribou hydro-electric development in California, which was completed last October, was originally laid out in the usual way for an ordinary two-mile tunnel job. Surface indications gave no warning of unusual conditions. As soon as the work was well under way, however, the actual sinking of shafts and advancing of headings became only a small part of the operation and the construction program had to be revised to give major time and attention to unwatering problems. Thus a phase of the work that could not have been foreseen called for the larger part of the time and money required.

Indifferent labor incidental to wartime conditions, soft material that would sink under timbering, and other ordinary tunneling problems were met. These were not unexpected, but the requirement that took precedence over all else was the unexpected necessity of handling countless streams of water that continually deluged the shafts and drifts, calling for more and more pumping equipment as the work advanced until each day became a 24-hour fight to keep the tunnel from flooding. Compressed air, as a means of unwatering the tunnel was not considered practicable because the inflow was under a head of about 150 ft. Pump breakdowns and uncertainty of power supply became very serious dangers and steam power plants were installed to avoid the flooding that promptly followed any interruption of the electrical current used for pumping. Pumping equipment was crowded into shafts and headings until there was barely room to pass men and materials and as much as 200,000,000 gal. per month were pumped against a head of 300 ft. from one of the shafts (see the view Fig. 1). By the time the work was finished a total of 2,000 electrical horsepower and 1,500 hp. in steam standby equipment had been installed for operating the pumps, hoists and other machinery used on the job. Despite all this there were times when the water won, temporarily, and headings were flooded for weeks at a time. Final success may be ascribed to the highest engineering skill supported by teamwork among the superintendents, foremen and mechanics on the job.

FIG. 1. PUMPING 5,000 GAL. PER MIN. FROM SHAFT B

The following notes on the driving of Tunnel No. 1 are confined largely to methods used in coping with the flow of water. No special importance attaches to the actual tunnel driving methods employed. The Caribou project as a whole was described in *Engineering News-Record* March 23, 1922, p. 472.

As finally completed Tunnel No. 1 is practically on the original location and conveys Lake Almanor reservoir water into Butt Creek, from which the Caribou plant draws its supply. The tunnel is 11,208 ft. long and has a finished cross-sectional area of 46 sq.ft. and a capacity of 900 sec.-ft. The driving of the tunnel was conduced from the upper and lower portals and from three shafts shown on the accompanying diagram, Fig. 2, as shafts A, B and C.

The tunnel penetrates the divide between the Feather River and Butt Creek, the northern portion of which was once a great valley that was afterwards filled in by successive lava flows, coming no doubt from Mt. Lassen. The southern portion of the divide is of shale, highly stratified and in many places badly broken. Both the lava and the shale were of loose texture, sufficient to make excellent water courses, this being proved by the quantity of water continually flowing from the heading and the completed drift.

The elevation of the reservoir averaged about 4,450, whereas the water table in the divide was slightly higher than this, showing that some of the water at least came from the mountains above the lake level.

Shaft B—The sinking of the shafts as far as the water table was a comparatively simple problem. Shaft B was begun in the early fall of 1919 and reached grade, 300 ft. below, in 90 days. The usual plan of providing two chambers in the shaft, a manway and a working chamber, was successfully carried out.

When the water table was reached, 173 ft. below the collar of the shaft, sinking pumps operated by compressed air were installed in the manway. The unreliability of the electric current supply soon compelled the construction of an auxiliary steam plant, which was kept in reserve so that the pumps could be quickly changed from air to steam.

When grade was reached, the quantity of water had increased to a point where it became necessary to construct an underground pumping station with duplicate steam and electrically operated centrifugal pumps; also a booster station located in the shaft above the water table. To facilitate unwatering the shaft a rod-connected pump with the motor located at the booster station and the pump within suction distance of the sump, was installed. In addition to this, a special motor-operated sinking pump of 3,500 gal. per min. capacity was installed in the shaft for emergency unwatering. With

the completion of the tunnel pumping station, the equipment could handle 7,000 gal. per minute.

As the tunnel excavation progressed down grade, pumping stations with motor-operated, centrifugal pumps were installed. These tunnel pumps discharged their water into a 16-in. wood stave pipe which emptied into the shaft sump, there to be pumped to the surface by the shaft station. In case of failure of the electric power, the heading would be abandoned, but the water would be kept down by the steam auxiliaries.

The ground water entered the tunnel chiefly from the west side, but as a rule the face and the entire tunnel for some distance back was a scene resembling a huge shower bath. This condition made progress exceedingly slow at times, though occasionally a dry face would appear, when excellent progress, as high as 26 ft. per day, would be made. This, however, was an unusual decided to drive a pilot tunnel with square sets, and this small tunnel was finally completed.

While the south heading of the pilot tunnel was proceeding from Shaft C, the wet sand was encountered from the south portal driving north. A pilot tunnel was then resorted to in this latter drift and the junction of the two headings drained Shaft C through to the south portal, a distance of 3,888 ft. On account of the 700 ft. of wet sand, however, it was decided to continue pumping the drainage water up Shaft C until the sand section could be lined. Timber crews were started at each end of the sand portion to enlarge the tunnel to the proper size. It was proposed to line the sand portion with a reinforced ring of concrete with cutoff walls at each end of the sand section. As soon as the timber work was completed, the concrete invert was placed and the drainage water collected at Shaft C was then allowed to run

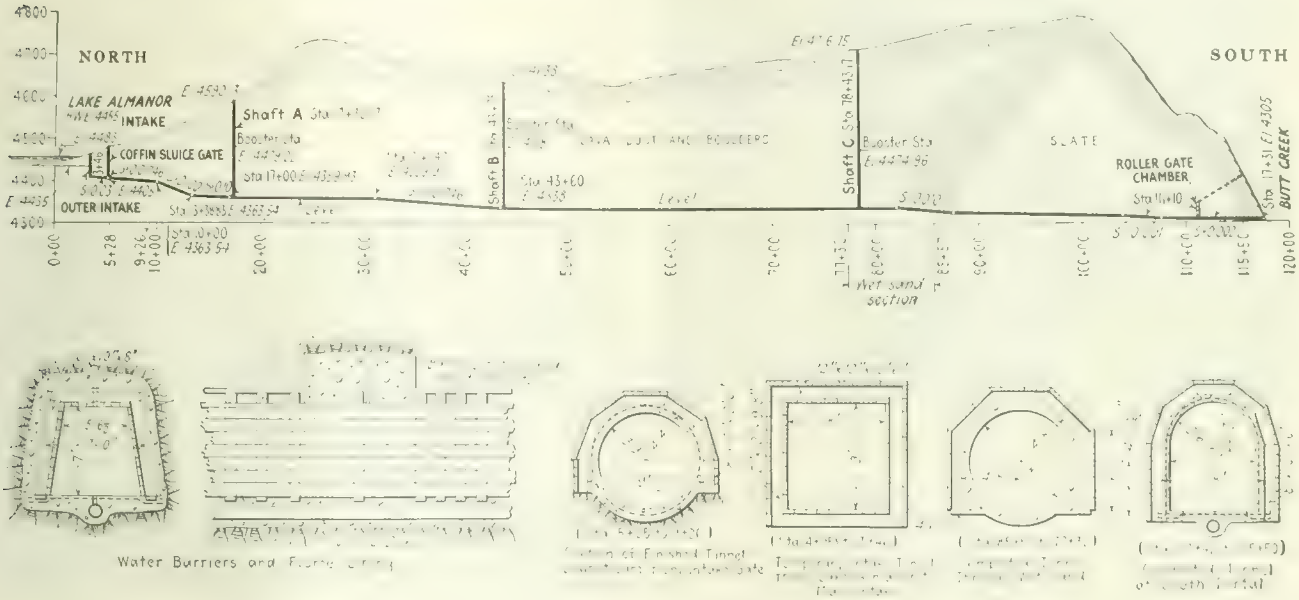


FIG. 2. CARIBOU TUNNEL NO. 1, PROFILE AND SECTIONS

condition. Keeping miners at work under the conditions noted was something of a task in itself. The character of rock encountered in the portions of the tunnel worked from Shaft B was chiefly broken lava, with occasionally layers of lava dust and boulders.

Shaft C—The sinking of Shaft C was begun in November, 1919 and continued without interruption until the water table was reached, when sinking pumps similar to those used in Shaft B were installed. This shaft soon developed considerably more water than the other, and the difficulties were increased by striking a stratum of fine lava resembling quicksand. From this point on progress was exceedingly slow. Grade was eventually reached at a depth of 400 ft. and the shaft turned to the tunnel. A tunnel pumping station was then installed with electrically-operated centrifugal pumps and an auxiliary set of steam pumps.

The tunnel to the south of the shaft was in this wet sand, and breastboarding was necessary for a distance of nearly 700 ft. To hold the timber sets in place heavy sills were worked down into the sand until a bearing was reached, but even these sills occasionally settled, due to loosening of sand caused by water rising through it, and the set had to be raised, under much difficulty. The timber sets showed so much movement that it was to the south portal. About 4,000 gal. of water per minute was thus disposed of through the south portal without pumping, and the pumping machinery at Shaft C was dismantled.

The north heading from this shaft did not present any unusual problems except the wet ground. The water drained away from this heading and mining conditions were somewhat better on this account. The heading practically throughout the entire period of excavation was covered with small streams of water, making the working conditions disagreeable and the progress slow, though the rock work itself was not especially difficult.

Shaft A—The unusually wet conditions found in Shafts B and C soon convinced the engineers that the project could not be completed on time without the use of a third shaft near the upstream end of the tunnel. Work at the north portal of the tunnel showed that no different condition than those encountered north of the Shaft B could be expected throughout the north half-mile of bore. Shaft A was therefore decided upon, and work was started in the winter of 1919-20. This shaft was 200 ft. deep and was entirely in lava rock, and below the water table was alive with springs, compelling the same methods of unwatering as in the other two

shafts, with a similar tunnel pumping station at the bottom. When the heading between Shafts A and B had broken through, the problems of pumping were simplified somewhat; but an important advantage was that the pumping stations of both shafts were available in case of tunnel flooding.

South Portal—The south portal heading was largely in broken slate, the water in which was more or less in large veins. Water troubles in this portion of the tunnel were therefore intermittent, but in general the ground was wet for the entire distance. The slate varied from large blocks where the heading work was comparatively simple to broken slate the size of a pea. This latter ground possessed the peculiar conditions of weathering swiftly, and under the action of running

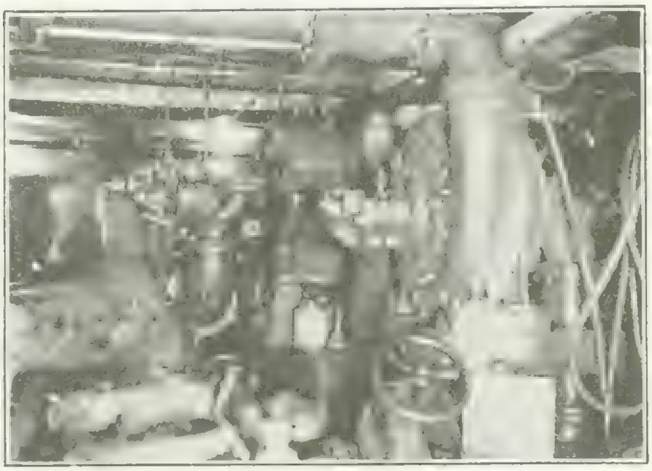


FIG. 3—CLOSE QUARTERS IN SHAFT PUMPING STATION

water was quickly softened. Ground of this nature compelled tight breastboarding, and progress through it was exceedingly slow. At Sta. 85 + 57, the wet lava sand was encountered and the pilot-tunnel method already referred to was adopted in driving from this point northward.

There were no pumping problems in connection with the excavation of this portion of the tunnel, as the water ran away from the heading and out of the south portal. About 4,000 gal. per min. was the maximum stream flowing from this part of the tunnel.

North Portal—The sill of the tunnel intake was only 50 ft. below the high-water level of Lake Almanor, and a slope adit was therefore driven to meet tunnel grade. Some of the wettest ground in the entire tunnel was encountered at this point, below the lake level, and on account of the hazards involved it was decided to construct only a portion of that part of the tunnel between the intake and Shaft A but to construct immediately the intake and install the Coffin gate as a protection to the balance of the tunnel. In addition to the protection of the gate, it was decided to leave a 70-ft. plug of rock between the Shaft A North heading and the intake, to be removed only when the rest of the tunnel was completed. The rock plug was located about 400 ft. south of the gate, and was the last portion of the tunnel to be driven.

Lining—Except in the wet-sand section at Shaft C, the south portal, and the portion of the tunnel immediately south of the intake, a standard lining (A in Fig. 2) was used. The floor of the tunnel was covered with a 9-in. slab of reinforced concrete, and at intervals of 100 ft. a concrete barrier 4 ft. wide was placed, to prevent a flow of water outside the tunnel lining. These barriers were poured against solid rock and were carefully grouted. The sides and roof of the standard section were covered with 3-in. surfaced planking carefully fitted and heavily spiked. The timber lining was put on after the concrete floor slab was in place.

To place the floor slab, a section of tunnel from 200 to 400 ft. long was dammed off by means of sack dams about 2 ft. high, a centrifugal pump installed at the upstream end, and the drainage water pumped over the section through a wood stave pipe. The floor was then trimmed to grade, with a 12 x 12-in. ditch in the center, in which was laid a tile drain to take care of small springs flowing into the section. After the reinforcing steel was hung in place, concreting was started at the downstream end of the section, the advancing concrete forcing the water through the tile drain in the completed floor. The floor was allowed to set several days before the upstream dam was broken and water permitted to flow over it. By thus taking a small section at a time, the work of concreting progressed rapidly, as

FIG. 4—PILOT TUNNEL THROUGH WET-SAND SECTION
16-in. wood-stave pipe carries water to shaft sump

the same system was used simultaneously in other portions of the tunnel.

Special sections and types of lining used elsewhere in the tunnel are also shown in Fig. 2.

At the tunnel outlet, a wooden flume built on pile bents and stringers, and terminating in an apron consisting of a reinforced concrete slab on a heavy pile foundation, was used to break the force of the water as it left the tunnel and to carry the water clear of the tunnel lining.

Flow Regulation—In order to control the flow of water through the tunnel, a 7-ft. Coffin gate was placed at the intake, and a roller gate at the lower end of the tunnel. The Coffin gate is to be used to shut the water from the tunnel entirely or to admit a full flow. The roller gate is designed to let through a partial flow, and at the same time to keep the tunnel under pressure. Both gates are electrically operated with local control.

The tunnel was placed in operation July 22, 1921. The entire development was constructed for the Great Western Power Co. by Stone & Webster, Inc. S. L. Shuffleton is the western manager of the company, and the writer was engineer-superintendent in direct charge of the work.

Data on Compressed-Air Sickness

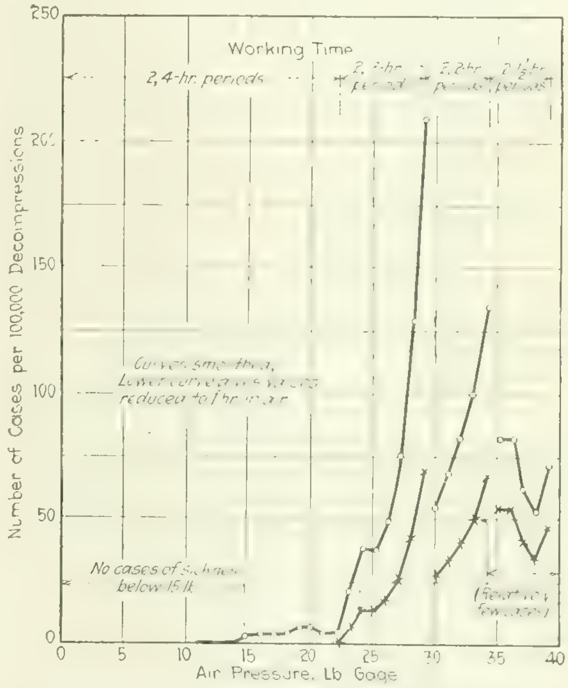
New Conclusions Reached and Existing Beliefs Strengthened in Bureau of Mines Report

BRINGING together the experience with compressed-air sickness obtained in the work of driving the Public Service Commission's rapid transit tunnels under the East River at New York within the past half dozen years, Dr. Edward Levy, in a report just issued (*Technical Paper* 285, Bureau of Mines) presents a number of conclusions differing from those previously accepted, or confirming prior views with better evidence. The total number of decompressions for these tunnels was 1,361,461, in which occurred 680 cases of compressed-air sickness. Data from the driving of the Pennsylvania East River tunnels, with 557,000 decompressions and 3,692 cases of sickness, are also taken into account after a report published by Dr. F. L. Keays in 1909.

Physical perfection in the worker is concluded to be less important than was formerly believed, on the basis of experience with mediocre workers during the war; the essentials are normal lungs, normal kidneys, and a good heart, and in older men a blood pressure not too high. Data on the influence of age are uncertain, but 87 men known to be over fifty years old developed only three cases of sickness, indicating that "in selected men advanced age may not be such an important factor as many writers insist." Obesity is not found to be an important factor; Dr. Levy says that "Men with a moderately-increased amount of adipose tissue are not more susceptible to compressed-air illness than is the average individual," and in consequence "he is less inclined than are some others, to enforce strictly a rule that no man with a tendency to fatness be employed." The outside temperature does not appear to be a factor in the incidence of compressed-air sickness, nor was humidity found to have any distinct effect.

As to the effect of pressure, it is noted that all of this work proceeded under the New York State law, which limits the working hours to eight (in two periods) for pressures up to 22 lb., two 3-hr. periods with a rest interval of 3 hr. for pressures from 22 to 29 lb. inclusive, two 2-hr. periods with a rest interval of 2 hr. for pressures from 30 to 34 lb. inclusive, two 1½-hr. periods with a 3-hr. rest interval for pressures from 25 to 39 lb. inclusive, two 1-hr. periods with a rest interval of 4 hr. for pressures from 40 to 44 lb. inclusive, and two ¾-hr. periods with a rest interval of 5 hr. for pressures from 45 to 50 lb. inclusive. The number of decompressions and the number of cases of sickness are given by Dr. Levy for working pressures varying by pounds. Reducing his figures to number of cases of sickness per 100,000 decompressions, and smoothing out the individual figures somewhat, the upper curve of the diagram herewith is obtained. The marked falling off in number of cases from 29 to 30 lb., due to the decrease in working hours from 3 to 2 hr., indicates that the time spent continuously under air pressure is an important factor. Further reducing the figures, therefore, to a basis of one hour's work, the lower curve of the diagram results. The sharp rise of the curves with pressure, and the abrupt decrease as the working time is decreased, still appear unmistakably.

Dr. Levy agrees with earlier investigators that the saturation of the tissues of the body with nitrogen is the cause of the compressed-air sickness. Carbon dioxide was not found to have any effect, within the close limits of control maintained on the Public Service Commission work, where the partial pressure of carbon dioxide reached 1 per cent only on two or three occasions. The symptoms in 92 per cent of the cases were localized pain in the body (chiefly pain in the joints), vertigo in 6½ per cent, and affections of the central nervous system (numbness, paralysis, etc.) in 1.6 per cent. Two deaths occurred, from choking and collapse respectively. These distribution percentages agree very closely with corresponding ones for the Pennsylvania



RELATION OF COMPRESSED-AIR SICKNESS TO AIR PRESSURE

Plotted from Dr. Levy's statistics of New York rapid-transit tunnel construction. Upper curve, cases per 100,000 decompressions; lower curve, same per hour working period. Both curves smoothed somewhat.

tunnel work. The disease showed itself within the first hour after decompression in 64 per cent of the cases (86% on Pennsylvania work), and no case developed after 18 hr. (23 hr.).

Treatment of compressed-air sickness, according to Dr. Levy, is most effectively conducted by providing medical air locks and arranging to have all the workers who may be taken sick, whether on or off duty, brought to the medical lock for recompression. He advises ample time of recompression, particularly in the more severe cases. Among his other suggestions are that decompression by the stage method should be based on an initial drop of pressure to not less than half the gage pressure (instead of half the absolute pressure), that chilling due to the cooling in decompression be avoided, that changing of men from one shift to another be avoided as tending to disturb living conditions and likely to induce anemia, and that the limits of working hours based on pressure be changed by lowering the upper limit of each class, so that, for example, the length of working period for pressures of 29 lb. and 34 lb. would be reduced, to eliminate the high peaks of the diagram curves.

Special Formwork Required in Setting Wharf Piers

Concrete Poured by Tremie Into Form Boxes Made of Timber and Steel Sheetpiling According to Profile of Foundation Rock

BY S. KENT
Engineer, P. J. Carlin Construction Co., New York City

SOME rather unusual features were included in the construction of a concrete wharf recently completed as part of the installation of the new steam power plant of the United Electric Light & Power Co. at 134th St. and East River, New York City. The sequence of operations in the construction of the entire plant, the limited space for the storage of concreting materials, and the general congestion both on land and in the river made the construction of the wharf piers quite difficult.

General Dimensions—The concrete wharf is about 475 ft. in length and varies in width from 70 ft. at the north end to 24 ft. at the south end. The foundations for this wharf consist of walls reinforced with steel cages at the ends to carry heavy concentrated superimposed loads of the steel-frame superstructure. These walls were built on rock at a grade varying from –17 ft. 5 in. on the inshore end to –35 ft. at the outshore end (zero being the mean low water at the nearest gage station). The walls serving as support piers to the concrete wharf were placed perpendicular to the bulkhead line and therefore somewhat oblique to the face of a sea wall (see *Engineering News-Record* May 26, 1921, p. 896) which carried the loads imposed by the river wall of the main steam power-plant superstructure. The wharf piers were generally 6 ft. wide by 31 ft. long.

Inspection of the river bottom revealed that for a distance of about 16 ft. on the inshore end the rock bottom was fairly level at -17.5 and for the balance of the pier length the rock dipped sharply to -35, at which grade the rock at the end of the wall was blasted to give a level seat, about 6 ft. square.

Form Details—A wooden form built in panels was therefore decided on for the inshore 16 ft. of wall and steel sheetpiling for the balance of the long sides and a wooden panel for the deep end. The three wooden panels on the inshore end were bolted together and to the open ends of this box form were bolted half pieces of steel sheathing. This box was securely braced and stiffened with steel I-beams or channels which also served to sink the box.

The overall height of the box was 28 ft. as the top of the wall was approximately at an elevation of +10. The boxes were built on a lighter and set in position by it and were securely braced to the sea wall and to the walls previously poured. After the boxes were satisfactorily placed wales, consisting of I-beams or channels built as shown in the accompanying view, were fastened to the box by 1¼-in. tie rods and supported at the outshore end by I-beams set on rock bottom. The ends of these wales above low water were guyed by cable to the sea wall or were braced to the walls previously concreted. After the wales were set at low and high water, sheetpiling was driven (locking at the ends of the open boxes with half-pieces of sheathing bolted to the box form) out to the outshore end of the wall on both sides.

A wooden panel with pieces of sheetpiling bolted flat on the ends was then lowered locking into both end pieces of sheathing, thereby making a complete inclosure. The box form was bolted securely at the corners and rodded across. At two points below low water 1¼-in. round tie rods were installed, to which wales, consisting of pairs of I-beams, were attached by divers. The wales were so built up that the sheathing was tight against the wales and lined up with the wood form.

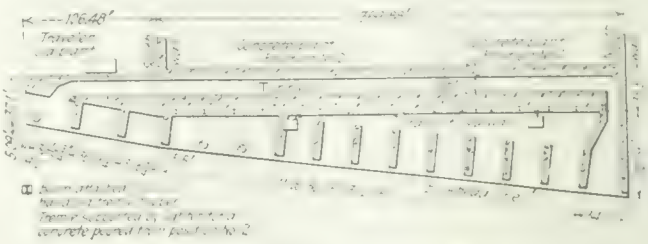


FIG. 1. LAYOUT OF PIERS. POSITIONS OF CONCRETE PLANT

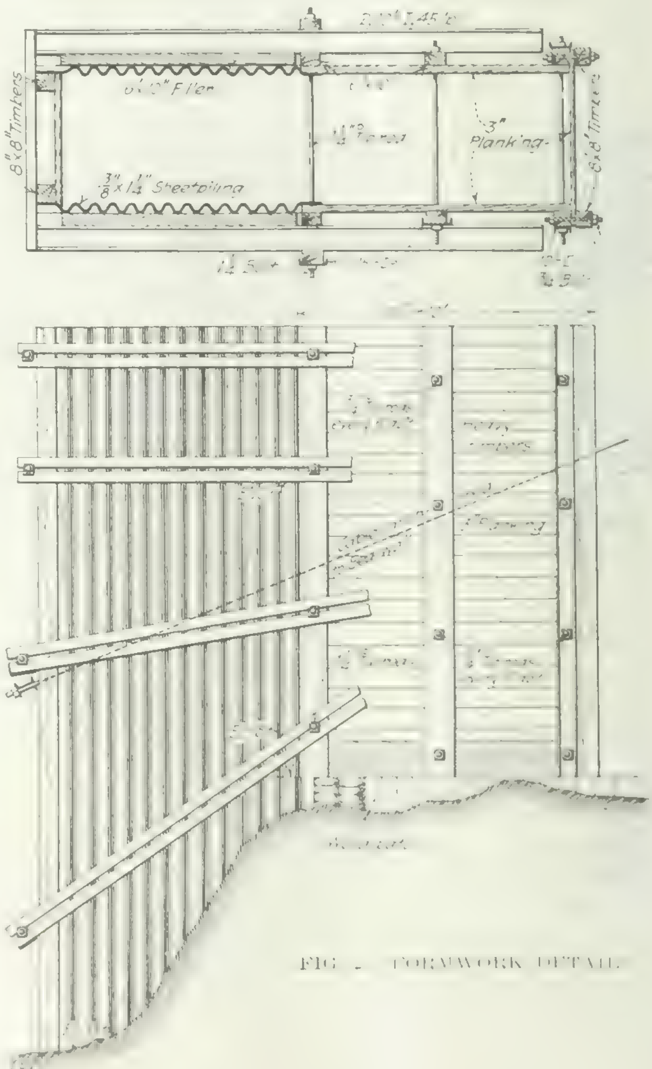


FIG. 2. FORMWORK DETAIL

The two ends were rodded across as shown on the plan with 1¼-in. rods to take up the pressure on both ends.

The wooden forms did not fit tightly against the rock foundations so it was necessary to patch on the inside with 2-in. planking set vertically. The entire outside of the box was bagged up with burlap bags filled with gravel to prevent leakage at the bottom.

Concreting Operations—To concrete the wharf foun-

dation walls with the tremie, work was laid out so that a mixing plant set at Station 1, as shown on the accompanying plan, would take care of about one-third of the work. It was then shifted to Station 2 to cover the second third of the work. The third or southerly portion of the pier concreting was handled from a stationary plant.

The plant at Stations 1 and 2 consisted of an 80-ft. wooden tower guyed to the steel superstructure, a 1-yd. mixer, a 25-yd. bin supported on timber bents set down on rocks, and a hoisting engine set on the sea wall. To support the tremie a wooden boom was set on various steel columns and was attached to the base of the columns with a Chicago boom fitting. During concreting the tremie was operated from an engine in the same manner as from the traveler plant, described in the article referred to above.

Handling Materials—The concrete was of a 1:2:4 mix. Aggregate was handled from scows kept alongside by a derrick on the lighter into the bin. Cement was carried off the barges and deposited in piles near the mixer and carried up to the working platform when needed. Concreting of walls was done in three stages: First, pouring concrete to the level of the highest point on the rock bottom; second, pouring up to low-water line, and, third, topping on the walls. Reinforcement was assembled on shore and lowered by the lighter immedately before any concrete was placed.

Before any formwork was put in place the entire site was cleaned of boulders and loose material to hard rock, so that all work necessary after the forms were in place was little more than to clean the bottom with an 8-in. material pump and patch up around the bottom.

The wharf deck consists of a steel framework supporting concrete slabs 8 in. thick, reinforced with wire mesh. The centering was similar in construction to that for concrete floors on a steel beam-and-girder construction. The beams at the ends of the walls were tied together to afford a rigid lateral tie for the 6-ft. walls.

The stripping of the walls was very simple. The panels were loosened up by removing the nipples and the sheathing was then removed, starting with the pieces next to the side panels.

The construction of this wharf and the piers was done by the P. J. Carlin Construction Co., New York City. E. A. Herrick was general superintendent and the writer engineer for the contractor on the job.

New Geographic Positions in Rocky Mountains

Geographic positions and elevations of triangulation stations on the newly surveyed Utah-Washington arc of precise triangulation are published in Special Publication 74 of the U. S. Coast & Geodetic Survey, just issued. The arc extends from near Ogden, Utah, through southern Idaho to the Columbia River at Umatilla, and thence down the Columbia to near Portland, Oregon. The extremities of the arc were tied into adjusted triangulation, which was not changed in position by the adjustment. In addition to giving the data on the stations, including descriptions of the stations, the publication sketches the methods and costs of the entire triangulation, and deals with the magnitude of the discrepancies distributed by the adjustment. It gives also an explanation of the North American datum and a brief statement of the advantages derived from using points on that datum for the control of local surveys. Methods for using such points are suggested.

The Record-Breaking Rainfall and Flood at Fort Worth, April, 1922

The unprecedented electrical storm, rainfall and flood at Fort Worth, Tex., of April 24-25, with its 8.81 in. of precipitation in 24 hours (actually in 14 hr. 22 min.) and its river flood height of 39.1 ft., or 0.1 ft. above any previous record (see *Engineering News-Record*, May 4, p. 749, for news report) is the subject of an article in the April *Monthly Weather Review* by D. S. Landis, local meteorologist of the United States Weather Bureau.

Rain began falling at 9:06 p.m., April 24. From 10:19 p.m. to 7 a.m. the next day (8 hr. 41 min.) the total precipitation was 7.5 in. The maximum fall in inches for various short periods were: 15 min., 1.02; 30 min., 1.74; 1 hr. (12 to 1 midnight), 2.5; 2 hr., 4.07. The accumulated depths for successive periods are shown in the accompanying table.

ACCUMULATED RAINFALL AT FORTH WORTH, APRIL 24-25, 1922

First line, time in minutes; second line, corresponding rainfall in inches.

5	10	15	20	25	30	35	40	45	50	60	80	100	120
0.06	0.14	0.31	0.54	0.70	0.75	0.89	1.28	1.63	1.89	2.43	3.07	3.62	4.07

The drainage area of the Trinity River above Fort Worth is 2,300 sq.mi. Reports from two points in the upper part of the area "warrant the belief that the torrential rains covered the whole drainage area."

Previous Heavy Rainfalls at Fort Worth—On Sept 20-21, 1900, 7.44 in. of rain fell within 24 hours, causing an estimated flood depth of 38 ft. On May 24-25, 1908, there was a precipitation of 6.99 in. within 15 hr. and 13 min., resulting in a flood stage of 39 ft., "estimated from ripple marks on bridge." In both these cases the rise of water was slow and but little destruction resulted.

Effects of April, 1922, Flood—Mr. Landis describes the latest flood and its results as follows (except for slight condensation):

The floods were of little moment to property or life, but had other factors not found in former floods. The river proper at the Government river-gage is 98 ft. wide in channel. Back 100 ft. from the channel a 10-ft. high levee was thrown up and grassed over. This levee gave a channel practically 298 ft. wide, and 30 ft. to river-bed level, supposedly allowing sufficient channel for any flood waters likely to occur. The test came the morning of the 25th. At 7 a.m. the river-gage showed 33.5 ft., being 3.5 ft. above flood stage with water running over the levee. No one knows how long the levee had been overtopped for the rainstorm had been so intense and the electrical storm so terrific that apparently no one had ventured out to note conditions.

The residential lowland district was under water before any one knew it, house pets giving first alarm by cries and scrambling for places of safety. People stepping out of bed found water ankle deep, and more, already in their homes, and the flood soon became waist deep. Ceilings were opened and refuge taken in lofts, and daylight found many people marooned on housetops awaiting rescue.

By 7:30 a.m. a crevasse was made in the levee some distance above the residential district, and the flood filled in rapidly, water running into residence windows by 10 a.m., and reaching the eaves of many homes by 2 p.m., when the flood crest stood highest of record at this station, 39.1 ft.

The lowland residential district embraces about 4 sq.mi. About 1,500 inhabitants were subjected to overflow waters. After the levee broke many head of live stock drowned in their stalls, at hitching posts, in wire entanglements, in hobbles and lariated, while many other animals were washed away.

Some Data on the Design of Steel Coal Bins

Experience Notes on Safe Practice—Weight and Friction Angle—Hopper Bottoms—Plate Thickness and Lining—Pressure Calculations—Bending Moments

By R. Fleming
American Bridge Co., New York City

PRACTICE in designing steel coal bins and bunkers varies considerably, without good reason. A discussion of the commonly available data and usual practices seems desirable as a help in clarifying the subject. The principal type of structure concerned is the overhead bin or bunker for the boiler room of a power house, which, located directly over the firing space, delivers coal direct to the stokers by gravity and provides for several days' storage.

The Paterson Accident—Study of coal bin design received an impetus from the failure of a large bin at Paterson, N. J., twenty-five years ago. A thousand tons of coal were dumped over boilers and machinery, breaking steam pipes and for a short time stopping street car and lighting service. Illustrations of the structure that gave way, together with a spirited and extended discussion on bin design, may be found in *Engineering News* of Aug. 19 and 26, Sept. 23, Nov. 4 and Dec. 30, 1897. An important lesson taught by the failure, not yet fully learned, is that bins should be designed for any probable or possible surcharge. The builders of the Paterson bin wrote in defense of their design that it was distinctly stated in their proposal that the coal was to be level on top of the bin. However, the conveyor was placed 8 or 10 ft. above the top. A miners' strike was impeding and in order to accumulate coal the bin was surcharged to the limit of its capacity. This was the natural thing to do. There seems every reason that in calculating stresses for any bin the greatest load that can be placed in it should be used.

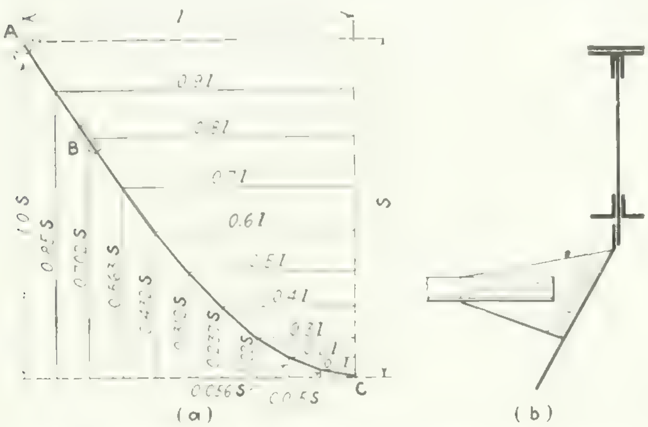


FIG. 1—CURVE OF SUSPENSION BUNKER AND EARLY SUSPENSION DETAILS

Weight of Coal—The weight of coal varies. A monograph, "Weights of Various Coals," by S. B. Flagg, Technical Paper 184 of the U. S. Bureau of Mines, gives the weight per cubic foot of 177 samples as determined by shoveling coal loosely into boxes measuring 2 ft. by 2 ft. by 2 ft. and leveling off with a straight edge. These weights justify the common practice of assuming the weight of bituminous coal at 50 lb. and of anthracite at 56 lb. per cu.ft. Coal in a storage pile or otherwise compacted or wet may weigh considerably more.

The angle of repose, or rather internal friction, is also a variable quantity. It has often been assumed at 30 deg. for anthracite and 35 for bituminous coal.

In designing bins to be located in coal breakers and washeries it may not always be advisable to follow the assumptions mentioned of weight and angle of repose. Local conditions may be different

Thus, the mechanical engineer of a coal company in Pennsylvania, while approving the assumption of 50 lb. and 35 deg. for bituminous coal for usual practice, notes a number of varying conditions. When finely crushed coal, either bituminous or anthracite, is deposited in bins by flushing with water it takes a very flat slope, anywhere between 5 and 35 deg. The size of the coal and the amount of water used in flushing affect the angle of repose. Large coal flushed with a small quantity of water will repose on an almost normal angle, say 27 deg., while with a large quantity of water its slope will decrease to 20 to 23 deg. Small-size coal such as rice or barley will take a slope of 10 to 20 deg. even when only a small quantity of water is used in flushing it in. Weights of coal also are variable, according to this engineer; anthracite coal absolutely free from slate or rock would weigh 54 to 58 lb. per cu.ft., but with much dirt or rock the weight may run from 60 to 65 lb., and bituminous coal varies similarly.

Sufficiently correct assumptions for practical use in calculations for bins in boiler rooms are: bituminous coal, 50 lb. per cu.ft., 35 deg. angle of repose; anthracite coal, 56 lb. per cu.ft., 30 deg. angle of repose.

Useful Literature—There is not much literature available to the practical designer on the subject of coal bin design. The engineer who has much work in this field should by all means own Ketchum's "The Design of Walls, Bins and Grain Elevators," preferably the latest edition. Cain's valuable "Earth Pressure, Retaining Walls and Bins," has a chapter on bins—mostly coal bins. Hess in his "Graphics and Structural Design," devotes a chapter to bins. An article "Some Formulas and Tables for Bin Designing," by R. W. Dull, *Engineering News*, Vol. 52, July 21, 1904, has been widely quoted.

Suspension Bunkers—The most common types of coal bins used in power stations are the suspension bunker and the hopper bin. Shortly after the failure of the Paterson bin, A. S. Berquist designed a bin for the American Coffee Co. of Brooklyn of steel plate suspended from two side girders; he patented it May 30, 1899. A description and an analytical investigation were given by Berquist in *Engineering News* of July 27, 1899, p. 54. The shape of the bunker is the curve of equilibrium for a cord suspended from two fixed points, carrying a load decreasing uniformly from a maximum at the center to zero at the points of suspension. The equation of the curve is

$$y \ [illegible] \ \frac{S}{l^2}\left(3 - \frac{[illegible]}{l}\right)$$

The maximum pressure, P, (at the center) for triangular loading $= \frac{Cw}{l}$. H [illegible] $\frac{Cwl}{3S}$; V [illegible] Cw and T [illegible] $\sqrt{V^2 + H^2}$. For a bunker level full, C [illegible] $\frac{5}{4}lS$; P [illegible] $\frac{5}{4}Sw$; $V = \frac{5}{8}Slw$; $H = \frac{5}{12}l^2w$.

in which (using Ketchum's notation) the symbols mean:

- l = one-half the span, feet;
- S = sag, feet;
- H = horizontal component of stress in plates, pounds per lineal foot of bin;
- w = weight of bin filling, pounds per cubic foot;
- T = maximum tension in plates, pounds per lineal foot of bin;
- V = reaction of bin, pounds per lineal foot;
- C = capacity of bin, cubic feet per lineal foot of bin;
- x, y = values of co-ordinates, with origin at lowest point of bin.

It is observed that Cw does not enter into the equation of the curve and that for a bunker level full S does not enter into the value of H. The curve may be laid out either analytically or graphically. Fig. 1a shows the ordinates in terms of l and S. If the bunker is surcharged by vertical walls the curve is extended until it meets the plane of the produced surface of the material; the half span l is then the distance from the meeting point to the center line and the sag S is the vertical distance from top of wall to lowest point of bunker.

It is common practice to make the upper portion of the curve a straight line and the lower portion the arc of a circle or the arcs of three circles. For a bin which is nearly an equilateral triangle the following figures (Hess) are approximately correct: Area of the bin section, fill level, $0.40L^2$; area of the bin section, triangular surcharge, $0.57L^2$; length of plate, no allowance for laps, $19.8L$ (inches); force in plate per foot of length at A (Fig. 1), $0.60W$ (pounds); force in plate per foot of length at C (Fig. 1), $0.30W$ (pounds); where L is the span in feet, and W is the load in the bin for one foot of its length (pounds).

The curve as determined from the theoretical equation is not strictly correct for bins partially filled, neither is the straight-line-and-arc strictly true for bins fully loaded; in fact, no curve is true for all conditions of loading. However, any deflection due to bending in the sides when the bin is not loaded as assumed is ordinarily not sufficient to cause trouble, either by distortion or by increase of stress in the plate.

Suspended bunkers have also been built with the curve a parabola, the ordinates of which are 0.01, 0.04, 0.09, 0.16, 0.25, 0.36, 0.49, 0.64, 0.81 instead of those shown in Fig. 1. A practically parabolic curve was used in one case, where the curve was determined by suspending a plate from two trolleys placed on a crane at points corresponding to the points of suspension and passing it through a third point corresponding to the lowest point of the bunker. From the suspended plate the drafting room obtained data needed for ordering material and making working drawings. The plates were laid out, punched and shipped flat leaving them to be bent at the site by the erector. A field difficulty arose from the fact that the plates with holes for discharge gates did not bend to the same curve as the other plates; these holes should have been cut in the field after erection.

For several suspension bunkers of concrete on ferro inclave the narrow supporting plates were shipped flat. At the site they were made to assume a predetermined curve by pulling them transversely with wires until tangent to wooden strips laid longitudinally.

Fig. 2 is the cross-section of a suspension bunker of decidedly different shape, built in 1915, the outline of which was suggested by Berquist a short time before his death. Several bunkers have since been built with almost identical outlines. It is observed that the supporting girders are vertical, thus enabling attachments

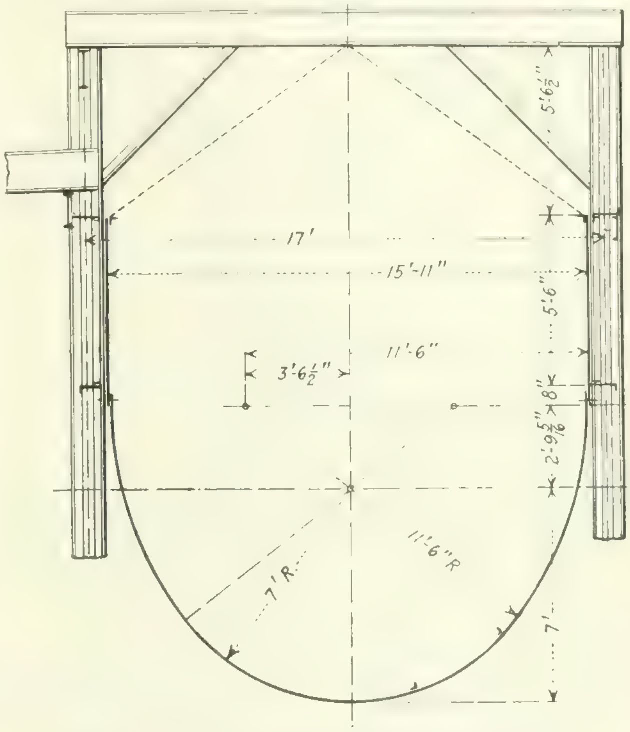


FIG. 2. LATER TYPE OF SUSPENSION BUNKER

to be easily made to inner flanges of columns. The top flange latticed to a vertical channel and a horizontal channel made part of the bottom flange prevent lateral distortion between columns. It is also observed that a greater storage capacity is obtained. On the other hand with the original form of bunker the curve is so nearly a straight line in its upper part that it can be made the web of a plate girder. The depth AB, Fig. 1 may be from ⅓ to ½ the distance between end supports depending somewhat upon the depth of the bunker. Two plates 7 to 12 in. wide serve for both tension flange and splice to attach the suspended plate.

The saving in steel by taking advantages of the tensile strength of the plates and thus avoiding supporting beams is considerable. Six Berquist bunkers ranging from 350 to 1,000 tons capacity, shipped, including supports, from 128 to 234 lb. per ton (2,000 lb.) of capacity, the average being 204 lb. These bins were designed in competition, and in some of them the thickness of plate could well have been increased. A weight of one-ninth of the contained coal for bin including supports and one-twelfth not including supports is usually a safe assumption (Kent gives these ratios in his "Mechanical Engineers' Pocket Book"). If the

bunkers mentioned had been of rectangular cross-section with hopper bottoms their weight would have been increased not less than 50 per cent. But the weights of bunkers and bins are dependent upon so many variables that no formula applicable to all cases can be given.

Suspension bunkers are not self-emptying. For this reason some prefer bins of the hopper bottom type. Concrete lining in Berquist bunkers may sometimes crack owing to the "breathing" of the bin from varying loads, but this has not been enough to prove a serious objection to their continued use.

The minimum thickness of plates for suspension coal bunkers should be ¼ in., and for large sizes preferably $\frac{5}{16}$ in.

Hopper-Bottom Bins—Coal bins of the hopper type may be divided into two classes—those in which the plane of rupture cuts the top surface of the material within the bin and those in which the plane of rupture cuts the side of the bin. The second class, though common, has not received the attention that has been given to the first. Most of the methods given for finding the pressures on retaining walls are for horizontal areas of unlimited extent and do not apply to the many coal bins where the plane of rupture cuts the side of the bin.

The writer for many years has used diagrams of lateral pressure made by a colleague, B. B. Priest. Fig. 3 shows one of these diagrams. (The method is adapted from that given in Church's "Mechanics of Engineering.") A tabulation of the diagrams is given in Table I. Pressures for angles other than 30 deg. are given for bins 20 and 30 ft. wide in Table II. The pressure in both Tables I and II for weights other than 50 lb. with the same angle of repose will vary directly as the weight.

A table used by the New York Central R.R., assumes the weight of coal at 52.1 lb. per cu.ft. and the angle of repose at 27 deg. The total pressure for depth d is $9.78\,d^2$ when the top surface is horizontal and of indefinite horizontal extent and $14.22\,d^2$ when the top surface is sloping at the angle of repose. These equations are derived from Trautwine's method for retaining walls. For bins of dimensions given in Table I the Trautwine method is needlessly severe.

Liquid-Pressure Calculation—Paaswell in his "Retaining Walls" mentions the method of using an equivalent liquid pressure for determining thrust against retaining walls. Dull, in his article previously referred to gives pressure-constants for several cases of bin loading for bituminous coal, anthracite coal, ashes and sand. His formulas, based on the theory of Cain, give the total horizontal pressure on vertical walls of steel-plate bins filled with bituminous coal (50 lb. per cu.ft., angle of repose 35 deg., top surface level), as $5.83d^2$; and on walls of bins filled with anthracite coal (52 lb. per cu.ft., angle of repose 27 deg.), as $8.39d^2$. For the same bins surcharged to the angle of repose, the corresponding figures are $16.75\,d^2$ and $20.6\,d^2$. These values are for the horizontal area of a bin unlimited in extent, which is seldom the case with surcharged bins. For bins, such as shown in Fig. 3, Dull gives no figures but recommends graphical computation.

Pressures for different depths of bin and weights of liquid are given in Table III. Comparing them with the figures of Table I it is seen that for bins with top surface of coal horizontal the lateral pressure is about equivalent to that of a liquid weighing 15 lb. per cu.ft. For the surcharged bins of Table I the equivalent weight of liquid varies from 15 to 25 lb. per cu.ft., depending upon the width and depth of bin. For angles of repose (ϕ) other than 30 deg., the remaining data being the same, the unit weight of the equivalent liquid is $\frac{1 - \sin\phi}{\sin 30}$ times as great; for example, if 15 lb. is the unit weight used for an angle of repose of 30 deg., the unit for an angle of 20 deg. is

$$\frac{1 - \sin 20}{\sin 30} \times 15. = \frac{1 - 0.342}{0.5} \times 15. = 19.74$$

The walls of some bins recently built for a coal breaker were designed by the writer for a liquid weighing 25 lb. per cu.ft. The conditions were not very well known and this weight was considered sufficient to take care of any probable contents with surcharge. Specifications of the Isthmian Canal Commission for 500-ton coal bunkers at Cristobal and Balboa called for the strength of framing to be proportioned on the assumption that the walls are subjected to the pressure of a

TABLE I. COAL PRESSURES

Horizontal pressure on vertical wall 1 ft. long, in lb., for coal weighing 50 lb. per cu.ft., with angle of repose 30 deg.

	Top surface horizontal		Top surface sloping 30 deg. to the horizontal from each bin wall											
			Bin 15 ft. wide		Bin 20 ft. wide		Bin 25 ft. wide		Bin 30 ft. wide		Bin 35 ft. wide		Bin 40 ft. wide	
Depth in Feet	Total Pressure	Pressure on Lowest Foot	Total Pressure	Lowest Foot	Total Pressure	Lowest Foot	Total Pressure	Lowest Foot	Total Pressure	Lowest Foot	Total Pressure	Lowest Foot	Total Pressure	Lowest Foot
2	30	26	60	57	60	54	70	60	70	62	70	65	70	66
4	100	51	210	91	220	95	240	106	250	111	250	116	260	117
6	230	77	420	120	460	130	490	144	510	151	530	158	540	160
8	410	103	690	144	760	161	810	175	850	185	880	195	910	199
10	650	129	1,000	166	1,110	187	1,190	201	1,250	214	1,310	226	1,350	236
12	920	154	1,350	188	1,500	208	1,610	226	1,700	240	1,790	255	1,860	269
14	1,260	180	1,750	208	1,940	230	2,090	249	2,220	264	2,320	281	2,420	298
16	1,650	206	2,190	228	2,420	250	2,610	271	2,770	288	2,910	305	3,040	324
18	2,090	232	2,660	248	2,930	271	3,170	293	3,370	312	3,540	329	3,710	348
20	2,570	257	3,180	267	3,500	291	3,780	315	4,020	334	4,220	352	4,420	372
22	3,110	283	3,730	287	4,100	310	4,420	336	4,710	356	4,950	375	5,190	394
24	3,710	309	4,360	307	4,740	330	5,110	356	5,440	376	5,720	397	6,000	416
26	4,360	335	4,980	316	5,410	348	5,840	376	6,210	396	6,530	419	6,860	438
28	5,040	360	5,620	325	6,130	368	6,600	394	7,020	416	7,390	441	7,750	460
30	5,790	386	6,280	335	6,880	386	7,400	411	7,870	435	8,300	461	8,690	480

TABLE II. COAL PRESSURES

Horizontal pressure on vertical wall 1 ft. long, in lb., for coal weighing 50 lb per cu.ft.

Depth in Feet	Slope of Surface and Angle of Repose	Total Pressure for Bin 20 ft. wide	Total Pressure for Bin 30 ft. wide
12	15°	2,300	2,490
12	20	2,060	2,150
12	25	1,775	1,925
12	30	1,500	1,700
12	35	1,310	1,480
16	15	3,850	4,100
16	20	3,350	3,690
16	25	2,575	3,050
16	30	2,420	2,770
16	35	2,040	2,350
20	15	5,700	6,280
20	20	4,940	5,360
20	25	4,130	4,660
20	30	3,500	4,020
20	35	2,950	3,440

liquid weighing 25 lb. per cu.ft., and that "the bunker shall have the stated capacity without trimming; that is to say with the top surface of the coal at the slope which it would naturally assume as delivered by the conveying system." Each bunker was 23 ft. 8 in. wide in the clear, 16 ft. deep on the rear side and 40 ft. on the front.

Vertical Pressures—The walls of bins differ from ordinary retaining walls in that the material back of them is of limited horizontal extent. Due to friction of the filling material upon the sides of the bins, part of the load is carried by the walls. In grain bins of elevators, where the height is great compared with the width, this side friction is such that the walls carry the greater part of the weight of the contents. In coal bins the ratio of wall-height to width is small and side friction is also small. Dull uses angles of friction between coal and bin sides of steel plates of 18 deg. for bituminous and 16 deg. for anthracite coal in determining the pressures previously quoted. If side friction were neglected his values would be increased about 6 per cent. It is a slight error on the side of safety to omit consideration of wall friction in the design of coal bins.

TABLE III—LIQUID PRESSURES FOR VARIOUS UNIT WEIGHTS

Depth in Feet	Total Pressure on Vertical Wall 1 ft. Long: 15 lb. Per Cu.Ft.	20 lb. Per Cu.Ft.	25 lb. Per Cu.Ft.	Water 25 lb. Per Cu.Ft.	Pressure on Lowest ft. of Water, Lb.
2	30	40	50	125	125
4	120	160	200	500	250
6	270	360	450	1,125	375
8	480	640	800	2,000	500
10	750	1,000	1,250	3,125	625
12	1,080	1,440	1,800	4,500	750
14	1,470	1,960	2,450	6,125	875
16	1,920	2,560	3,200	8,000	1,000
18	2,430	3,240	4,050	10,125	1,125
20	3,000	4,000	5,000	12,500	1,250
22	3,630	4,840	6,050	15,125	1,375
24	4,320	5,760	7,200	18,000	1,500
26	5,070	6,760	8,450	21,125	1,625
28	5,880	7,840	9,800	24,500	1,750
30	6,750	9,000	11,250	28,125	1,875

For hoppershaped bottoms the problem of design is more complicated than for vertical walls. The graphical method given by Ketchum for determining pressures and stresses is not difficult to follow. Cain gives four methods for determining the resultant pressure on the inclined bottom of a specified bin. With bin surcharged it varies from 11,400 to 12,400 lb. per lin. ft.; with coal level on top the variation is from 8,100 to 10,100 lb. The vertical forces, however, are so much greater than the forces due to the tendency of the coal to slide that they are the dominating factor. For a number of bottoms inclined 45 deg. and less to the horizontal the writer found that multiplying the weight of the coal by the secant of the angle of inclination and designing the bottoms for this increased amount considered as vertical load gave a close approximation to more theoretical methods. This is equivalent to taking the weight of the coal as acting normal to the inclined bottom.

Bending Moments—The maximum moment for a simple beam of length l and load W distributed so as to vary uniformly from zero at one end to Wl at the other end is $M = 0.128\,Wl$. For the same load W distributed uniformly over the beam $M = \frac{Wl}{8} = 0.125\,Wl$.

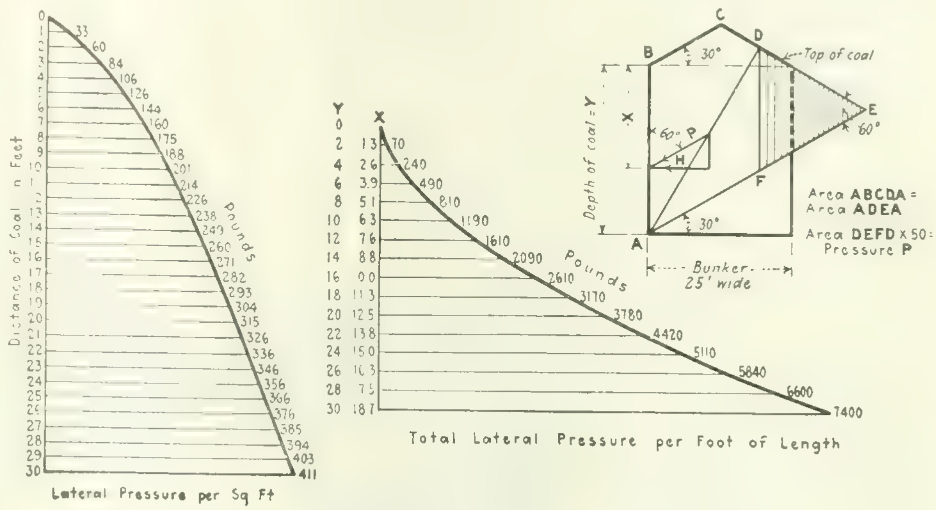


FIG. 3. PRESSURE DIAGRAMS FOR NARROW BINS
Horizontal pressure per square foot and total pressure per longitudinal foot of bin, for coal of 50 lb. per cubic foot and angle of repose 30 deg.

That is, the triangular loading on vertical beams due to liquid pressure can be assumed to be uniformly distributed with an error of but 3 per cent. If the assumptions of Fig. 3 are made the error is even less.

Grashof's formulas for determining the thickness of flat plates fixed or supported at their edges are given in textbooks. Plates act as catenaries as well as beams and the contents of a bin may act in some degree as arches between beams. In sharp competition, advantage is sometimes taken of these catenary and arch actions in an arbitrary manner, and plate thicknesses are used which, when figured by beam formula, give stresses far beyond allowable limits. Especially is this true of bins filled with heavy material. A recent experience of the writer is to the point. For a proposed ore bin the best that he could do was to estimate the bottom plates $\frac{5}{16}$ in. thick, but the contract was awarded (and presumably the bin was built) on a design with plates $\frac{3}{8}$ in. thick.

In designing flat plates for ordinary coal bins the writer uses the following rules: For square plates riveted or bolted on all four edges the plate is considered a beam with fixed ends (plate held on two sides) loaded with one-half the load. For rectangular panels with the longer axis $1\frac{1}{2}$ times the shorter one the plate is considered a beam spanning in the shorter direction carrying three-fourths the load of the plate, while if the longer axis is two or more times the shorter one the sides are considered to carry the whole load. The distance between supporting beams is considered the shorter axis. Plates often extend over two or more beams but as they are invariably bolted or riveted to each beam they are considered as beams with fixed ends of a length equal to the shorter axis.

A working stress of 20,000 lb. per square inch is used for plates figured as beams.

Lining—Owing to the injurious action of the sulphur and moisture in coal on steel plates it is well to have bins lined. This is usually done with concrete held in various ways. In the 5,000-ton W-shaped bunkers of the Ninety-Sixth St. power station, New York City, there is no exposed steel whatever. Suspension bunkers are often lined with tar or asphalt enamels or mastics.

Where bins are not lined (and there are many such) the calculated plate thickness should be increased. "I always add $\frac{1}{16}$ in. for abrasion and $\frac{1}{16}$ in. for corrosion," said one engineer. This is not a bad rule to follow. However, bins for bituminous coal may have the abrasion allowance omitted without harm, while on the other hand in coke bins abrasion is specially important.

Details Important—In conclusion, attention is called to the importance of proper detailing in bin work. Bins of the hopper type, with sufficient material, do not always measure up to their supposed strength because of reprehensible details. In one case certain horizontal reactions were neglected and the tension in rivets designed to take shear from vertical loads was all that kept the structure from pulling apart. "Do give us a good detail for attaching a discharge gate to the meeting point of the four inclined plates of a suspended hopper bottom," said an engineer recently. Connections should be detailed in accordance with the stresses they must resist and the proper proportioning of some connections requires engineering ability of as high an order as the proportioning of main members. By no means should a bin or bunker be weakened by poor details.

Drainage of Irrigated Lands

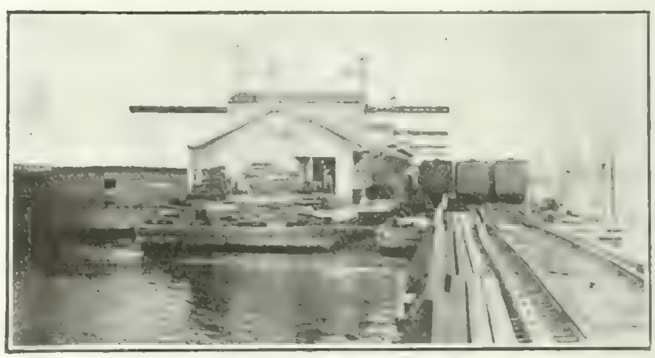
Construction of drainage works for irrigated lands represents about 12 per cent of the expenditures from the Reclamation Fund during the past few years, according to figures given by J. L. Burkholder, drainage engineer, in the July number of the *Reclamation Record*, issued by the U. S. Reclamation Service. This work represents an annual expenditure of about $1,000,000 and has aggregated $8,000,000. It includes 889 miles of drainage ditches, 183 miles of pipe drains, several pumping stations, and also the investigations for present and future installations. The work completed is estimated to have reclaimed and protected from seepage about 370,000 acres of irrigable land, and there remain about 125,000 acres which are damaged to some extent by seepage. These drainage works are located on seventeen projects in thirteen states. In addition to the work of the Service, several projects have constructed drainage systems without assistance from the Reclamation Service. Government forces are employed on most of the Service work owing partly to the necessity of making frequent changes as the work progresses and partly to the difficulty of securing contractors who are equipped for economical construction. Ditches are dug mainly by 30- to 90-ton dragline excavators and pipe trenches by trenching machines of the ladder type. During 1921 these machines excavated at a unit field cost of 10.3c. per yard; 6.7c. being for operation and 3.6c. for plant and depreciation cost.

War-Time Concrete Barges Now Used for River Terminal

Large Car-Floats Designed and Used in New York Harbor Transfer in Various Services on Mississippi

During the war the government built twelve large reinforced-concrete barges 226 ft. long by 36 ft. wide for car-float service in New York harbor. They were of great service to the military authorities in transferring cars between the railway terminals of New York. After the war one of the barges was sunk while tied up in the Navy Yard at New York, but in the spring of 1920 the eleven others were transferred to the Mississippi-Warrior Federal Barge Line, which operates a fleet of towboats and barges on the Mississippi River between Cairo, St. Louis and New Orleans, and in the Warrior River to Birmingport, Ala. The barges were towed down from New York around Key West to New Orleans by U. S. Shipping Board vessels. Some encountered severe storms but all weathered them successfully. It required 34 days on account of bad weather for one barge to make the trip while ten days is a normal voyage.

CONCRETE CAR-FLOATS ALONGSIDE CONCRETE BARGES MAKE CAIRO RIVER TERMINAL



CARS ON CAR-FLOAT BEING LOADED TO BARGES

At New Orleans the Federal Barge Line built warehouses 200 ft. long by 56 ft. wide, on two of the barges. These with two car-float barges were towed up the Mississippi to Cairo, Ill., where they were fixed by the barge line for terminal purposes. The car-floats were connected together by steel trusses and coupled to the shore by an inclined cradle over which freight cars are carried to and from the floats. The two warehouse barges were placed alongside and secured to the car-floats, as shown in accompanying photographs, furnished by W. H. Tippitt, of Cairo.

Each warehouse is cut by two transverse housings containing cantilever cranes which reach out over the car-float on one side and the river barge on the other.

Accidents to any of the barges do not seriously interfere with the operation of the terminal. Last December a large hole was broken in the track barge connected to the cradle, but this did not stop work or make it necessary to pull the cars from the barge. A bulkhead was built around the hole, the necessary reinforcement was inserted and the hole was filled with concrete. After this was sufficiently hardened the compartment was pumped out and the barge was as good as before.

Use of Sulphuric Acid with Alum in Water Purification

By John R. Baylis
Principal Sanitary Chemist, Water Department, Baltimore, Md.

The possibility of using acid alum instead of the basic for water purification has been suggested by several authors. Except for recent trials at Baltimore very little has been done towards trying it out. The desirability of keeping the acidity of the water as low as possible, after the application of a coagulant, was thought to be best accomplished by using a basic alum. So universal has become the custom of specifying basic alum, that it is doubtful if any other kind is now manufactured for water purification purposes.

It is shown from data available from many sources, that the optimum pH value for nearly complete precipitation of the alumina in alum, as aluminum hydrate, takes place in a fairly narrow range of pH values. This point has not been definitely established, and the indications are that it varies for different waters. The optimum point for the water now supplied Baltimore seems to be between 5.5 and 6.

Experiments occasionally conducted during the past few years, have, in every instance when the turbidity was low, shown that the addition of a small amount of acid to the water, before, or at the same time as, the alum, has materially aided coagulation. As we thought it best not to increase the acidity of the water, little notice was given the fact until recently. This was due to a change in the character of water treated, caused by an increase in the supply for the City of Baltimore.

This change made necessary the use of considerably more alum than formerly for low turbidities. Experiments were immediately started with a view of finding a more efficient means of properly coagulating the water. Carbonic acid was tried with very encouraging results, in so far as helping form a good coagulation. It has not as yet been possible to try it out on a large scale; that is, to carbonate all the water for a period of a few hours.

Sulphuric acid was next tried with very gratifying results. A number of carefully conducted laboratory experiments indicated such a saving in alum that a few tons of acid were purchased and tried. Several trials have now been made under operating conditions, with results that show a material saving in alum.

The method of conducting these tests has been to mix a certain amount of acid with the alum solution. Amounts varying from 30 to 80 per cent of the amount of alum have been tried, with results indicating that the stronger acid mixtures are more efficient than the weaker.

The test of longest duration was 32 hours, in which time 150.6 m.g. of water were treated. The amount of alum necessary for coagulation without acid would have been at least 15 tons (this being slightly less than what was actually being used at the beginning of the test), costing $450. The amount of chemicals actually used was 7.211 tons of alum costing $216.33, and 10,000 lb. of 66-deg. Bé. sulphuric acid costing $90. To this should be added about $20 for the increased amount of lime necessary for neutralizing the increase in carbonic acid. This made a total cost of $326 compared with $450 if acid had not been used. The average amount of water now treated at the Montebello Filters is approximately 100 m.g.d., so this was a daily saving of about $82. Acid can be purchased under contract cheaper than $18 per ton. Quotations indicate the cost can be reduced about 25 per cent.

The test outlined was made under actual operating conditions, in which the amount of acid added to the alum solution was changed three times in order to test the efficiency of various mixtures. The water at all times indicated an excess of coagulant, filtered perfectly clear, and showed a minimum of residual alumina present in the filtered water.

No attempt to give any of the experimental data obtained in the laboratory will now be made. These experiments enabled us to estimate very closely what to expect under actual operating conditions, and will, when made public, show how closely operating condition can be duplicated in the laboratory.

This announcement is made with the hope of encouraging others to make similar tests. It is not likely that the treatment described will be applicable to all waters but there are many places where its use would effect great economy. Many places that do not care to use acid can with profit specify acid alum, instead of basic, as is now the universal custom. It is believed there are very few conditions where basic alum is best for water purification, except possibly for acid waters.

Propose Engineering Certification of Safety of Buildings

Laws and regulations under which the safety of new buildings would be certified by competent structural engineers are demanded in a resolution of the structural subsection of the New York Section, American Society of Civil Engineers. The resolution, reported by J. B. French is as follows:

Whereas, the recent widespread attention directed to the disastrous theater failures in Washington and Brooklyn makes this an opportune time to emphasize the importance of competent structural engineering in the construction of such buildings; and

Whereas, the responsibility of the structural engineer can only be effective if accompanied by commensurate authority covering both the design and construction of all parts of the building on which safety and stability are dependent; therefore

Be It Resolved, that the New York Section of the American Society of Civil Engineers would be doing a public service and furthering the express objects for which it was organized by exerting its influence for such reforms in building laws and engineering practice as would make it impossible for any building in this metropolitan district where public safety is involved to open its doors to public use until its safety and stability have been certified by a competent structural engineer.

Bolivian State Railway Being Built by Americans

Mountain Line to Connect with Argentine Railways for Atlantic Outlet—American Money, Engineers and Contractors

A 124-MILE railway now under construction in Bolivia is of special interest and importance in that it is being financed and built by an American firm with American engineers and that it will form a connection with the railway system of the Argentine Republic so as to open communication with Atlantic ports. Heavy mountain work is involved. A plan and profile of the line are given in Fig. 1, together with a map showing its relation to the railway system.

An earlier step in American development of railways in Bolivia was made in 1906 when the Bolivian Government arranged with Speyer & Co. and the National City Bank of New York for a bond issue to finance a railway system. At that time there were only two railways: (1) From La Paz, the capital, to Guaqui on Lake Titicaca (El. 12,600) with steamer connection to Puno, Peru, and thus with the Southern Ry. of Peru (standard gage) to the port of Mollendo; (2) the 30-in. line from Oruro to Uyuni, connecting with the Antofagasta & Bolivia Ry. to the Chilean port of Antofagasta. Numerous surveys were made and a line was built from Viacha, near La Paz, to Oruro. But in 1908 the American bankers sold their concessions to the British company which owns the Antofagasta line.

In the general topography of Bolivia a central plateau at an elevation of 12,000 to 13,000 ft. lies between the central and coast ranges of the Andes and extends south into Argentina. Much of this plateau is desert. Lowlands in the eastern section may be developed for agriculture and cattle-raising. But to reach this district from the west coast requires the crossing of the coast range at about 14,000 ft. and the central range at about 16,000 ft., so that the commercial outlet for the lowlands probably will be eastward through the valleys of the Amazon and Parana rivers. Communication with the capital must be provided also, but in view of motor vehicle developments it is thought that a study of this little known region may suggest a highway rather than a railway.

Bolivian Railway System—Three main divisions of the present railway system are as follows (see Fig. 1): (1) The Bolivia Ry., running south from La Paz to Atocha, 390 miles, and now being extended to connect with the Argentine government railways; (2) three western lines connecting with foreign railways to the Pacific ports of Mollendo, Arica and Antofagasta; (3) three railways extending east from the Bolivia Ry.

These three eastern lines are the Yungas Ry., the Cochabamba Ry. and the Potosi-Sucre Ry. The first is intended to reach the headwaters of the Amazon and has 30 miles in operation with about ten miles partly graded, but work is practically suspended. From La Paz the line climbs to El. 15,300 at about Mile 15 with 200-ft. curves and compensated grades of 6 per cent operated by geared locomotives. The Cochabamba line reaches an elevation of 14,000 ft. at Mile 34 and descends the eastern slops with 3 per cent grades and 350-ft. curves. With a sidehill location along steep slopes it is subject to slides and washouts, since the river grade is about 3 per cent. The latest method of protection against washouts is to build heavy masonry blocks, as in Fig. 2, and allow them to settle as the river bed is scoured by floods. The Potosi-Sucre line has its summit elevation of 15,814 ft. at Mile 50. It has 3 per cent grades and 328-ft. curves, but being in firm ground its maintenance gives little trouble. The government is extending the line to Sucre, 150 miles from the Bolivia Ry., and has it in operation for 105 miles to Betanzos with grading partly completed for 20 miles further. This extension, involving heavy work, is under the direction of an American engineer, W. L. Milner, as general manager and chief engineer.

All the Bolivian railways are of meter gage and have maximum grades of 3 per cent, except for 6 per cent on

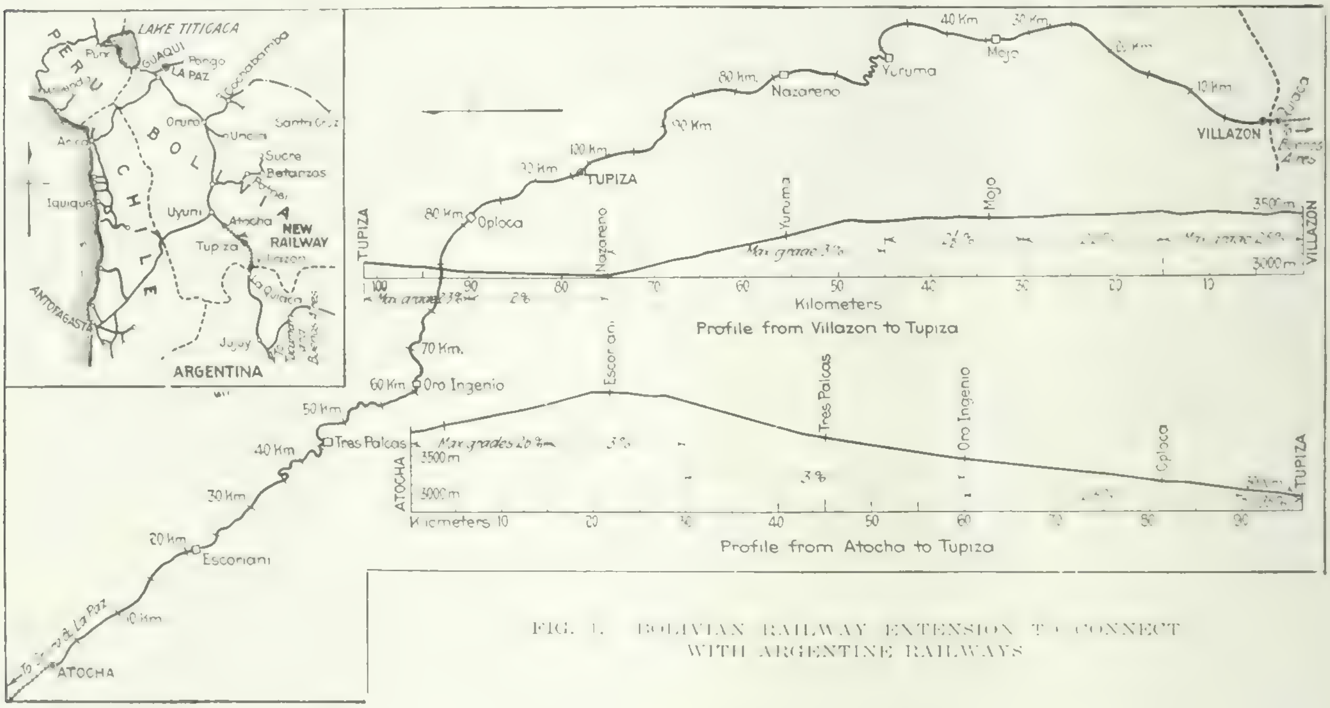


FIG. 1. BOLIVIAN RAILWAY EXTENSION TO CONNECT WITH ARGENTINE RAILWAYS

the Yungas Ry. Curves are generally not less than 328-ft. radius, although 270-ft. curves are sometimes used. Rails are usually 60- to 65-lb. per yard, with 2,420 ties per mile. Steel 110-lb. trough ties are used extensively and there are also California redwood, Douglas fir and Chilean oak. Rolling stock is generally of the American type, but sleeping cars are on the compartment system. Railways which follow the valleys are subject to slides if they cut deeply into the steep slopes and to washouts if they keep near the river bank. Side drainage into the valleys is also a source of trouble, as the whole bed of a ravine, when wet, may move bodily like a glacier and carry away bridges and their foundations. Extensive surface drainage works are necessary to control these conditions.

Atocha-Villazon Railway—The Atocha-Villazon line is the extension of the Bolivia Ry. now being built to connect with the Argentine government railways at La Quiaca. The Bolivia Ry. opened the line from Uyuni to Atocha, 56 miles, in 1913. In the same year a contract was given to a French company to extend the line to Tupiza, but after the grading and masonry had been completed for 30 miles the World War caused the cancellation of the contract. In 1920 a construction cotract was made with Lavenas Poli & Co., Buenos Aires.

In July, 1921, the Ulen Contracting Corp., New York and Chicago, undertook to finance and build the entire line from Atocha to La Quiaca, 124 miles. The original contract provided that the company should take a government bond issue of $7,000,000 and complete the line in five years, carrying out the work at cost and receiving a fixed fee for its services. Later the company agreed to take a $10,000,000 bond issue and to complete the line by July, 1925. Plans based on the preliminary surveys have been approved by the government and final location will be completed early in 1923.

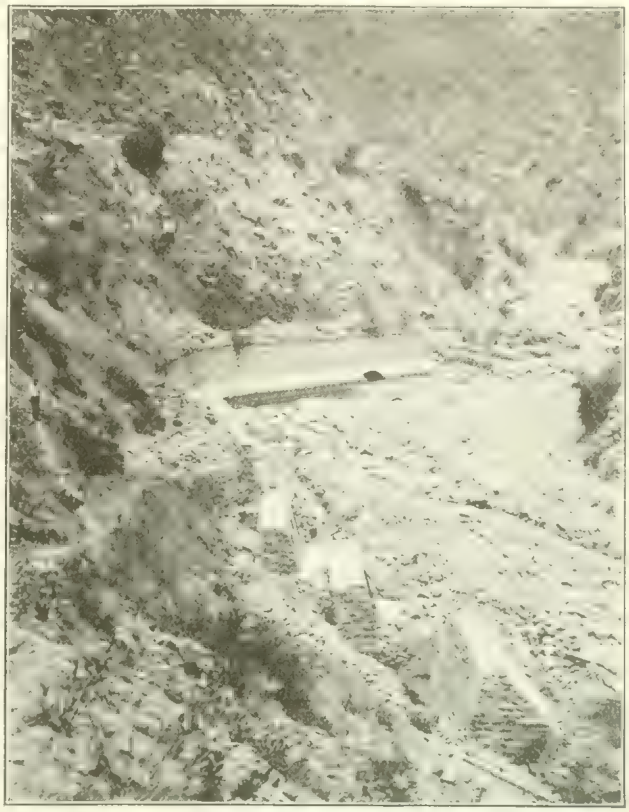


FIG. 2. WALL AND BLOCKS TO PROTECT FILL FROM MOUNTAIN TORRENTS

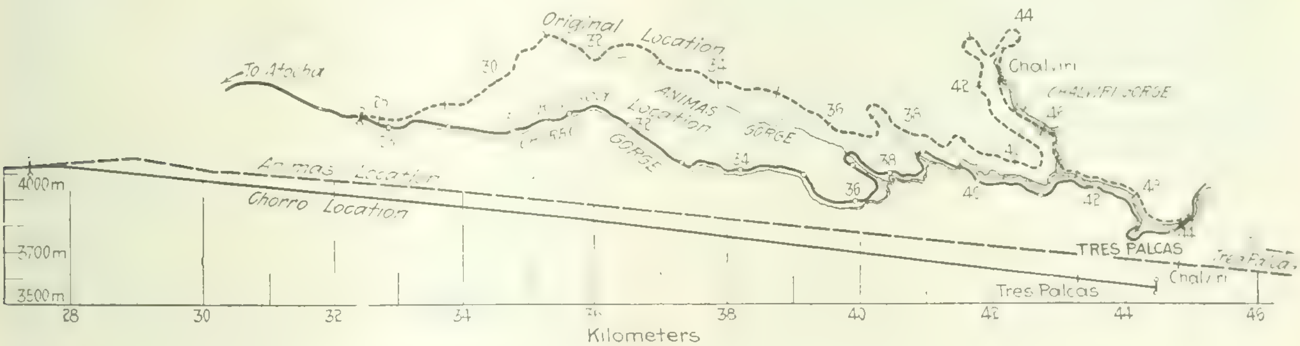


FIG. 3. ALTERNATIVE LOCATIONS IN ROUGH COUNTRY

Leaving Atocha, El. 9,840, the line reaches its summit elevation of 13,307 ft. at about Mile 13 (K.20). Four miles further (K.28) the descent begins on a supported line with 3 per cent grades to Mile 28 (K.46) and down the river to Nazareno, (K.125) El. 9,184 ft. Another supported line with 3 per cent grades then ascends to El. 7,872 at about Mile 93 (K.150) and this general elevation is maintained to La Quiaca (K.200). The Argentine firm is continuing its contract on the La Quiaca-Tupiza section under the direction of the Ulen company and is expected to have track laid by December, 1923. From Atocha the Ulen company is working with its own forces.

Engineering Features—Two principal features of location requiring special study were the 3 per cent line from Mile 17 (K.28 to 45) and the valley line beyond Mile 28 (K.45). Previous surveys for this latter section had followed generally the route along the Animas Quebrada shown by the dotted line in Fig. 3, but careful study indicated the possibility of a shorter line following the Chorro Quebrada. After some difficult field work a practicable line was obtained saving about three miles in distance, 830 deg. of curvature and 96 ft. in summit elevation.

A typical view on the line above Mile 28 (K.45) is shown in Fig. 2. As the subgrade is 130 to 165 ft. above the bed of the stream dry masonry walls at the edge of the roadbed will be used in many places to limit the slopes of fills and thus reduce the excavation. On the valley section, Fig. 4, the steep slopes extend to the river bank. For eight months this stream is dry and its bed serves as a highway, but for the rest of the year it is subject to heavy floods which are apt to be destructive owing to the steep fall of the river. Heavy sidehill cuts are undesirable, since the broken shale formation makes slides probable. In other places the ground is too unstable to permit of benching the

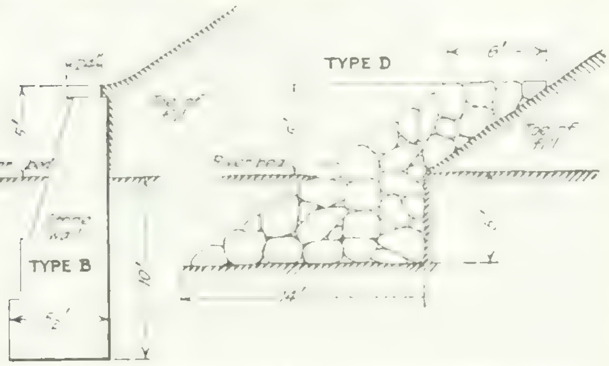


FIG. 4. PROTECTION OF FILL ALONG RIVER BANK

line except at excessive cost and maintenance.

These conditions necessitated a location which in many cases would extend the slopes into the river channel and therefore required the use of protection walls as shown in Fig. 4. The heaviest section, B, is for use where the current strikes directly against the wall. Gravel, sand and boulders, with some silt form the river bed. Floods change the channel continually and show

FIG. 5. VALLEY ROUTE FOR HEAVY SIDEHILL LOCATION

differences in elevation of 3 to 5 ft. in a few hours, so that fairly deep foundations are required. Careful work is required in location in order to minimize protective masonry without involving excessive excavation.

The Ulen Contracting Co. has established headquarters at La Paz, with F. T. Hoit as general manager and Major H. R. Gabriel as chief engineer. Most of the location has been in charge of T. M. Whedbee. The general design of the railway, the preliminary plans, contracts with the government and other features have been developed under the direction of F. Lavis, consulting engineer, New York. This article is prepared from data given by Mr. Lavis and the Ulen company.

Sand Cement Analysis

On page 265 of the August 17 issue, *Engineering News-Record*, the analysis of sand cement secured at the Camarasa Project, where the highest dam in Europe is under construction gave the second item $Al0_3$ as 54.30, instead of 5.80. The corrected table follows:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
CaO	33.20
[illegible]	[illegible]
SO_3	1.38
[illegible]	[illegible]
	100%

Brickwork From Building Stronger Than Laboratory Samples

By Rudolph P. Miller
Consulting Engineer, New York City

There is a widespread feeling that laboratory tests on brick masonry have been made on specimens laid up with special care to secure the best results possible or at least with the consciousness that they were to be tested, and that the specimens consequently were better than the brickwork found in ordinary practice. Tests on masonry as actually constructed have not been made or if so have not been reported.

That brickwork having a compressive strength equal to that developed in laboratory tests can be built, and actually is in use, is shown by the results of some tests made by the writer in 1919 in the 400,000-lb. Olsen testing machine at Columbia University.

The specimens used in the tests were taken from the four-story wing of the former home of the Racquet and Tennis Club in West 43rd St., New York City, while that structure was being demolished to make room for a new business building. They came from an interior 8-in. partition wall at a point where it had been enlarged to form a pilaster having a width and thickness of 20 in. For the purpose of the tests the brickwork was cut into four sections, each about 2 ft. in height, and trimmed down to approximately 12 x 16 in. in cross-section, to suit the capacity of the testing machine. Two sides of the specimens were the original finished faces of the pilaster.

There was nothing unusual about the character of this brickwork. It was laid in ordinary English bond, every sixth course a header as called for by the New York building code. The workmanship was good, but apparently no especial care had been taken to produce superior work. The joints were not thoroughly slushed up, and though they were fairly well filled there were voids here and there in which an ordinary lead pencil could be inserted, such as are not uncommon in ordinary good acceptable brickwork. The brick, from the Hudson River district, were sound and well-burnt. According to specifications, corroborated by the superintendent in charge of the work at the time of its original construction in 1903, a 1:3 portland cement mortar was used.

During its life of about 16 years the masonry had carried a comparatively light load, such as would come from a floor used as offices and reception rooms. The load probably never exceeded 100 lb. per sq.in. on the masonry, and perhaps was ordinarily not more than one-fourth of that amount.

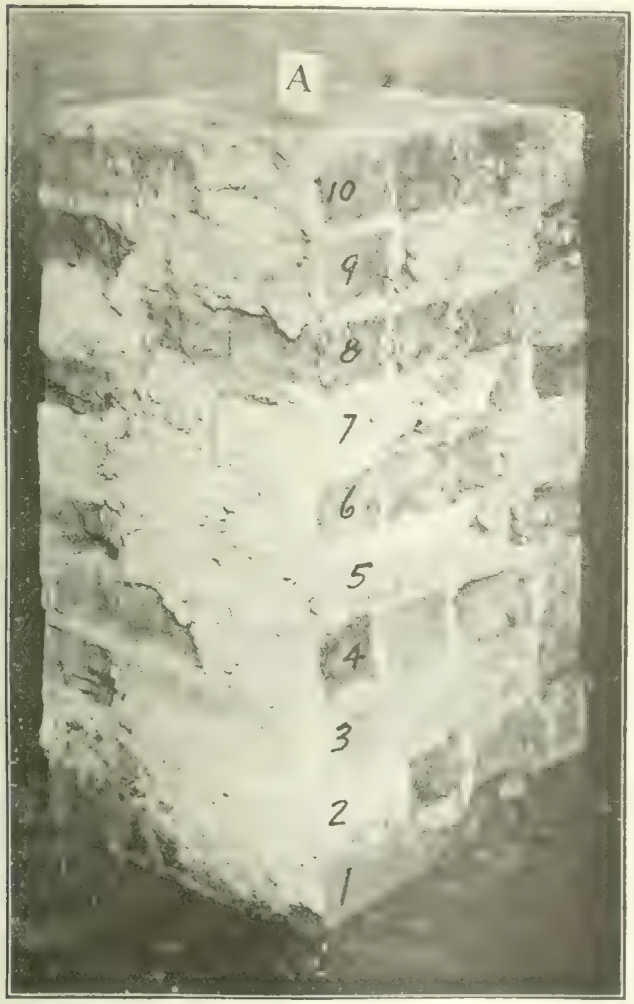
The results obtained in the tests, expressed in pounds per square inch, were:

Specimen	1	A	B	C
Ultimate crushing load	1,389	877	2,093	1,862
Appearance of first crack	516	640	1,588	1,275

The average strength of the four specimens is 1,555 lb. per sq.in. The low value for specimen *A* was due, it is believed, to uneven bearing on the pressure plate of the testing machine, which was not noticed until the initial load had been applied. For comparison, however, it has been retained in figuring the average.

In the table following, the results above are compared with the results of tests made on laboratory specimens. Only such tests are used, however, in which the materials and construction are substantially like

those found in our specimens. Of the Watertown Arsenal series (made at various times since 1884) only those tests are considered in which common brick laid up in 1:3 portland cement mortar was used. Similarly, from the Bureau of Standards series (Pittsburgh, 1917) those cases were selected in which the brickwork was made of Grade 2 brick (common brick) laid in 1:3 portland cement mortar. A series of tests made by Prof. James S. Macgregor at Columbia University



PIER SECTION "A," BEFORE TEST

to determine the proportion of cement in mortar that might be replaced by lime without reducing the strength of the brickwork is also included to the extent to which no diminution of strength was found for common brick. Comparison was also deemed proper with some tests at the Technical High School in Stockholm, Sweden (reported in *The Clay Worker* for July and August, 1917), as the crushing strength of the brick used, 4,040 lb. per sq.in., indicated a brick of about the same quality as used in New York. Of the University of Illinois series (Bulletin No. 27, September, 1908), only two tests appear to be comparable, as shale brick having a crushing strength of over 10,000 lb. per sq.in. were generally used; in the two tests cited, clay bricks having a strength of about 3,900 lb. per sq.in. were used.

The table shows that the average strength of the actual brickwork is about 4 per cent greater than the average strength of the laboratory specimens. And it should be remembered that our specimens had been

TESTS OF ACTUAL BRICKWORK COMPARED WITH LABORATORY TESTS

Series	No. of Specimens	Average Strength Lb. per Sq.In.	—Variation from Average— Highest, Lb. Per Sq.In.	Highest, Per Cent	Lowest Lb. Per Sq.In.	Lowest Per Cent
Actual Brickwork	4	1,555	2,093	134.6	877	56.4
Watertown...	8	1,705	3,422	200.7	900	52.8
Bureau of Standards	16	1,391	2,070	148.8	700	50.3
University of Illinois	2	1,060	1,090	102.8	1,030	97.2
Macgregor	5	1,337	1,685	126.0	1,170	87.5
Stockholm	4	1,862	1,980	106.3	1,700	91.3
Average of laboratory tests... (35 specimens)		1,490				

subjected for many years to actual load, had been subjected to more or less shock in the process of demolition of the building, and had been further punished by transportation to the laboratory and trimming for the testing machine.

Cement Joints for Water Mains

AS A RESULT of experience at Los Angeles with cement joints for water mains, as reported in *Engineering News*, Nov. 25 and Dec. 30, 1915, D. D. Clarke, then engineer of the Water Bureau of Portland, Ore., recommended the trial of cement joints on 1,000 ft. of 8-in. pipe at Portland. This was so successful, says Mr. Clarke in a letter published in the June *Journal* of the New England Water Works Association, that since then, according to F. W. Randlett, successor to Mr. Clarke, cement joints have been used almost exclusively, except where the main must be put in use within 48 hours of the time of calking the cement. Aside from his introductory statements, summarized above, Mr. Clarke's account of the practice and results at Portland is as follows:

The method of preparing the cement and filling the joint adopted here is practically the same as that used in Los Angeles: First quality medium setting cement is used, mixed so dry that the impress of the hand will be left upon a small ball which will crumble when let fall from the height of 12 in. The pipe should be laid upon a firm foundation; the spacing of the spigot in the bell may be effected by placing a small bit of lead under it. A small bit of yarn should be used, just sufficient to keep the cement from entering the pipe. After filling the bell with cement it is thoroughly compacted with a yarning iron, by hand. This will have to be repeated two or three times before the face of the joint can be properly smoothed and rounded.

To the present time there have been laid in this city approximately 27.8 miles of 4- to 16-in. pipe with cement joints besides which about 4,000 ft. of 24- and 30-in. pipe has been relaid with cement joints during the progress of "grade crossing" elimination work.

When the first line of 8-in. pipe was laid in 1916, minute leaks occurred which were entirely taken up in a few weeks time. In relaying the 30-in. pipe mentioned above it was placed in a concrete-lined tunnel which afforded an opportunity of observing the leakage. When the pressure was turned on the 500 or more feet of 30-in. pipe in the tunnel section, the leakage was very considerable. After draining the water from the tunnel two or three times the leakage was noticed to be decreasing and at the end of six months had stopped entirely and all the joints have since remained tight.

At a later date it became necessary to raise 100 ft. of 16-in. pipe which had been laid with cement joints. This pipe was raised approximately 4 ft. under full working pressure of about 70 lb. without any leaks resulting.

Prior to the general use of cement as a jointing material, as indicated above, the department instituted a series of tests to determine the degree of flexibility in the joints of cast-iron pipe when laid with joints of neat cement, leadite or pig lead.

Engineers in Many Fields Discuss Licensing

Extracts from Letters Commenting on the Editorial Discussion of the Subject Published in Engineering News-Record of July 6

Since the publication in the issue of July 6, of an editorial discussion on "A Rational Approach to the Licensing Problem," Engineering News-Record *has invited comment as to the viewpoint therein presented from a number of representative engineers. Some of these were known to favor the licensing principle, some disapproved and others either were neutral or had never expressed any opinions. The replies that have been received indicate a widespread approval of the principles advanced in our discussion, but few of the writers can find valid reasons for the licensing laws that have been enacted and are now contemplated. The following extracts are from some of these replies. Others will appear in an early issue.*—EDITOR.

George E. Stevenson
Civil and Mining Engineer, Scranton, Pa.

Having just read your editorial discussion on the engineers' licensing problem, in the issue of July 6, I take the liberty of congratulating you upon its excellence, and of expressing my own views, especially on the act passed by the legislature in Pennsylvania.

Your queries, "Are the present laws for the protection of the public against such [engineering] failures inadequate? Has state supervision over plans and operations been carried to its maximum usefulness? Does the public safety demand that the state go back of the work itself and certify to the competence of all those who may be called on to plan and execute such works? Will the net results of such a procedure measured in increased public safety justify the labor and expense involved in its administration?"; followed by your statement that "licensing must be justified wholly on the ground of the public welfare and not at all on that of professional advantage," embody all the items that either justify or condemn the principle of licensing professional engineers and land surveyors.

Our present act, "To Regulate the Practice of the Profession of Engineering and of Land Surveying," alleges in Section 1, "that in order to safeguard life, health and property,—etc." In this respect, the act differs from other acts requiring the registration and licensing of those practicing other professions, as for example, medicine. The act of June 3, 1911, is preceded by a preamble, which reads as follows: "Whereas, the safety of the citizens of this Commonwealth is endangered by incompetent physicians and surgeons and due regard to the public health and the preservation of human life demands that none but competent and properly qualified physicians and surgeons shall be permitted to practice their profession. Therefore, etc." The act regarding the practice of optometry of June 30, 1917, contains a preamble as follows: "Whereas, the eyesight of the citizens of this Commonwealth is endangered by incompetent persons practicing optometry, and due regard for the protection and safety of the citizens demands that only authorized and qualified optometrists shall be permitted to practice." The dental act of June 9, 1897, contains a preamble as follows: "Whereas the health and comfort of the public and in many instances the lives of individuals, are contingent upon the intelligent and competent dental service, etc." The act regarding the practice of pharmacy of May 24, 1887, reads as follows: "Whereas, the safety of the public is endangered, etc."

Evidently, the promoters of the engineers' licensing act were not brave enough to make any such false assertion, regarding the practice of land surveying, which is defined in the act "as the determination of area, or the establishment of land boundaries, and the sub-division and plotting of land," or a similar statement with regard to the practice of the professional engineer, who is defined as "one who initiates, investigates, plans and directs the control of the forces of, and the utilization of the materials of nature and human activities in connection therewith for the benefit of man, etc."

In the State of Pennsylvania we now have in force laws which are ample to protect the public and to safeguard the life, health and property of the citizens of the commonwealth, which I believe cover all of the activities of the professional land surveyor and professional engineer that in any way affect the public safety. Pennsylvania Water Supply Commission, Public Service Commission, the State Board of Health, the Bureau of Labor and Industry, the Board of Education, and the State Highway Department, all have power to pass upon the correctness of structural plans covering water supplies, bridges, canals, highways, sewers, factory buildings, buildings arranged for public assemblies, theaters, schools, elevators, steam boilers, etc., and these laws regarding engineering and architectural structures are constantly being remodeled to cover the increased necessities for public protection. Electric power and light companies' construction is supervised, and the crossing of public highways, railroads, etc., by high-tension lines must meet specifications issued by the Public Service Commission and the plans approved by Highway Department or the railroad officials.

Pennsylvania mine laws have been used as a pattern in almost every state where coal is mined, and together with the system of inspection adopted in Pennsylvania, have proved adequate in the main to protect the public and the employees. Whenever experience has dictated more stringent laws they have been immediately passed by the legislature, and plans for structures and the opening of mines must comply with these acts and are subject to the inspection and supervision of the Bureau of Mines.

Why burden the professional engineer and land surveyor, who is engaged in an independent practice, with a registration and license act, under the false claims of protecting the safety and lives of the citizens of the commonwealth, while the engineers employed by the companies engaged in interstate commerce, who plan, build and care for the maintenance of the railroads and bridges, are exempted, and while the selection of the railroad engineers, conductors and signalmen, who operate fast trains over these same railroads and bridges, is left entirely to the judgment of the railroad executives?

Why have the land surveyor registered when we have no standard of qualifications for the motormen and conductors on our street cars, upon whose qualifications and skill the safety and lives of our citizens depend?

Why have the men practicing mechanical engineering registered and licensed on proving their qualifications, when we issue a license to any youth of 16 or over to operate an automobile on a public highway without the slightest attempt to show that the applicants are qualified, or even have any knowledge of the common rules of the road? His acts in operating a motor car are a greater menace to the lives and safety of the citizens of the commonwealth than any blunders of the civil, electrical, mechanical, chemical or mining engineer in independent practice.

I have before me a prospectus of the American Association of Engineers, mailed with the blank application for

membership in the association, from which I quote as follows: "Legislation Concerning Engineers—The Association is primarily responsible for the enactment of laws licensing engineers, thereby protecting competent engineers from the unjust competition of dabblers and quacks, and protecting the public by requiring men who wish to practice as engineers to qualify before a legally constituted board. So far there are 20 states with license laws. Fifteen proposed but did not pass such legislation last year, and in only 13 has any legislation not been initiated. This work must be completed to make the work already accomplished more effective."

I notice in the article by Prof. Harry Tucker, of North Carolina State College of Agriculture and Engineering, advocating the licensing act, that he claims that the most important needs for registration of engineers are, in the following order: 1, for the protection of the qualified engineer; 2, for the protection of the name "engineer"; 3, that the standards of the profession may be raised; (and, apparently in his estimation, last and least) 4, for the protection of the public.

It seems quite evident, as alleged recently in *Mining and Metallurgy*, published by the American Institute of Mining and Metallurgical Engineers, that the professional engineers and land surveyors of the United States have been asleep and have permitted a small minority to put across these iniquitous licensing acts, which even on the showing of their advocates hold the protection of the public as a consideration secondary to the interests of the professional engineer who fears competition and desires to exclude it. The real engineer welcomes competition always, especially from the quacks and dabblers, for such competition invariably enables him to extend his field and increase his fee.

It may interest you to know that some of us in Pennsylvania are awake to the situation and are contesting the constitutionality of the act, which among other things, provides "that no man shall practice land surveying or professional engineering as an independent practitioner until he is 25 years of age." How in the world they can ever justify the licensing of land surveyors on the theory that it is for the protection of the lives and safety of the people of the commonwealth is inconceivable. A test case following the arrest of a practicing land surveyor is now under way in Pennsylvania. If this is unsuccessful, we propose to go to the next legislature and work hard for the repeal of the present act and if possible to prevent the passage of a future act. To that end we solicit the assistance of all those who are interested against this selfish licensing scheme.

* * *

T. J. Wasser

President, State Board of Professional Engineers and Land Surveyors, Jersey City, N. J.

Your editorial on "A Rational Approach to the Licensing Problem" in the issue of July 6, 1922, was discussed at a meeting of the State Board of Professional Engineers and Land Surveyors, and it was found that each and every member of the board had previously read it. We feel gratified to know that the conclusions reached by you coincided exactly with those reached by our board and previously adopted.

Particular attention is called to your second principle. The board is unanimous in the opinion that the license must actually define the kind of engineering work followed by the licensee. This is not very clear in the law, but legal opinion justifies the board in reaching its conclusions. This is fully covered by Rule No. 8, which has been adopted by the board and which reads as follows:

Branch of Professional Engineering. In making application for license as a professional engineer, applicant must state clearly which division of professional engineering to which applicant belongs, as for instance, "Civil, Mechanical, Electrical, Mining or Chemical Engineer."

If applicant belongs to the division "Civil Engineering," state clearly the sub-division in which applicant is qualified, as for instance, "Railroad Engineer, Municipal Engineer, Sanitary Engineer, Highway Engineer," etc.

This rule is for the benefit of applicant who has specialized in one of many sub-divisions of civil engineering, and the Board reserves the right in issuing licenses as a civil engineer or for any of its sub-divisions, to use its discretion as provided for in the act.

The board feels justified in proceeding in this method and is pleased to know that its judgment was so ably seconded by your article.

* * *

F. M. Randlett

Engineer, Bureau of Water-Works, Portland, Ore.

Your editorial discussion, entitled "A Rational Approach to the Licensing Problem," seems to me to be a very fair one and I think you are to be congratulated on not having written to curry favor with the licensing enthusiasts. It is a pity that a slightly more dignified word could not have been used; one that would have tended to raise instead of lower the profession in the eyes of the general public. The lawyer is admitted to the bar and the doctor passes the state board examination, while the engineer takes out his license.

In Oregon the statute has been in force about three years and discussion for and against it has been going on with the enthusiasm shown more by those in favor of the law than by the opposition. The opponents seem to have rather quietly acquiesced, paid their fees and gone their way. The public, as such, has so far failed to express any opinion. Whether or not the public has been benefitted is hard to say, but it may be safely stated that it is probably apathetic as to whether the engineer is licensed or not.

The companies or corporations requiring engineering service are apparently able to protect themselves from the unqualified seeking to sell their services and evidently employ fairly good talent. Possibly some of the smaller towns and cities have been imposed upon, but usually due to the fact that they accept the proposal of the lowest fee and consequently get about what they pay for, with the usual results. When it comes to hiring an engineer for state or municipal purposes the fact that the candidates are licensed does not insure the employment of the proper man. The public, therefore, is not necessarily protected, and as a licensed engineer only may be appointed, the effect of the law is purely class legislation.

There is no distinct line whereby we may know when the engineer ceases to be an engineer and becomes an executive, except as indicated by the title of his position, which often is not indicative of his duties. A manager or superintendent may function as the engineer and the engineer may be executive only. In such instances who shall be licensed to protect the public?

I quite agree with your summary and closing paragraph, except that I sometimes think "the avowed purpose of its advocates" is possibly a blind for the class legislation it is hoped will prevail.

* * *

A. L. Dabney

Consulting Engineer, Chairman Tennessee State Board of Architectural and Engineering Examiners, Memphis, Tenn.

The editorial discussion in your issue of July 6 correctly presents the principles on which license laws for engineers should be based. Unquestionably the only consideration with legislators must be: Does the public interest demand such laws? One who has reviewed many applications for license in a state that has recently adopted the licensing of engineers must concede that it does.

It is true that many employers of engineers have the ability and means to find men of whose competence there is no doubt; but the clientele of many engineers is largely represented by boards of laymen (city and county officials and others) who do not devote the necessary time and thought to investigating the engineer's qualifications. The recently enacted law in this state recognizes that only those engineers who are responsible for results, and not their subordinates, should be licensed.

The writer is fully convinced that the public interest

demands that engineers be licensed, and that the interests of the profession demand it; and while the legislature can consider only the public interest, the profession may properly avail itself of this method of improving its status before the public. The analogy of the engineer's case to that of the doctor and lawyer should, of course, be viewed with proper allowances. It may be suggested that while members of the medical and legal professions have more frequently a clientele of individual citizens, it is largely among neighbors and acquaintances of long standing. Their field is geographically small and does not change much. The engineer must frequently find his clientele among persons who have never seen him before, and probably never before had occasion to employ an engineer. As a result, a young man with ambition and nerve but little technical ability, is frequently employed for important work and takes up his abode in a community that has theretofore given little thought to what an engineer is. He becomes that community's conception of an engineer; and an appreciable part of the population of this country regards the engineer not as a member of one of the learned professions, but as one of a class of persons resembling their new fellow-townsman.

When the licensing of engineers has become general and the standards for granting licenses are raised to a proper level, our profession will be, in the estimate of our fellow men, on a much higher plane than it now occupies.

To attempt to define, by a license certificate, precise bounds within which the licensee must confine himself, would be a difficult task. Might we not hope that as the standard is raised through succeeding years, the time will come when no engineer may be licensed who is not substantially grounded in the underlying principles of all engineering knowledge? Then, although the licensee may pursue a special branch of engineering, he would not be ignorant of all other branches; and his standards would not permit his undertaking work for which he knew himself to be indifferently qualified. How many engineers have any of us known, of real standing in the profession, who would undertake work for which they were not qualified? License laws, properly framed and enforced, should ultimately bring all practising engineers to this standard by eliminating those who cannot be brought to it. Again resorting to analogy: a physician's license does not attempt to define his specialty.

After assisting in the drafting of a law and then trying to recognize it, after various committees have modified it, one decides that at present theory and practice in this matter are still far apart. Reassurance lies in the thought that if a state legislature recognizes, by the passage of any bill, however weak, that the public interest demands licensing of engineers, the details of the bill are of little moment. They can be gradually improved as the state becomes accustomed to the license idea.

* * *

F. G. Jonah

Chief Engineer, St. Louis-San Francisco Ry., St. Louis, Mo.

I personally have always been opposed to the licensing of engineers, first, because it does not add anything to the competency or qualifications of the men possessing the licenses, and consequently does not make for increased ability in the profession, nor does it in any way give the public any better service than it now receives.

I am opposed to it because it means one more governmental regulating body in each state, and we are cursed with these now, nationally and locally. What it means is a machine for examinations set up by some board in each state, who we know in some instances are using their offices to make engineering a closed corporation and keep out the outsiders; and these examining boards are politically appointed and paid by the state.

If, however, any state is bent upon putting a license bill through, then I think the best thing we can do is to have a uniform law that has already been adopted in several of the states.

Hugh L. Cooper

Consulting Engineer, New York.

I think the six principles that you have laid down at the end of your discussion of this licensing subject are all of them at least steps in the right direction. While the liicensing of engineers is a very great question, it is a question that should be met and decided squarely on its merits and just why engineers should not be licensed on their merits is something I have never been able to understand.

A good many thousands of lives and a good many millions of dollars would have been saved in the past if the public were honestly informed through some legitimate licensing system or some other good fountain of intelligence as to the qualification of the engineer for the work he was attempting to do.

* * *

Allen Hazen

Consulting Engineer, New York.

The editorial discussing licensing, which appeared in your issue of July 6, is, I think, the most comprehensive and fair statement in regard to the subject that I have seen. I have been one of the consistent objectors to licensing from the beginning and up to the present I have seen no good reason for changing my point of view. In other words I have been unable to see any advantages either to the profession or to the public to compensate us for the very considerable trouble and expense to which we are put in connection with licensing.

Any firm of engineers employing a considerable staff must be in danger of violating state laws more or less frequently in its ordinary professional practice. However many licenses it may take out, it hardly seems feasible to apply for licenses in every state that passes such a law for everyone of its men, and the problems that come up usually require prompt action.

Engineering practice is not limited by state lines and in my judgment it would be very unfortunate to have any such limits drawn. If licensing is to become a permanent system a much greater degree of reciprocity between states would seem desirable and almost necessary.

* * *

C. J. Tilden

Professor of Engineering Mechanics, Sheffield Scientific School
Yale University, New Haven, Conn.

I have read the editorial carefully and with much interest. It seems to me that you have put the case well and I find myself substantially in agreement with what you say. I do not believe, however, that we can dismiss the matter by saying that licensing is not worth while. As in so many other cases, we are confronted by "a condition instead of a theory." Many states have already adopted license laws and others will undoubtedly do so. What we should do, therefore, is to guide the lawmakers, so that the resulting legislation will do the least possible harm and, if possible, some good. I have in mind particularly the recent law enacted in Pennsylvania, which seems to me a complicated, cumbrous piece of machinery, causing unnecessary irritation.

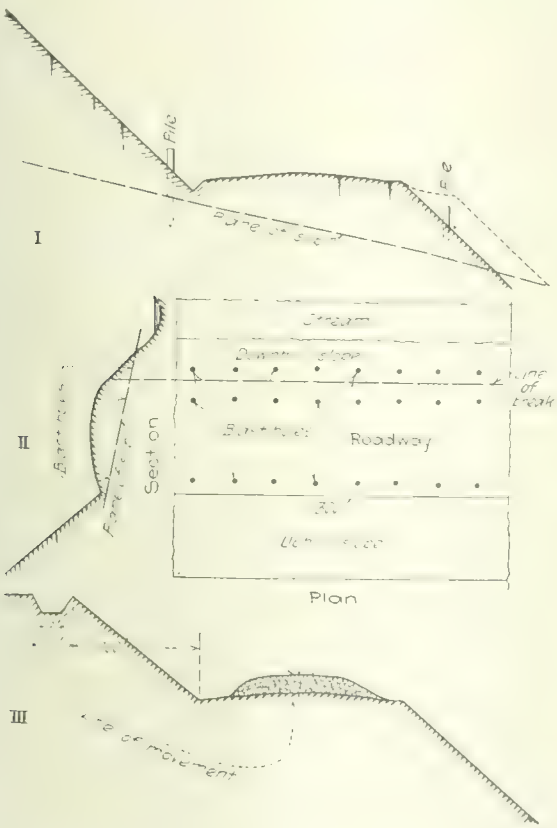
We should recognize frankly, as you say, that no law can fully protect the public from incompetence. The claim put forward at the time of the Knickerbocker disaster was absurd. The law should provide hardly more than an authorized list of engineers practicing in the state. The requirements of the law should be as simple as possible and the expense of registration merely nominal. The qualifications specified should be *minimum* and not an elaborate list of the desirable qualities in a trained engineer. It should be distinctly stated that the state assumes no responsibility in the matter and gives no assurance of safety to the public.

I congratulate you on the editorial. A clear and impartial statement of this sort will help greatly in clearing the atmosphere.

Methods of Overcoming Slides on Side Hill Roads

Inclined Rock, Shale or Clay Stratum Usual Cause —Relocation Often Only Remedy—Each Slide a Different Problem

LATERAL slides have made maintenance a troublesome task on side hill highways in Ohio. Within a few years several hundred slides have required cognizance by the state maintenance forces and some of them have called for expensive remedial measures. Usually each occurrence has required separate treatment but a number of methods have been satisfactory enough in several different instances to establish themselves as good practice. They are ditching to remove water and stabilize the soil; driving piles to lock together the sliding layers; and a subsurface blasting to roughen the rock surface and thus keep the overburden from sliding.



TYPES OF SIDE HILL SLIDES AND REPAIR-METHODS

All three methods, as carried out in special instances, are illustrated by the accompanying sketches.

Ordinarily slides have occurred when a shale, or a clay or a rock layer, inclined downhill, provided a sliding plane. On this sliding plane the overburden was disturbed sufficiently by the cutting to permit water and gravitation to overcome a previous state of equilibrium. It is noted among the observations of these Ohio slides that a hill-slope of fragmentary material on an inclined solid stratum of any material impervious to water is often made unstable by a very slight removal of material particularly in the form of a continuous gash like a highway cutting. Commonly, earth movement does not at once follow and this, with the always pressing need of keeping down the cost, has led to taking a chance in locating the road and in not opening back the uphill slope and buttressing the downhill slope with an ample fill. In some instances, as stated, no practicable amount or character of cutting would prevent movement. Relocation is the only resort.

Where the stratum on which the slide traveled, as shown by Diagram I, is shale or clay penetrable by piles, considerable success in holding the moving earth has been had from driving two rows of piles as indicated. The piles spaced about 10 ft. apart, practically nailing together the moving and the stationary strata, were enough of an obstacle to check movement.

In the second diagram, where the sliding plane was rock, sliding was stopped by roughening the ledge surface to increase the friction. Holes were drilled through the overburden and into the rock and light blasts were fired. These blasts broke and heaved up the ledge surface making it sufficiently rough and irregular to retard the slide.

A more common remedy is to ditch the uphill crest as shown by diagram III. In this instance the earth movement had heaved up the road surface without much lateral movement. By ditching along the uphill crest and leading the surface water right and left along the road the slipping was checked.

Erection Record on a Chicago Building

ERECTION of 7,500 tons of steel in 70 working days with two derricks and a crew averaging 90 men was the record for the frame of the first section of the Illinois Merchants Bank Building, Chicago, which was completed June 17. The crew worked an 8-hour shift daily for 5½ days each week. Fig. 1 shows the record flag hoisted over the erecting gang of 24 men. Fig. 2

FIG. 1 STEEL ERECTION GANG WITH RECORD FLAG

shows the work partly completed with the two derricks in position.

This 21-story building will be 316 x 178 ft., but is being built in two duplicate sections, the first of which will be finished and occupied before the old three-story bank building on the adjacent site is torn down. This old building is shown at the left in Fig. 2. Thus the total amount of steel will be about 15,000 tons. In the present section, approximately 167 x 178 ft., there are

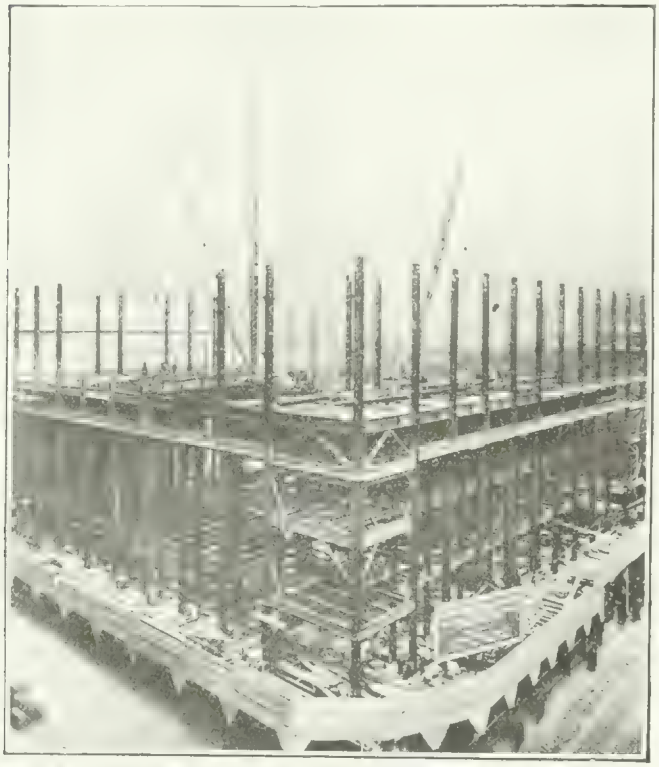


FIG. 2. ILLINOIS MERCHANTS BANK BUILDING, CHICAGO

two sub-basements, basement, mezzanine floor, nineteen regular floors, attic and roof.

Two steel guyed derricks did all the erection, placing the steel for two floors at each setting and averaging $4\frac{1}{2}$ days for the two stories. Each derrick had a 112-ft. mast, 100-ft. boom and 100-hp. electric motor. They worked as independent units, each derrick raising itself to the new level at each setting. The heaviest members handled were two-story columns weighing 24 tons. A maximum record was made of 320 tons placed in one day.

This erection work was done by the Overland Construction Co., Chicago, the steel being fabricated by the American Bridge Co. The Henry Ericsson Co. has the general contract and Graham, Anderson, Probst & White are the architects.

St. Paul Water Consumption

The water consumption in the City of St. Paul during the year 1921 was 83.2 gal. per inhabitant, and 416 gal. per day per tap. The taps are 96.5 per cent metered but only 68.3 per cent of the total consumption is metered. The average quantity per day passing each meter is 321 gal. The cost of supplying water per million gallons figured on the total maintenance charge is $44.73, but figured on total maintenance plus interest on bonds and sinking fund it is $73.51. St. Paul supplies only about 60 per cent of the total water consumed within its limits.

Comprehensive Program for Denver Water-Works System

Single Control of South Platte Water and Use of Marston Lake as Terminal Reservoir Recommended—64-M.G.D. Filters

UNIFIED control of all the water of the South Platte River above Denver under the management of the city and a gradual concentration of all the supplies through a new set of conduits leading to and from Marston Lake as a distribution reservoir where all water would pass rapid filters, are the main recommendations in the report of the Engineering Board of Review recently submitted to the Water Commissioners of Denver, Colo. Immediate construction to increase the present supply by 60 per cent at a cost of $6,700,000 is advised. The principal items are as follows: New conduits, $3,037,000; 64-m.g.d. filter plant, $1,250,000; distribution mains, $1,955,000; pumping station improvements, $334,000.

The Board of Review, consisting of Dabney H. Maury of Chicago, H. T. Cory of Los Angeles and H. S. Crocker of Denver, was appointed at the suggestion of the Denver Civic and Commercial Association after a $5,000,000 bond issue for certain improvements failed of passage at an election held on May 17, 1921. A committee of prominent local engineers from the association nominated a list of engineers from which the members of the Board of Review were chosen by the water-works officials. The board of Review has been at work since February. Its main conclusions and recommendations, leading to an ultimate supply of 200,000,000 gal. a day, are:

The health of the citizens must be safeguarded by insuring the quality of the water used by them. This result can only be obtained by aeration and more complete filtration than the existing plant affords. About half of the water consumed annually is adequately filtered, the remainder being sterilized by chemical processes. Sufficient pressure for fire protection can only be provided by increasing the size of street mains and by making extensive additions to the distributing system in the business district as well as in the other portions of the city where low pressures exist. Extensive areas in scattered sections of the city have insufficient supply and pressure for household purposes and lawn irrigation.

Water is brought to the city from Platte Canyon through a complicated system of wood-stave pipe lines which are in various stages of decay. One or more of them may fail at any time and the excessive cost of their repair is becoming too great to be borne by an intelligent community. The failure of even one of these pipe lines during the period of greatest consumption would seriously impair the supply. The immediate imperative need is the construction of a new and dependable conduit system. It is recommended that a permanent aqueduct be built from Kassler (mouth of Platte Canyon) to Marston Lake of sufficient ultimate capacity to serve the future requirements of the city.

The water rights of the city are involved with the irrigation rights of others. The lands about Denver are, except for a relatively small acreage with the earliest water rights, unsatisfactorily irrigated. The real water requirements of the lands around Denver are almost exactly the same as of these lands when put to urban uses. Thus by providing ample irrigation water for its environs, Denver automatically provides water for its practically unlimited growth. To provide an economical and satisfactory administration the proper legal steps should be taken by the city for a unified control of the South Platte watershed above Kassler, thus insuring the greatest beneficial use of the stream. The City of Denver seems to be the only feasible agency. The purchase by the city of the Antero Reservoir

and High Line Canal is recommended as part of this general plan.

The supply available from the eastern slope is inadequate for the future Denver. Provision should be made at once to secure a perpetual right to all possible diversion from the western slope. It is conservatively estimated that 250,000 acre-ft. [81.5 billion gallons or 225 m.g.d.—EDITOR] may be obtained from that source.

The city is facing a water shortage, and an adequate supply of water and proper water service are as vital to Denver's life as food is to any one of her citizens. Denver has a larger population and a greater assessed valuation than had Los Angeles when it embarked on the installation of the $30,000,000 Los Angeles Aqueduct. [Population of Denver, 256,491 in 1920; 213,381 in 1910; 133,859 in 1900. Population of Los Angeles: 576,673; 319,198; 102,479. The Los Angeles Aqueduct was projected in 1904-5.—EDITOR.]

A great deal of electric power can be generated as a byproduct of the comprehensive development of water conservancy outlined in this report. The total installed capacity of all practicable plants will ultimately exceed 100,000 kw., and although most of them may run but part time, the total annual output will exceed Denver's probable consumption for a long time to come.

In explanation of the concentration of the supplies in Marston Lake and the decision to eliminate ultimately the slow sand plant at Platte Canyon and the present sites of galleries and rapid filters the report states:

The small sources of supply at the Mississippi Street and Cherry Creek galleries are the residues of an endeavor to provide water for a small population.

The establishment of Platte Canyon as the principal point of diversion and purification, and the carrying of treated water thence, was the result of endeavoring to bring mountain water to a relatively small unit (96,000 population) in the face of an intrenched, existing supply, and before any really promising reservoir site on the watershed above had been located.

The almost ideal terminal raw water storage for a very large mountain supply, Marston Lake, was developed not so much for that purpose as to render Bear Creek an available source of supply. Because of its size it is impractical to cover it, and without such covering algae growths develop, especially during the summer months. As such growths are much more abundant in clear water than in turbid water, Marston Lake is not well adapted to the storage of clear water, filtered and ready for immediate consumption.

Notwithstanding the large amount of distant storage in Lake Cheesman, the major portion of the pure water supply to the city is now dependent on conduits carrying water 23 miles to terminal storages in the city holding altogether but little more than a single average day's consumption.

It is necessary to shift, as gradually and economically as possible, from the existing arrangement to a plan whereby the terminal storage of raw water will be at Marston Lake, practically on the outskirts of the city, with all aeration and filtration works located on the city side of that storage, and with several conduits leading thence to the filtered water reservoirs within the city proper.

In support of the recommendation to consolidate control of the South Platte water for domestic purposes and irrigation the report states that about 100,000 to 150,000 acres near Denver are poorly irrigated. Control has not been uniformly satisfactory and will not be unless some agency outside of land owners takes the initiative. All signs point to Denver as the agency. Storage, seepage and exchange of unregulated water in one place for regulated water in another place are the three points necessary to regulate the supply. Ultimately, power as a byproduct only will be developed.

Discussing terminal storage in relation to fire losses the report states that since conduits which bring water from distant sources cannot be made failure-proof, sufficient capacity should be provided to meet the city's demands for a period as great as the time required to repair any possible damage. Taking 200 m.g.d. as the ultimate draft, Marston Lake provides 30 days' storage. The construction of a 225-m.g.d. conduit, 12½ per cent in excess of 200 m.g.d., to carry raw water from Kassler at the mouth of Platte Canyon to Marston Lake, is advised as the lake could be refilled in eight months.

Ample mountain storage opportunities exist in the South Platte for the entire region. Data on fourteen reservoir sites having capacities aggregating 1,154,000 acre-ft. are given. The cost varies from $16 to $135 per acre-ft. capacity.

For trans-mountain diversion from an area within 60 miles of Denver along the western rim of the Continental Divide, three tunnels aggregating 14.6 miles long are contemplated to bring water from the Blue, Williams Fork and the Fraser Rivers. Two of the tunnels would carry 1,200 sec.-ft. and the third, 1,000 sec.-ft. Diversions from the Fraser to Boulder Creek through the pilot tunnel of the Moffat Railroad would be exchanged with owners of irrigation rights below Denver.

Purchase of the Antero Reservoir and the High Line Canal was recommended as one of the first steps toward Denver obtaining control of the situation, although as to the legality and wisdom of the contract to purchase these properties by the old Public Utility Commission the Board of Review stated it did not feel qualified to express an opinion. Litigation is still pending on the contract to buy.

Meters are not recommended. As stated in discussing a reduction of wastes on certain water-logged hay lands, Denver at the present time is more concerned in demonstrating the greatest beneficial use of water than in reducing wastes or inefficient uses to a minimum. Other reasons given are as follows:

At least 80 per cent of Denver's supply comes to the consumer by gravity, so that the cost of pumping the water would be only slightly reduced. The cost of filtration would be reduced almost, but not quite, in proportion to the amount of water saved by the meters. The capacity of the first installment of the permanent plant should under no circumstances be made less than that herein recommended, so that no fixed charges could be saved at this time.

To meter all of the services in Denver would cost about $1,250,000 and would entail an added annual expense for reading and testing and for making out and collecting meter bills. There is a strong local prejudice against meters.

The present meter rates in Denver are inequitable and are far from being such as would tend to make meters efficient in preventing waste. Incidentally, the Denver meter rates are much lower than those in many cities located in places where water is more plentiful and close at hand. The fact that Denver is located in an arid region and has to bring its supply from an unusually long distance greatly increases the cost of furnishing water, but this fact is not reflected in its meter rates.

When meters are installed in Denver, as they surely will be at some time when their installation would postpone a large expense for new construction, an entirely new schedule of meter rates will be essential.

Aeration to eliminate tastes and odors is liberally provided for in the filter plant design. It is proposed to build sixteen 4-m.g.d. filters having a nominal filtration rate of 150 m.g.d. per acre, filtration to be preceded by 3½-hours' sedimentation after coagulation. An experimental filter plant is recommended to ascertain how much aeration is necessary and what type of aeration is most effective in removing tastes and odors.

Emphasis in Education Shifted to Research Work

Defines New Educational Objective, and Pictures Ideal University as Clearing House of Knowledge for Public Service

IN DISCUSSING the evolution of educational ideals and purposes at the fifty-first commencement of the University of Illinois, last June, Dean Eugene Davenport, of the College of Agriculture of that institution announced a shift in the educational objective. His views are covered in these extracts from his address:

Now, the most significant feature of this evolution in education is not the agricultural college, the engineering college, or even vocational education. It is the shift in the objective and the consequent change in the essential features of university outlook and activity. Traditionally, the objective in education had been almost exclusively personal; namely, to endow certain favored individuals with a mental equipment which should set them apart as members of a privileged class distinguished for culture or aptitude for government, or other leadership, in any event freed from the ordinary problems that plague humanity.

But now the objective is *life;* how to understand it and how best to live it for the common good. So has the scene shifted from the man to his activity. So have language, literature, and history; agriculture, engineering, and economics; the natural sciences and their applications; philosophy and art in all its forms—these and their relations to mankind have become objects of study as means of understanding life and of living it more successfully rather than as means of educating individual men and women for their personal advantage over others. This means that today the student has become the means to the end, like a good book, rather than the end itself; and this is well.

Research Fundamental—Incidentally this change in objective from the man to the activity has radically altered many of our fundamentals in procedure. For one thing, it has shifted the emphasis from instruction to research. So long as the only objective was the education of the individual, we were inclined to satisfy ourselves with that which chanced to lie at hand, and discovery of new truth was left for the few solitary souls who may be called educational pioneers by nature.

But when the chief objective becomes the development of this, that or the other field of knowledge, then the faculty of an institution becomes a body of real scholars who will exert all their powers toward discovering new facts and setting them into their proper places with related facts in order that principles may be brought to light and safe procedure indicated. Where this great process of critical analysis and synthesis, with logical deduction which we call research, is going on, the student catches the spirit almost out of the atmosphere, and instruction becomes incidental to that kind and that thoroughness of inquiry after new truth which seeks to learn all the facts with which life and its activities must reckon.

It is this shift from instruction to research that has brought the university into new relations to the public. Farmers, for example, ignored the agricultural college for thirty years, but they did not ignore the experiment station. They said they wanted facts, not theory. They got them out of the experiment station and so did the student, and what has been done in this newest of all educational attempts is being done, or will be done, for every essential activity of the people of the commonwealth. As the support of the farmer has come to rest upon what scientific study could do for the business and life of farming, so will the university as a whole be supported both morally and financially in proportion to what the public believes the institution will contribute to the common welfare.

All this, declares Dean Davenport, means that the faculties of the state universities must take their cues from the broad problems that puzzle the people, and seek to aid in solving them. He continues:

For all these reasons our state universities are coming to be regarded as repositories of knowledge needful to the people, and the dwelling places of prophets who have some peculiar insight into the future, because knowing the present and the past with a relatively disinterested perspective, they may speak as one having some authority.

The world needs and wants and will have, if we permit it, the closest possible contact with such repositories of knowledge and such sources of prophetic wisdom. We are honored today by the visit in a body of the first citizens' organization to officially undertake, as they did some quarter of a century ago, the moral and financial support of an essential part of the work of a state university. I refer to the Illinois Farmers' Institute. Their example has been followed and will be further followed as the years go by. For it is because the world believes in the value of such sources of information that the states have endowed these institutions beyond the dreams of a half century ago and will still further endow them in proportion as their present hopes are realized and all our eyes are still further opened.

After pointing out the benefits of the co-operation that have existed between the citizens of Illinois and its university, and after urging a resumption by the state of the ten-year program for "a biennial investment of $10,500,000, in the discovery and promulgation of knowledge and its application in the State of Illinois," Dean Davenport declared that:

We hear too much about educating for leadership. What the world wants is not leaders, of whom it has a surfeit, but rather information and trained habits of thinking that it may select its leaders wisely. This all means the closest possible working relations between the institution and the citizenship of the state; between those who, feeling the pressure of unsolved problems, realize the need of better information, and those whose business it is to supply the need. A university so guided will remain close to the people and close to its problems. A university that so functions will not come very far from fulfilling its highest usefulness, and a university so favored will not, in the long run, want for support, though its normal condition will be one of poverty because the load will always come before the relief.

Such university has no special schemes to promote, no propaganda to "put over." It is a public service institution, serving the world in every way possible at all times and places where knowledge is needed, drawing upon that world in turn for all it is able to contribute to public welfare through the medium of its everyday experiences. Such a university is a clearing house of knowledge, both old and new—free to all who need it for the public good.

Effect of Dyes on Protozoa in Sewage

The British Minister of Health, Sir A. Mond, was recently asked during question hour in the House of Commons whether his attention had been called, according to London *Municipal Engineering and the Sanitary Record,* "to the discovery by Thomas H. Fairbrother and Dr. Arnold Renshaw, of Manchester, England, of several dyes, which, in the activated-sludge process of sewage purification, can kill the devouring protozoa without harming the purifying bacteria; and whether he would give facilities for carrying out the results of this highly important piece of laboratory research work." To this the minister replied that the matter had been brought to his attention but that he was "advised that further research work would be needed in order to test the application of this and other discoveries to the activated-sludge process of sewage purification, and he was making inquiries as to the best means of facilitating the necessary investigation."

Notes From The Intermountain Country

By W. W. DeBerard
Western Editor, *Engineering News-Record*

Engineering in Utah—Ogden and Salt Lake

ENGINEERS have followed the example of the prevailing religious faith in Utah in that they have learned well the lesson and advantages of organization for efficiency. Perhaps nowhere else in the country does the engineering profession count for more in a truly helpful civic way than in Ogden. Shoulder to shoulder with the business clubs is found the engineer and his organization. He gets on all general civic betterment committees and when he does anything he gets into the newspapers. In a broad way he is here carrying out what the recently issued book on "Publicity Methods for Engineers" advocates—do something and then tell about it. Co-operative effort in public affairs, however, does not mean uniform accord on engineering subjects. In a comparatively new country where there are so many problems, debate is strenuous.

While debate proceeded, for example, on the maximum lift feasible for an irrigation project, Ora McDermitt built and is now operating one successfully beyond the limits under consideration—the Bonneville Project with 150 and 300-ft. lifts. However, all projects are not in 6-acre tracts and do not have markets developed so

HIGH HEAD PUMPING PLANT FOR IRRIGATION WATER AT THE NARROWS

close to Salt Lake as has this one. At another project at the Narrows a lift of 175 ft. is employed for late irrigation. This is shown in the accompanying view.

Two other examples may be cited. Smoke haze hangs over the eastern and better residence portion of Salt Lake in the winter time due to this area being in an air eddy created by a down draft through City Creek Canyon. Shall a large sign board air deflector be built to direct the air current so as to sweep away the smoke or is the only way to avoid the nuisance improvements in firing methods and the use of smokeless fuel such as coke or gas? Both fuels ultimately will be available for all conditions are favorable to their production at a low figure.

Like El Paso, torrential storms occasionally flood sections of the city that need a storm drain because of the very steep slope on which most of the city has been built. These storms lodge debris on certain paved and unpaved streets for miles at a stretch. Undue washing is being prevented by constructing curbs and gutters long before pavement can be afforded, the roadway being given a high crown to deflect the water into the gutter, and oiled to prevent erosion.

An effective campaign for funds for a storm sewer must be waged for property owners are well fed up on high taxes. A heavy storm occurred during my visit causing damage exceeding twice the annual interest charge on the proposed improvement ($850,000). This storm was taken advantage of by the city officials to educate the public in the newspapers to these facts. S. Q. Cannon, city engineer, says that bond issues are usually voted upon favorably in Salt Lake if the people understand what the money is to be spent for and the utility of the finished project. If they do not understand or there is much technical debate the people take the view that the engineers must first be sold on the proposition and be in favor of it. Lack of education in an election authorizing bonds for water-works extensions last year defeated the issue.

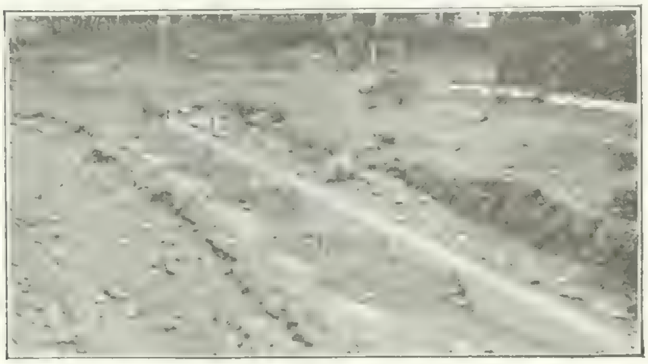
Salt Lake Water Department—In the water-works office H. K. Burton, superintendent, has problems winter and summer, noted often in these columns; but a new one developed last winter following a 120-in. snowfall at Lakes Phoebe and Mary. Due to a wrecked 'phone line an attendant left on the job to make observations and handle the gates did not report for five days. After the third day snowshoe parties were started from the city to effect his rescue. Mr. Burton is now considering the installation of a radio outfit.

The scenery at the head waters of the city's supply is unsurpassed. An excellent road is maintained to Brighton, a summer resort much frequented, but the real views are obtained from the dam sites. Waterworks men invited to take this trip when in Salt Lake should have extremely good excuses before declining it. A day is enough but it is guaranteed to produce sleep if not a lasting memory of a wonderful mountain panorama. Incidentally a snow survey is usually made in April of about 10 square miles of the 48 square miles of watershed. Thus the city knows early whether there is likely to be a water shortage for storage purposes long before the runoff reaches the reservoirs. About 400 soundings are made in the survey, every other fork of the stream being covered. About 100 density tests are made averaging around 40 per cent moisture. Getting sufficient water for all of the industrial concerns of the city has not been easy and as the large and small consumers pay the same rate, 4½c. per 100 cu.ft., many efforts are made to obtain private supplies. One of the larger refining companies recently sunk a deep well only to find that when it was pumped it drained the water from 50 individual wells in the vicinity. The city still has the refinery as a customer.

Road and Bridge Work—Some highway work in Utah is at a standstill due to various political causes and differences of opinion between state and federal engineers. For instance, it is with reluctance that the federal engineers will approve an additional 3 to 3½-in. concrete layer as a replacement wearing surface over the structural floor of a bridge. This question of whether to allow abrasive traffic directly on structural portions of the bridge might well be debated with profit over the country. The dual capacity which the upper layer of

concrete must play when cast monolithic and the almost certain impossibility of obtaining a future bond when replacement becomes essential are non-debatable. After noting how the floor slabs in some of the smaller bridges in Utah had been worn down, one could hardly sanction anything but a distinctly replaceable wearing surface over the structural floor.

Lighting on bridges has come into controversy. A fatal accident due to faulty lighting causing an optical illusion has led to a proposal of a radically different lighting system from the ordinary, with the lights on tall poles rather than on the low conventional standards which have the effect of rapidly increasing and decreasing the pupil opening of the eye, thus tending to blind and confuse the driver. Most bridge lighting systems are an abomination from the utility standpoint and could well be given more attention by highway engineers than they are accorded at present.



FLOOD DURING CONSTRUCTION OF GUTTER BEING BUILT TO CARRY JUST SUCH RUNOFF

Close spacing of dams to retain water for curing concrete indicates steepness. High crown even before grading completed deflected water toward gutter.

Returning from the trip to Provo over many of the road sections under construction when a similar trip was made in 1919 but few places were noted not in good condition. This was particularly true of a comparatively thin slag black base and bitulithic top of which there was some doubt when it was laid. True the edges were ragged at some points, but on the whole the main roadway was in good condition. (See *Engineering News-Record,* Dec. 11-18, 1919.)

To a certain extent Salt Lake wants in the railroad line quite the same thing that Denver needs. Both would like to be directly on more transcontinental routes. When the Moffat Tunnel project seemed assured by action of the Colorado Legislature in voting to go ahead with the project, former Governor Bamberger of Utah started to New York to finance the continuation of the line through the Uintah Basin to Salt Lake. This basin is rich in agricultural prospects and natural resources. If an outlet is not found into Salt Lake the traffic emanating therefrom will go in other directions. The governor's task is no light one as the routes will be extremely tortuous and grades heavy over the mountains intervening between the basin and the city.

The natural resources of Utah are beginning to attract developing capital. The Utah Steel Co. is planning to spend $300,000 in sheet and plate mills and hopes to be able to raise two or three million dollars this year for blast furnaces. A 60,000-ton mill will probably be in operation before long. For sheets, plates and reinforcing bars the company hopes to compete successfully East as far as Omaha and West for trade on the Pacific Coast and the Orient. All of the raw products, coal, iron and limestone are within reasonable distance of the small plant now in operation. Practically all of the haul is down hill.

Irrigation—Irrigation development is Utah's middle name, meaning that without irrigation she was nothing and that water is her life blood. The pioneers the first year lived on Seger lily bulbs, thistle tops and cactus apples but no one since that time has had the least desire to repeat this experiment. So water storage is being studied seriously to utilize all the water available to best advantage. Richard Lyman, professor of civil engineering, University of Utah, and recently elevated to be one of the twelve apostles of the Mormon church (no small honor) is now a member of the Utah Storage Commission which has taken up officially the work so well started by A. F. Parker (See *Engineering News-Record,* May 27, 1920, p. 1064). The commission is working in conjunction with the U. S. Geological Survey on the Jordan and Weber Rivers first.

Professor Lyman received me in the million dollar church office building and arranged for me an inspection of this marvelously beautiful structure of Ionic architecture. The many striking marbles of Utah are used throughout, except for the floors, for which Tennessee marble, because of its wearing qualities, is considered preferable. No engineer or architect visiting Salt Lake should miss the opportunity of seeing this building if he is so fortunate as to get an invitation to view it.

To return to irrigation Professor Lyman mentioned the many-times suggested scheme of pumping Utah Lake down to a much lower level, thereby reducing its large area of shallow water with its tremendous evaporation loss. Much land in Toole County around Garfield Point which projects nearly into Great Salt Lake could then be brought under cultivation and the water saved. Other engineers, however, hold that between the city and Great Salt Lake 70,000 acres of land could easily be drained and should be utilized first because of its proximity to the city.

Ogden is paving a lot of its wide streets. Work on more than thirty blocks is under way. This means much water pipe extension and 1,500 tons of 12 to 20-in. pipe will be put underground this season. Heretofore steel pipe only has been used but W. S. Craven, new city engineer, drew up the specifications for cast iron as well as steel, although his estimate indicated that the steel pipe would cost but 84 per cent as much as cast iron. Mr. Craven is starting an experiment looking to an increase in the supply of artesian well water located in a valley up Ogden Canyon back of the city. The wells now flow, but 8 out of 30 are to be pumped with air lifts to increase their output. Whether the underground storage held back by a natural dam at the inlet to the canyon will prove to be as prolific in water as the officials hope will not be known until at least this season is over. What is going to happen as to storage and interference of the various wells, as well as other underground phenomena will be interesting.

Ogden and Salt Lake are connected by a 37-mile highway ribbon of concrete. The agricultural development between is so intense that the suburbs of one seem almost to touch those of the other. So do engineers and the works of civilization shorten the lines of intercommunication. No one can say that Utah engineers are behind their eastern brethren in utilizing the forces of nature to the benefit of man.

Condition of Railway Transport in Soviet Russia

Unfit Locomotives, Bad-Order Cars and Bad Fuel Handicap Operation—Repair Parts Lacking and Wages in Arrears

IN A recent issue of *Commerce Reports* appears a summary of railway transport conditions in Soviet Russia as compiled from statements made in the Soviet official daily, *Economic Life*, for whose accuracy, however, the Department of Commerce assumes no responsibility. The following abstract presents the substance of that summary:

Locomotives and Fuel—The actual number of sound locomotives, the number per 100 miles of track in actual use, and the percentage out of commission are shown in the following table. Idle engines represent those classed as sound but sidetracked for lack of fuel. The data for 1914 represent substantially the area now included in Soviet Russia in Europe. All statistical data include the Ukraine and the Caucasian States.

Date	Mileage of Lines in Use	Sound Engines	Ratio per 100 Miles	Per Cent of Unfit Engines	Idle Engines
Normal of 1914	41,500	17,140	41.3	15	
November, 1917	33,180	15,154	45	27.4	
July, 1920	39,000	6,232	16	58	270
January, 1921	40,000	7,544	19	57.4	429
July, 1921	40,000	7,167	18	57.9	587
January 1, 1922	40,700	6,538	16	64.3	1,296
April 1, 1922	41,400	6,302	15.2	67	387
May 10, 1922	41,400	6,931	16.7	63.8	410

Unsuitable fuel has recently done much damage to engines, and instances have been common during the past winter of brand-new locomotives being sent in for repairs after a couple of months operation. The principal trouble was with wood, although the coal was constantly complained of as being full of ash and cut too heavy for the fire boxes. A report of the commissariat of transport, dated March 3, 1922, states: "The wood is dumped on the tenders in sections of logs, sometimes hardly even trimmed, and is damp right through and encrusted in snow and ice. This sort of fuel rapidly causes wholesale leakage of fire tubes and the breaking up of grates."

Cars Available—The number of cars available for service from the middle of 1920 to May, 1922, is shown in the following table:

Date	Total Number Cars	Unfit Cars	Per Cent Unfit
July, 1920	442,985	90,093	20.3
January, 1921	447,594	87,585	19.5
July, 1921	444,266	114,536	26.0
January, 1922	419,819	118,745	28.3
February, 1922	415,987	119,936	29
February, 1922[1]	394,342	115,849	30
April 7, 1922[1]	387,420	170,387	44
May 10, 1922[1]	392,927	183,298	47

[1] Freight cars only, not including tank-cars.

Scarcity of Repair Material—The following statement is published in *Economic Life* for Feb. 22, 1922, from the official report of the chief transport committee regarding the repair of transport equipment: "The supply of materials and spare parts has dwindled to alarming proportions, especially during the past few months, since the works and stores, having been put on a business operating basis, demand spot payments from the commissariat of transport, while the commissariat has no funds at its disposal. An utterly abnormal situation has been created when articles and materials of repair badly needed for the rolling stock are lying at the works and factories and cannot be obtained on any account, while at the same time the transport service is being strangled for the need of these articles.

Traffic Figures, 1916-1922—In 1916 the average number of daily car loadings was 35,900; in 1919, they were 8,973; in 1920, they were 15,308; and in 1921 they numbered 10,614. The average for January, 1922, was 8,820 cars and for February 8,750 cars.

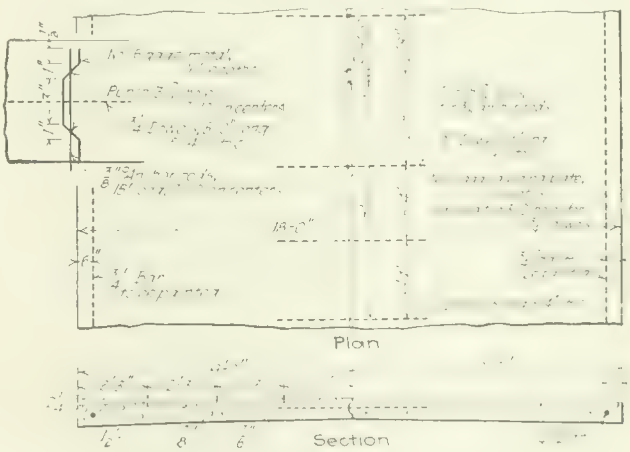
The total quantity of freight carried in 1921 amounted to 2,400 million poods as against 15,500 million poods for the same track mileage of Russian territory in 1913. (A pood equals 36.1128 lb., roughly then there are 62 poods to the long ton.)

According to the official report already quoted, the financial condition of the railroads calls for drastic measures. The deficit for the months of January and February amounted to 94,000,000 pre-war rubles, or 14.1 trillion Soviet rubles at the March rate. On several railroads up to February, at least, the men had not as yet been paid for November. The actual rate of pay due for that month was 165,000 Soviet rubles per man, but on account of rise in prices this became equivalent (figuring the purchasing value in February) to only 8 lb. of rye bread per employee for the month.

Plan of Operation for 1922—The chief transport committee decided to divide the railroad system for 1922 into three groups or zones according to the importance of their work to the state. The first group of trunk lines, supposedly most essential to the economic and political power of the Soviets and aggregating 20,500 miles (first main-track mileage), were to receive 100 per cent of their requirements. The second group, representing the branch lines feeding the railroads of the first category and totaling 6,950 miles, were to be taken care of to a less extent. The lines of the third group, 14,000 miles, were to receive their supplies irregularly, and the traffic on them would be operated sporadically, subject to complete suspension as occasion might require.

Two-Strip Concrete Pavement Built on Ohio State Roads

A NEW development in Ohio in concrete road design is the split slab with a buckle-plate joint doweled every 5 ft. 4 in. and with continuous dowel rods along the edges. In general the design resembles that employed during the last two years in Illinois and described in *Engineering News-Record* March 24, 1921, p. 504, but the buckled joint plate is that used in New Jersey and described in *Engineering News-Record*, June 8, 1922, p. 963, except that in the Ohio design the plate is completely submerged and the slab is finished smooth over its top.



SPLIT SLAB CONCRETE ROAD IN OHIO

LETTERS TO THE EDITOR

This Department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Amusement Riding Devices Are Safe

Sir—Your issue of June 22 contains an editorial (p. 1022) entitled "Dangerous Amusement Devices," which deals with the Ferris Wheel largely and condemns these rides and advocates the abolition of amusement machines. We maintain that you should now publish the other side of the case and allow the writer the same amount of space to show the favorable side of the business.

I have built and operated amusement riding devices for nineteen years in this country, in Canada, Mexico, South America, Spain, France, Belgium, England, Austria, Germany, Italy, and the Philippines, and have never had an accident, having carried millions of people during that time.

When there is a railroad wreck you do not ask the abolition of railroads and when there is a smash-up with automobiles you do not ask the abolition of automobiles. Therefore, we think, in the light of fairness, you should allow the writer the same amount of space in your publication to show the conservative side of this question. R. S. UZZELL.

New York City, Aug. 9.

A Dissenting View on Rivet-Hole Deductions

Sir—Regarding the net section of riveted tension members and your review of Prof. C. R. Young's bulletin on this subject as well as D. B. Steinman's comment in your issue of June 22 permit me to say that in my judgment the profession is entitled to know just what is the experimental proof of the correctness of the theory employed both by Prof. Young and Mr. Steinman.

Prof. Young has ignored tests which I made and published in *Engineering News*, May 3, 1906. These tests proved that a bar is equally liable to break in a right transverse section or a zigzag section of the same area. This is quite contrary to the rule that was in force at that time and to the theory used by Young and Steinman, all of which require a large addition in area in a zigzag section. The experiments which Prof. Young cited are not pertinent to the case but were on riveted splices. Also I called his attention to the fact that at the time my experiments were published no defense of the 30 per cent excess in a zigzag section was brought out excepting one, which was from Theodore Cooper, and his experimental confirmation was from riveted plate splices and not riveted or punched tension members.

A plate splice is not equivalent to a tension member with holes punched out of it. In the latter the stress has only to distribute itself around the holes. In the former each rivet is a concentrated load tending to tear the metal beside the hole. Tests on plate splices are therefore valueless for any other purpose than to discover the value of such splices. My tests were made on plates having holes so located that there was equal area in either a zigzag or a transverse section. Some of them broke in the transverse line, proving that no excess area is needed in the zigzag section, as Cooper, Young and Steinman assert.

The theory of combined stresses is a mere hypothesis until it is at least approximately confirmed by tests. The theory that treats a cube of metal in the body of a member as though it were isolated and free to revolve (through an infinitesimal angle) ignores the rigidity of the metal in which that cube is embedded. Such theories as this one and the one on which Poisson's ratio is based have never, to my mind, received theoretical confirmation.

The rule which I advocate is that the zigzag area be equal to that required in a transverse section. Unless my tests can be shown to be controverted by other tests, Cooper's rule, the one given in the Am. Soc. C. E. Tentative Specifications for Railroad Bridges, and those given by Young and Steinman mean a large waste of metal.

I should like to see some definite constructive response to this letter that does not refer to tests on some other thing than the net section of riveted tension members.

Pittsburgh, Pa., June 26. EDWARD GODFREY.

Water Power Auxiliary to Steam

Sir—I note your editorial concerning "Water Power Auxiliary to Steam."

In a report which I made on a water power in the State of Pennsylvania, dated May 24, 1916, occurs the following paragraph:

"We have calculated a large number of combinations of steam and water based on running the water power at a high load factor in connection with the steam plant used as an auxiliary, and then again, figuring the steam plant with a high load factor and the water power as an auxiliary; and after analyzing all these layouts we find the best results would be obtained by taking the steam power on a 100 per cent load factor during the time at which it is run when the water is below the crest of the dams and by operating the water power at that time at 33⅓ per cent load factor. The combined load factor of the entire plant would be 50 per cent. During the time when there is water enough to run over the crest of the dam the steam and water plant would be run at about 50 per cent load factor. For this purpose one of the best combinations possible is a 135,000 kw. water plant and a 54,000 kw. steam plant."

J. W. LEDOUX,
Consulting Engineer.

Philadelphia, Pa.,
July 8.

A Tasmanian Concrete Flume

Sir—You published an excellent article on reinforced-concrete flumes in *Engineering News-Record*, March 16, p. 436, built by the U. S. Reclamation Service. Herewith is a description of a concrete flume, the construction of which involved some features essentially different from those described in your article.

In order to increase the capacity of its Great Lake hydro-electric scheme, the State Hydro-Electric Department of Tasmania recently constructed a diversion channel from the Ouse River to the Great Lake, situated on the central plateau of Tasmania, at an elevation of about 3,500 ft. A portion of this channel consists of a reinforced-concrete flume. A small diversion weir was constructed in a deep and narrow gorge and below this weir the flume winds along the sides of the gorge into the head of a canal. For a portion of its length the foundation consists of a rock fill, but for the greater part it takes the form of a bench excavated in the almost precipitous sides of the gorge.

Coarse aggregate for the concrete consisted of diabase quarried near the mouth of the gorge and crushed to 1-in. size. Fine aggregate was washed from excavated material and consisted of a mixture of quartz-sand and clay. Material was loaded through chutes from the storage piles to ¾-yd. trucks running on a 2-ft. gage track laid on the flume foundation, the trucks being drawn by a horse.

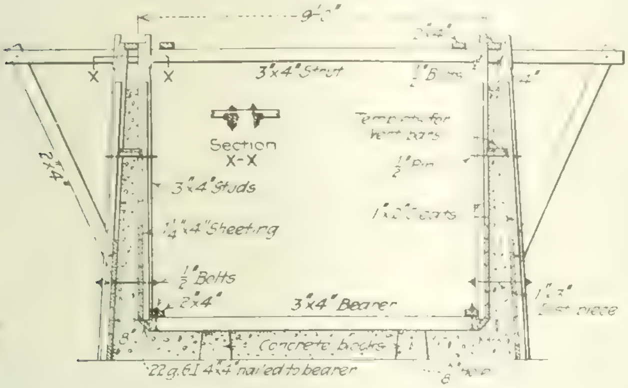
The rough foundation was trimmed with crushed stone and given a smoothing coat of 1 : 3 : 6 concrete carefully screeded off to grade. Besides preventing some of the 1 : 2 : 4 concrete, used in the flume, from being lost in the stone of the foundation, this smoothing coat provided an accurate surface on which to erect the forms and also enabled material, dumped from the trucks, to be easily shoveled into the mixer. The discharge of surface water from the sides of the gorge was provided for by the construction at intervals of concrete box-drains.

The flume foundation provided the only route for the conveyance of material both to the flume and the weir, and this was the controlling factor in the design of the forms and the construction methods adopted. As much material as possible was stored at the weir site before commencing the flume, but the balance was transported through the flume forms on the 2-ft. gage track.

The flume has walls 6 ft. high, an inside width of 9 ft.

and a capacity, when running 5 ft. deep, of 450 sec.-ft. The walls are vertical on the inner face, the outer face being inclined. Transverse reinforcing bars are spaced 7 in. c. to c., every third bar extending to the top of the wall but the intermediate ones stopping at lower levels.

The forms consisted of frames spaced 4 ft. c. to c., the outer studs resting directly on the concrete foundation. The inner studs were supported on 4-in. x 3-in. bearers resting on precast concrete blocks, built into the floor. Sheeting was supported against cleats nailed to the studs. The correct spacing between inner and outer studs at the top was maintained by wedging against shoulders on the top strut, and near the bottom by wooden distance pieces and tie bolts, the former being removed after concreting the floor. After the walls had set sufficiently, the tie bolts were withdrawn and the holes filled with grout. The frames were braced laterally by outside diagonals and light struts were sometimes nailed on in addition to stiffen the forms further. The frames were spaced by 2-in. x 4-in. longitudinals notched for each stud. The rails of the track rested directly on the 3-in. x 4-in. bearers, the sleepers hanging in the intermediate spaces. Light removable ramps provided a grade into and out of the forms and planks laid between the rails formed a track for the horse.



SECTION OF TASMANIAN CONCRETE FLUME

All reinforcement was bent to shape on a bending table placed at the mouth of the gorge. Longitudinal bars were in random lengths and were lapped 40 diameters where they broke joints. Transverse bars were made in one piece, the ends being hooked. Plain round bars were used throughout. The concrete blocks had holes in them through which two of the ½-in. longitudinal bars were passed. These bars supported the transverse bars which in turn supported the remaining longitudinal ones. Bars were tied at each intersection. The transverse bars were spaced and supported in position in the walls by wooden templets which were made in two pieces and rested on steel pins passing through the studs. These pins were later withdrawn and the holes grouted.

One hundred frames were used and sufficient sheeting was provided to permit forms to remain in place for at least three days, as low temperatures were common in the locality even in summer. Sheeting was used five or six times, some pieces lasting longer than others. All portions of the forms in contact with the concrete were originally oiled but not again before re-using.

An air line from a compressor at the mouth of the gorge was provided with outlets at each 100 ft. and, on completion of the excavation, the line was connected to a pump and used to convey water to a hose by means of which the concrete was regularly sprayed for about seven days after placing.

A joint extending through walls and floor was put in at intervals of 50 ft. Before filling the wall joints, the galvanized iron was pierced by a vertical row of small holes spaced 3 in. apart and small stirrups of No. 10 wire were hung through the holes to bond the mortar on the outside to that on the inside of the joint. Before filling, one end of the joint was oiled in order that the mortar should bond to the concrete on one side of the joint only. Small vertical cracks have appeared in the walls midway between joints but, after being in service for one year, the flume is reasonably tight.

Work was commenced at the upgrade end and 100 ft. of forms were erected at a time, a similar length of track being lifted. At the same time the track was relaid in the section behind. The mixer was stationed on the foundation immediately outside the forms and was provided with measuring hoppers. The reinforcement was brought up close to the forms on trucks and by means of a short turnout the sand and stone were dumped from the trucks onto the foundation in small piles from which they could be easily shoveled into the mixer hoppers.

The general design of the forms was the outcome of the conditions governing conveyance of materials and they proved fairly satisfactory under those conditions. Where an independent construction road can be made alongside of or near to the flume, the method of working from the inside of the forms is not to be recommended, but, where this procedure cannot be avoided, the type of sheeting adopted, whereby the wall forms are built up as they are filled, has the advantage that the minimum amount of lifting of the concrete is attained. Further, as the concrete is never far below the top of the forms, it can easily be well spaded and worked against them in order to obtain a good surface without employing an unduly wet mix. A slight disadvantage arises from the fact that the pieces of sheeting are not exactly of the same width so that the last piece does not coincide with the level of the top of the concrete in the wall and cannot be used as a screed for striking off the top of the concrete. By marking the top of the wall on each of the studs, however, it was found that a man could trowel the top of the wall with sufficient accuracy to satisfy the eye.

The work was carried on by the labor of the Hydro-Electric Department of Tasmania, of which J. H. Butters is chief engineer and general manager, and A. H. Bastow engineer for hydraulic construction. The writer was resident engineer on the diversion scheme and was assisted by A. E. Kelso, who was in immediate charge of the concrete work.

W. NIMMO, Assistant Engineer,
Hydro-Electric Department.

Hobart, Tasmania, May 8.

Deflection vs. Impact in Concrete Road Tests

Sir—In *Engineering News-Record* of June 29, 1922, p. 1065, there appears an editorial pertaining to the Pittsburg (Cal.) roads tests. I was much interested in this article, as well as the detailed article on page 1066.

In the fourth paragraph in the article on p. 1065 reference is made to the disintegration beginning at construction joint and transverse cracks and emphasizes the effect of impact on a road surface. Unfortunately, due to the volume of detail work in connection with the making of these tests at Pittsburg, accurate and systematic measurements of deflections at transverse construction joints and transverse cracks was not carried on.

From my observation of failures in concrete roads I am firmly convinced that failure is the result of the deflection in a concrete slab exceeding certain permissible amount. From measurements made by myself at Pittsburg I determined to my own satisfaction that slab failure bore a direct relation to slab deflection, regardless of impact. In other words, the transverse crack, whether it be a construction joint or otherwise, weakens the pavement to the extent that a very considerable deflection takes place over that which occurs at points where there is no transverse crack. The amount of this deflection is in most cases determined by the character of the subgrade. It is interesting to know that no failures occurred over the tunnels where all of the impact tests were conducted. Some of the roughest concrete roads in California have stood up much better than other roads with much smoother surfaces.

The only point that I wish to make is that the word "deflection" in my opinion, should be substituted for "impact" in the great majority of cases where failure in concrete slabs is under discussion. E. E. EAST.

Los Angeles, July 10.

NEWS OF THE WEEK

New York, August 31, 1922

Rules Issued for Federal-Aid Road Work

Secretary of Agriculture Outlines Policies to Govern State Highway Departments

Rules and regulations for administering the federal highway act of Nov. 9, 1921 have been promulgated by the Secretary of Agriculture, for whom the work will be carried out under the general direction of the U. S. Bureau of Public Roads. The chief points in the new regulations are summarized below:

On request the state highway departments, before any agreement is reached regarding road construction, shall furnish information regarding state legislation, organization and equipment of the highway department, funds available and provision for maintenance. Each state is required to file with the Secretary of Agriculture a statement showing the proposed federal-aid highway system, and indicating the primary and secondary routes, constituting, respectively, three-sevenths and four-sevenths of the so-called 7-per cent system. The Secretary will inform the state highway departments of the acceptability of the system and when agreement is reached on the whole or a part of the system the state shall make a formal request for approval. Pending formal approval, only such projects will be approved as are on routes indicated on the proposed federal-aid highway system. After the federal-aid highway system shall have been selected, designated and approved, no project statement shall be submitted for any route or part of any route not embraced in the system. Until plans, specifications and estimates of cost for the project shall have been found satisfactory, no project shall be placed under contract.

Advertising Essential

Grade crossings shall be classified for priority between the state departments and the Bureau of Public Roads. No part of the expense of surveys, plans, specifications or estimates prior to the beginning of construction work shall be included in the estimate or paid by the federal government. No federal money shall be paid "until it has been shown to the satisfaction of the Secretary of Agriculture that adequate methods, either advertising or other devices appropriate for the purpose, were employed, prior to the beginning of construction, to insure economy and efficiency in the expenditure of such money." If the contract be awarded to any other than the lowest responsible bidder, the federal government shall not pay more than its pro rata share of the lowest responsible bid, unless it be shown that it was advantageous to the work to accept the higher bid.

No part of the money appropriated under the act shall be used directly or indirectly to pay or to reimburse a state, county, or local subdivision for the payment of any premium or royalty on any patented or proprietary material, specification, process or type of construction, unless purchased or obtained on open actual competitive bidding at the same or a less cost than unpatented articles or methods, if any, equally suitable for the same purpose.

Bids Opened on $4,600,000 of Road Work in North Carolina

The North Carolina State Highway Commission received bids at Raleigh, Aug. 30, for the construction of 197 miles of state highways, estimated to cost over $4,600,000. Of this amount $839,000 is for reinforced-concrete bridge and culvert construction.

About 120 miles are of standard plain or reinforced concrete, or asphaltic types of paving; 9 miles are of waterbound macadam; and 68 miles are of topsoil, sand-clay or gravel construction. It is believed that this is one of the largest lettings of state highway construction ever offered by a state highway department in a single day.

Philadelphia Building Congress Is Organized

At a meeting in Philadelphia recently of the construction conference group which has been functioning during the past two years informally along lines conforming to the activities of the National Federation of Construction Industries and of the New York Building Congress, the organization of what is to be known as the Philadelphia Building Congress was effected. Matters transacted at the meeting included adoption of the constitution and by-laws, the creation of several committees with important functions, and the election of officers, *pro tem.* Officers elected were: President, D. Knickerbacker Boyd; vice-presidents, James W. Pearce, Edwin L. Seabrook, and Harry C. Woods; secretary, H. J. Baringer; and treasurer, Herbert L. Towle.

Educational Classes by Chicago Chapter of A.A.E. to Reopen

Classes on "Railway Management" and "City Management," which were inaugurated last winter by the Chicago chapter of the American Association of Engineers, will be reopened in September. The former will cover the work of station agent, yardmaster, trainmaster, roadmaster, superintendent and division engineer. The latter will include budget making, taxation, charters, municipal corporations, public accounting, civil service and the purchase and issue of supplies. A third class is proposed and three subjects for this have been submitted for vote of the members: "Engineering Administration" "Business Administration" and "Building Superintendence."

Flood-Control Legislation Hearings Postponed

Meetings Planned in Hope That Those Most Interested May Decide on Form of Legislation Wanted

Washington Correspondence

Hearings set for September 5 before the flood-control committee of the House of Representatives, at which further flood-control legislation was to be discussed, have been postponed in the hope that those most interested in the legislation may agree on the form it will take. Some of the people in the lower Mississippi Valley are demanding that the federal government pay the entire expense of bringing the levee line up to the grade and cross-section recommended by the Mississippi River Commission, and in addition leveeing the trbutaries and outlets of that stream. They contend that the flood waters originate in many states and reach dangerous heights on the lower stretches of the river because all natural reservoirs have been eliminated and because tile drainage on northern farms and other works of development make for a more rapid runoff.

Contrary Views Held

Others in the lower valley contend that the federal government is not likely to agree to assume the entire burden of flood control and even if it did would continue its levee work in the same halting manner made necessary in the past by the limitation put on appropriations. Since the losses from a single overflow are greater than the entire amount involved in completing the levee system, this faction proposes that the local interests pay the entire bill. This plan, they argue, has the advantage of allowing the work to be done under continuing contracts under which levee building could be prosecuted as rapidly as physical conditions permit. Since most of the levee boards in the lower valley have not only exhausted reserves but anticipated incomes for several years in making the recent high-water fight, it is proposed that the federal government advance $50,000,000 for bringing the levees up to standard and for the construction of levees on tributaries and outlets. The amount is to be covered by levee board bonds bearing interest at the rate of 4½ per cent, to be repaid on an amortization plan which will allow their liquidation during a period of forty years.

There is still another faction in the lower valley which favors additional appropriations under the existing flood-control act. Practically all of the money authorized by this act has been appropriated. Under the terms of the flood-control act two-thirds of the cost of levee construction is paid from the federal treasury.

With such divisions among those most interested in the legislation, it is recognized that the chances would be better if the local interests can decide among themselves which form of legislation they will urge.

State Water-Works Convention at Filtration Plant

The filtration plant of the water-works at Gastonia, N. C., has been chosen as a meeting place for the North Carolina Section of the American Water Works Association, Nov. 14 and 15. There will be an exhibit of water-works appliances. The program includes a variety of topics to be presented by some two dozen speakers. The secretary-treasurer of the association is Prof. Thorndike Saville, of Chapel Hill.

Street Sanitation Association To Meet in Chicago

The International Association of Street Sanitation Officials will meet in Chicago Oct. 9 and 10, with headquarters at the Hotel La Salle. There will be morning and afternoon sessions Monday, Oct. 9. It is expected that the following day will be devoted to a boat trip to the locks of the Chicago Sanitary Canal. The date has been changed from that given in an earlier announcement on account of the meeting of the American Society for Municipal Improvements at Cleveland, Oct. 2-6. The president of the association is W. J. Galligan, Bureau of Streets, Chicago, and the secretary is A. M. Anderson, 10 S. La Salle St., Chicago.

Complete Cofferdam No. 2 at Wilson Dam

Rapid progress is being made by the Army engineers in the construction of cofferdam No. 2 across the north channel of the Tennessee River at the Wilson dam, Muscle Shoals, Ala. It probably will be possible to start the work inside of this cofferdam before Oct. 1 when the $7,500,000, recently appropriated, becomes available. With that money it is intended to continue raising the section of the dam already started and to complete the foundations for the power house. The remainder of the appropriation will be used to carry forward the construction of the power house just as far as the money will permit.

Military Engineers at Ball Game

Col. T. L. Huston, a director of the New York Post, Society of American Military Engineers and part owner of the New York Yankees, entertained the members of the post at a double-header session between the Yankees and the St. Louis Browns on Aug. 25.

British Engineering Joint Council Formed

According to a recent communication from the British Institution of Mechanical Engineers and Engineering Joint Council composed of representatives of the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects and the Institution of Electrical Engineers has been formed. The object of the Joint Council will be, among others, to improve the status of engineers, to secure the better utilization of their services and the appointment of properly qualified individuals to responsible positions, and to prevent the unnecessary duplication of activities. Emphasis is placed upon the fact that at the present the Joint Council is composed of the four principal British engineering societies. However, it may be that the Joint Council will be increased in size but that remains a matter for future consideration for the Council and the institutions concerned.

Hydro Works for Gatineau River

Following negotiations which have been in progress during the past five years the Hull Electric Co., Hull, Ont., Can., has acquired a large number of properties along the shores of the Gatineau River, including riparian rights to Paugan falls situated about 35 miles from the city, and upon a selected site later on will commence the construction and installation of a hydro-electric power development which will have an ultimate capacity of 150,000 hp.

This development involves the constructon of a concrete dam 125 ft. high; and will form a reservoir above the dam about 15 miles in length. It is understood the ultimate cost of the scheme will be in the neighborhood of $10,000,000.

It is also understood the final surveys in connection with the Paugan falls development will be undertaken this fall, and that construction work will be started next summer.

Flood Outlet for Lower Mississippi Proposed

New Orleans Engineer Committee Would Divert Flood Waters to Lake by Spillway

A report has been drawn up by a committee of five New Orleans engineers recommending an artificial outlet six miles below Jackson Barracks, New Orleans, by which flood waters of the Mississippi River will be discharged into Lake Borgne. The committee reports that a spillway 6,000 ft. wide and about 5 miles in length at such a location could be built for between $4,000,000 and $5,000,000, including the price of the land that would have to be purchased. No outline of the plan for raising the money or for obtaining legal authority to undertake the work is included. The report was submitted to the Safe River Committee of One Hundred by the following five men: John Klorer, city engineer, chairman; Col. Allison Owen, Prof. W. B. Gregory, J. B. Kemper and Hampton Reynolds. This report, which is the first definite relief measure proposed for the Lower Mississippi, will be placed before Major-General Lansing H. Beach, Chief of Engineers, U. S. Army, within the next few days during his visit to New Orleans.

Spillway Believed Justifiable

The committee has investigated the records of the New Orleans water purification plant and has found that there seems to be no direct ratio between the higher gage heights and the degree of turbidity of the water during floods. Therefore, if the river is capable of carrying in suspension its maximum load of silt with slopes such as it has at stages 6 or 7 ft. below the maximum height, the fear that it may drop its sedimentary load as a result of lowering this height below the spillway may justly be questioned.

The proposed spillway would give a discharge of 30,000 sec.-ft. with the Canal Street river gage at 16 ft., and a discharge of 250,000 sec.-ft. (or a lowering of the river height of 4.2 ft.) when the Canal Street gage would stand at 20 ft.

ABOVE—PROGRESS MADE ON COFFERDAM NO. 2, WILSON DAM, ON JULY 1, 1922. BELOW ONLY OPENING LEFT ON AUG. 2, 1922

Conservation Association Formed in Texas

Pertinent Hydraulic Data to be Compiled —Engineer Council Outlines Needed Work

Conservation in Texas continues to be a live issue, and the Texas Conservation Association, formed at Waco, Aug. 16, represents the first actual step taken by the state in the control of its flood waters. Following closely on the heels of a meeting of Texas civil engineers called Aug. 7, at Austin by Governor Neff to formulate plans for flood protection, the Waco meeting presented the same subject to the engineers and the business men of the state combined and Leonard Tillotson, of Sealey, was chosen president. Homer D. Wade of Fort Worth, assistant manager of the West Texas Chamber of Commerce, who issued the call for the conference, was elected secretary-treasurer. Vice-presidents selected were: Carl S. Guinn, Ballinger; John M. Lawrence, Bryan; W. D. Wilson, Bay City; E. C. Snow, La Feria; Sam T. Morgan, Dallas; J. A. Kemp, Wichita Falls; and W. T. Eldredge, Sugarland.

Plan of Organization

The plan of organization suggested and adopted provides for an annual meeting to be held on the second Tuesday of July at which officers will be chosen. Other meetings are to be held at the call of the president or when requested by five or more members of the legislative committee. A feature of the plan of organization calls for an advisory council of engineers which is made up as follows: Chairman, Dean T. U. Taylor, University of Texas; John B. Hawley, Fort Worth; C. T. Bartlett, San Antonio; E. E. Sands, Houston; Fred A. Jones, J. C. Nagle, E. N. Noyes, Dallas; W. F. Shaw, Mercedes; F. A. Merritt, Galveston; V. L. Sullivan, El Paso; E. H. Sellards, Texas Bureau of Economic Geology; R. A. Thompson, Wichita Falls; and W. B. Tuttle, San Antonio.

Instructions to the engineer committees for the fifteen drainage areas of the state, covering methods to be followed in securing rainfall, streamflow, dam-site, flood-mark, and other essential data were to be sent to these district chairmen by the council by Aug. 25. The council has also begun a comprehensive, detailed study of the needs of the State Reclamation Department and the State Board of Water Engineers, and will submit suggestions as to the scope of the works to be undertaken and accomplished by them, respectively, during the coming two years, with estimates of probable cost.

Seek Legislative Support

Among other resolutions, one was addressed to the state legislature urging "the importance of extending to this movement for reclamation and flood control the active co-operation of the departments of the state government, by directing the State Board of Water Engineers, and the state reclamation engineer to secure at as early a date as may be practicable a topographic and hydrographic survey of the watershed area of the principal streams of Texas; to make stream measurements, with estimates of the volume of flood waters such stream channels are capable of discharging; to prepare estimates of the volume of surface and flood waters to be controlled, and the storage capacity essential to their conservation; to ascertain the location of reservoir sites, with estimates of capacity and the cost of impounding dams; to investigate the feasibility, usefulness and probable cost of straightening stream channels, and by directing the proper state agency to conduct a survey of agricultural land in the watersheds of rivers most affected by soil erosion, and to make recommendation thereon"; and to provide funds to enable the said departments of the state government to develop and assemble such engineering data as expeditiously as is consistent with accuracy and reliability.

Montreal Approves Port Improvement Plans

Plans for the improvement of Montreal harbor involving an expenditure estimated at $4,319,849 have been officially sanctioned by Hon. Ernest Lapointe, Canadian Minister of Marine. The following are the important works to be constructed: Grain elevator, $2,347,000, with an initial capacity of 2,000,000 bu. and an ultimate capacity of 8,000,000 bu.; extension to the high-level quay walls, $475,000; extension of wharves and piers, $900,000; improvement of the channel approach, $97,849; and paving and extension of harbor railway terminal, $50,000. The money will be provided from a loan of $5,000,000 made by the government to the Harbor Commissioners. The construction of a bridge to the south shore has been definitely decided upon and $50,000 have been appropriated for preliminary work and plans. The bridge, estimated to cost approximately $10,000 000, will be built under the supervision of the harbor engineering staff and preliminary work is now in progress.

Logging Trucks are Washington Road Menace

In the State of Washington logging operations in which motor trucks are used to transport logs from woods to boom have been operated with loads of 18 tons, and it is claimed by logging companies that it is unprofitable to operate with smaller loads. A gross load of 12 tons per vehicle is the maximum permissible loading that may now be operated over Washington highways and as a result the transporting of logs by truck has materially decreased. The logging truck is charged with causing practically all the damage to Washington highways that has resulted from the operation of vehicles. The Washington standard for state highway paving calls for a minimum center thickness of 6¾ in. on which, state highway officials assert, anything now operating on pneumatic tires is unlikely to cause damage.

Mediators Fail to Settle Shop-Crafts Strike

Following the general meeting of the Association of Railway Executives held in New York last week a group of railroad presidents representing 52 companies, aggregating 85,000 miles of line, continued in conference with the leaders of the five train-service brotherhoods who had been acting as mediators in the shop-crafts strike.

These executives were unwilling to agree to any plan of settlement that would affect the rights of loyal employees and those hired since July 1, but were willing to pledge themselves to find employment at the same terminal points as before, at their usual class of work, and at the Railroad Labor Board rate, for all strikers not guilty of proved acts of violence.

The roads disclaimed any desire to curtail the pension rights or other privileges that the strikers had earned by virtue of their term of service and offered to take the men back with such privileges unimpaired. These roads stated that they were in position to do this without prejudice to the rights of the loyal employees.

The proposal contemplated further that if after the men returned to work there remained any unsettled disputes that could not be settled in conference, such matters should be referred for final determination to a commission of ten members to be composed of the five train-service brotherhood executives acting as mediators and five railroad executives experienced in such matters.

This proposal was rejected by the shopmen, largely on the ground that separate agreements with the roads in question would weaken the position of the men of other roads now on strike. The mediators have given up hope of a settlement at this time, and both railroad executives and shop-crafts leaders express their intentions of carrying on the struggle to a finish.

Corps of Engineers to Utilize Water Transportation

Due to the transportation situation and the likelihood of there being a car shortage throughout the winter, the Corps of Engineers expects to resort to water transportation in securing the materials needed for their river and harbor projects. Difficulty already has been experienced in securing deliveries of cement. To supply its Ohio River projects, the Corps of Engineers is bringing cement by barge from Hannibal, Missouri.

Texas Bonds Bring Premium

The highest bids offered on bonds of the city of Dallas for some time past were received recently by the Board of Commissioners when a premium running as high as 5½ per cent was offered in the fourteen bids opened. Three issues of city bonds were involved, amounting to $800,000, including a $560,000 street-improvement issue, the $140,000 school issue, and the $100,000 sanitary sewer issue, all bearing 5 per cent interest and maturing in forty years. The actual price offered was 105.57.

New York Mayor Plans Municipal Rapid Transit System

Plans for a city-owned and city-operated rapid transit system for New York have been announced by Mayor Hylan of that city. The proposal contemplates the "recapture" of about 100 miles of existing subways now operated by private companies and the construction of 126 miles of new lines, together with new cross-river tunnels and bridges and a $25,000,000 bus system. The cost is estimated at $600,000,000 which, together with the $300,000,000 of city investment in the existing subways, would make a total municipal transit investment of $900,000.000.

The plan for operation contemplates the termination, as soon as legally possible, of the existing partnerships between the city and the two operating companies, the Interborough Rapid Transit Co., and the Brooklyn Rapid Transit Company. The fare on the new system is to be fixed at 5 cents and universal transfers between its lines are to be issued.

It is anticipated that the submission of this plan at this time as an offset to that of the Transit Commission, the only body having legal authority to initiate and carry out transit improvements (see *Engineering News-Record*, May 18, 1922, p. 842) will have an important influence on the fall political campaign in New York State. The Transit Commission was created by legislation fathered by Governor Miller whose term expires next January; and the city administration has been consistently hostile to the commission's conduct of transit matters and its plans for transit expansion. The plans of the Transit Commission are blocked, owing to the necessity of its obtaining funds for construction from the New York city administration; and the Mayor's plans are blocked because of the necessity for the approval of the Transit Commission. It is difficult to see how the deadlock can be broken except by further legislation or by a political overturn, either in the state or the city. The outlook for actual transit extension in the near future is, therefore, not overbright.

The announcement of Mayor Hylan's transit plan makes no reference to any engineer or other technical advisor, as being responsible for, or associated with, its preparation.

Part of Pacific Highway Paved 27 Ft. Wide

A portion of the Pacific Highway extending 4.9 miles to the north from the city limits of Seattle, Wash., is being paved with concrete 8 in. thick and 27 ft. wide. The work is being done by the Washington Department of Public Works, Division of Highways, and is one of those projects on which federal-air funds are used. The paving is being placed in two 13½ ft. sections with a ⅜-in. expansion joint between. The work is to be completed this fall at a total cost of about $46,800 per mile.

In order to accommodate traffic going through the city to this road, the city of Seattle has recently built within the city limits 5 miles of concrete paving 40 ft. wide and 8 in. thick, connecting with the Pacific Highway at the city limits.

The Engineer in Public Life

JOHN T. FULLER

Chief executive of an industrial community with a population varying from 2,500 to 7,000 is one of the duties of John T. Fuller, superintendent of the American Bauxite Co. at Bauxite, Ark. He was born in Wilkes Barre, Pa., Nov. 8, 1880, and was graduated from Lehigh University in the class of 1903. His experience has included service as engineer and mine manager with the DeBeers Consolidated Mines, Ltd., in South Africa, and with both American and Canadian mining companies.

At Bauxite the company owns the entire town, land and buildings, and Mr. Fuller's appointment as superintendent marked a reorganization of the whole method of town administration. He appointed a town manager and organized to operate under that official departments of police, fire, sanitation, streets, etc. Acting in an advisory capacity with the town manager is a town council chosen from among the best citizens, both men and women, of the community. A director of personal relations was another of Mr. Fuller's appointees and under his supervision departments of safety, labor, commissary, and medicine are operated. The whole scheme of town government developed by Mr. Fuller aims to avoid as far as possible any interference on the part of the company with its employees and to protect their rights and liberties as citizens of the community. Among other activities was the organization of school districts, serving about 600 pupils and requiring 18 teachers and three school buildings.

Washington Water Conduit Award

The War Department, through the chief of engineers, has authorized the award of a contract to the Arundell Corp., Baltimore, Md., for the construction of the new water conduit from Great Falls, Va., to the Dalecarlia reservoir at the District line, a distance of eight miles, at a cost of $2,058,725. Army engineers expect the work will begin Sept. 1, and be completed June 30, 1924. The construction will be of concrete.

Pittsburgh Creates Department of City Planning

A City Planning Commission has been appointed at Pittsburgh, Pa., with Morris Knowles, consulting engineer, Pittsburgh, as chairman, and Frederick Bigger, secretary. U. N. Arthur is chief engineer and Charles F. Miller is assistant chief engineer. Included in the nine members of the commission besides Mr. Knowles and Mr. Bigger, is Charles A. Findley, chief engineer of the Pittsburgh Department of Public Works.

Railroad Strike Now Key to Coal Supply

Congress Averse to Coal Legislation Unless Carriers Fall Short—Expect Anthracite Peace

Washington Correspondence

Principal emphasis is being placed by those opposed to legislation looking to the control of coal prices and distribution on the argument that such control no longer is needed. Many law makers are of the opinion that the situation is such that it can take care of itself. Those who favor the legislation might be willing to accept the argument if they were sure that the railroads could function at a high rate of efficiency. With the uncertainty as to railroad operation, however, they contend that this control must be established. They contend that at the end of price control in 1919 everyone was confident the situation would take care of itself but they point to the profiteering in coal in 1920 as a glaring instance wherein the government did not function in the protection of the public. They think the country is in much the same frame of mind now but they deprecate statements creating a false sense of security.

Coal Stocks Gone

Theoretically at least, all stocks of coal now have been wiped out. Whatever stocks there may be in fact are known to be negligible and too low to enter the winter with safety. The market cannot be expected to tranquilize until a considerable amount of coal has been put in storage. How soon such a point can be reached depends entirely on the service which the railroads can give. The American Railroad Association makes the ambitious estimate that the carriers can transport 9,000,000 tons weekly. At the National Coal Association it is thought that 8,000,000 tons is the maximum. Disinterested traffic men, however, point out that if coal shipments reach 8,000,000 tons of bituminous, in addition to the anthracite that is expected soon to be moving, and at the same time, the usual volume of other freight is handled, the railroads will have performed an extraordinary feat.

There is an increasing feeling among officials in Washington, however, that the railroad managements are not being entirely frank with them or with the public. They seem to think that the situation with regard to railroad equipment is much worse than the railroads are willing to confess, to say nothing of their ability to attain a high degree of efficiency with the morale of its employees in its present state. The attitude of the railroad executives is compared with that of the coal operators early in the strike, when they declared it would be crushed flat by July 1. The railroad management seems to be just as sure that the strike is beaten, but officials in Washington have evidences that the men are possessed of determination not to yield.

It is fully expected that an agreement will be reached promptly in the anthracite field and that the mines there will reopen after Labor Day. It is expected that the operators will recede from their demand for arbitration and that the men will be forced to recede from their demand for a two-year contract.

Convention Features, New England Water Works Association

Features of the forty-first annual convention of the New England Water Works Association to be held at New Bedford, Mass., Sept. 12-15, are a carefully selected list of papers, Superintendents' Day, two excursions, a golf tournament, and an exhibit by the manufacturers.

The water-works of New Bedford will be described and experiments with substitutes for lead as a jointing material for cast-iron pipe will be outlined by Stephen H. Taylor, superintendent of the New Bedford Water Works. Among the other papers scheduled are: "Service Pipes," by David A. Heffernan, superintendent of water-works, Milton, Mass.; "Cross Connections for Private Fire Protection," C. M. Saville, chief engineer, Hartford water-works; "Meter Setting and Maintenance," James A. McMurry, assistant engineer, Department of Public Works, Boston; "Legal Points in the Purchase of a Water Company," Henry A. Symonds, Boston; "Water Supplies of Southeastern Massachusetts," X. H. Goodnough, chief engineer, Massachusetts Department of Health; "The Water Supply of Fall River," H. K. Barrows, Boston; "A New Method of Purifying Water," Harry W. Clark, chief chemist, Massachusetts Department of Health; "The New Water Supply of Providence," Frank E. Winsor, chief engineer, Water Supply Board, Providence; and "Hydrogen-Ion Determination," Robert Spurr Weston, Boston.

One session will be devoted to high-pressure fire service. The Boston system will be taken up by Frank A. McInnes, engineer, Water Division, Boston. The underwriters' viewpoint will be presented by George W. Booth, chief engineer, Board of Fire Underwriters, New York City. There will be short statements by fire chiefs on the value of high-pressure service.

The first of the two excursions will be an automobile trip over the New Bedford water-works on Tuesday afternoon, and the second excursion will be on Thursday afternoon, by steamer on Buzzards Bay to Fairhaven, then by trolley to Fort Phoenix where a clam bake will be served at 7:15 p.m., after which there will be music and dancing, and finally a return trip to New Bedford by trolley.

Details of the golf tournament and other features are given in the programs of the convention, which may be obtained from Frank J. Gifford, secretary, Tremont Building, Boston.

Engineering Institute of Canada to Meet in Winnipeg

Arrangements for the thirty-sixth annual professional meeting of the Engineering Institute of Canada, which is to be held in Winnipeg Sept. 5-7 have been completed. Considerable attention is to be given hydro-electric development, and a luncheon is to be served at the plant of the Manitoba Power Co. An inspection of the Winnipeg hydro-electric power plant, followed by a dinner served by the Winnipeg Hydro System is another feature. Discussion will also be given railway terminals and highways as well as other engineering topics.

Start Construction on Lincoln Highway Ideal Section

Construction work on the Ideal Section of the Lincoln Highway between Dyer and Schererville, Ind., was begun this month under an agreement with Stone & Webster, Inc., of Boston, under whose direction J. C. O'Connor & Sons, of Fort Wayne, Ind., will build the concrete roadway. The design calls for a 40-ft. width, paved with a 10-in. thickness of reinforced concrete, which, with appurtenances, is estimated to cost $100,000 a mile.

Civil Service Examinations

UNITED STATES

Applications for civil service positions listed below should be addressed to the United States Civil Service Commission, Washington, D. C., or to any local branch of the Civil Service Commission.

For vacancies in the Public Health Service: Technical assistant in Sanitary engineering, $1,500 to $1,800 per year; junior assistant sanitary engineer, $1,960 per year; and assistant sanitary engineer, $2,500, $2,800, $3,150 and $3,250 per year. Examinations (for junior assistant sanitary engineer and assistant sanitary engineer postponed from Aug. 9) Sept. 6.

Engineering Societies

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal, Que.; Professional Meeting, Winnipeg, Man., Sept. 5-7.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, San Francisco, Oct. 4-9.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Convention, Cleveland, Oct. 16-19.

The Texas Section of the American Society of Civil Engineers will meet Oct. 20 and 21 at San Antonio. Seven subjects are scheduled for discussion among which are the following: "Strength of Concrete," by F. E. Giesecke; "Levee Building in Texas," by A. A. Stiles; "Report on Governor's Engineering Conference," by E. N. Noyes; "Bridge Problems of Texas Highway Department," by G. G. Wickline, and "The Water System of Corpus Christi," by C. J. Howard.

The Akron Engineering Council has been organized to co-ordinate the activities of all local engineering societies. The Council was organized by representatives from the Engineering Society of Akron, the American Association of Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. H. T. French of the Herberich-Hall-Harter Company, is chairman of the Council and R. R. Metheany, division engineer with the Pennsylvania R.R., is vice-chairman.

Personal Notes

E. H. QUINNEY, has severed his connection with the South Dakota Highway Commission by which he was employed as resident engineer, and has gone into business under the firm name of the Dakota Highway & Materials Co., Watertown, S. D.

J. G. G. KERRY, a consulting engineer of Toronto, Can., has been retained by the City of Vancouver, B. C., to report on a suitable site upon which a municipally-owned hydro-electric power plant is to be constructed.

JOHAN STÖRE, civil engineer, Christiana, Norway, whose experiments on the use of a large canvas hose to make temporary low dams as described in *Engineering News-Record*, May 26, 1921, p. 911, is visiting in this country.

ARTHUR BUX, until recently in the city engineer's office of Springfield, Ill., has been appointed city engineer of Manhattan, Kan. He will assume his new duties Sept. 1.

T. D. MYLREA, for the past few years employed by Norman McLeod, Ltd., engineers of Toronto, Ont., and formerly in the city architect's office, has been appointed assistant professor of structural engineering at the University of Illinois.

THOMAS M. HATCH, formerly of the Summitt Construction Co., is now a member of the Sterling Constructors, street, highway and sewer contractors, of Akron, Ohio. Mr. Hatch has for some time been prominently identified with the Associated Pennsylvania Highway Contractors.

F. M. DOBSON has been elected professor of hydraulics at the University of Kansas to succeed Prof. Jones who recently resigned.

CHARLES D. CAMPBELL, for the past four years engaged in surveying and general engineering work in Hamilton, Ont., has been appointed city engineer of Belleville, Ont. Mr. Campbell is a graduate of the University of Toronto. He was former city engineer of Galt, Ont., and at the same time acted as resident engineer for the Galt, Hespeler & Preston Ry.

J. P. POPE, former chairman of valuation for the Southern Pacific Co., has been appointed consulting valuation engineer for the company's Pacific System, effective immediately. Other valuation department appointments announced by the company are: G. E. B. WELLES, supervisor of land valuation, appointed engineer of land valuation with jurisdiction over land valuation work; and J. H. BAKER, office engineer, valuation department, appointed assistant engineer of valuation with jurisdiction over engineering valuation matters. These three men will

continue to make their headquarters in San Francisco.

ROLLEN J. WINDROW, of Kansas City, a consulting engineer in the service of the Missouri State Highway Commission, was in Washington, D. C., last week conferring with officials of the Bureau of Public Roads in regard to Missouri projects and plans.

C. E. DARE, who for more than two years has been a resident engineer for the Richmond, Fredericksburg & Potomac R.R. Co., has been made engineer of maintenance-of-way. His appointment became effective Aug. 15.

COL. SPENCER COSBY, Corps of Engineers, U. S. Army, has been relieved from duty and station at Savannah, Ga., and assigned to duty at Cleveland, Ohio.

A. W. BUFORD, formerly employed by the U. S. Bureau of Public Roads as highway bridge engineer, has recently been appointed district engineer by the Arkansas State Highway Department.

ALEJANDRO BARRIENTOS, of Havana, Cuba, has been appointed chief engineer of the Province of Havana.

EARL LEWIS MOSLEY, who during the past year has been with the engineering department of the City of Colorado Springs, Colo., as field and office engineer, has been appointed superintendent of construction on the new Colorado Springs city auditorium. Work on the structure, the estimated cost of which is $315,000 began Aug. 5.

C. J. LAUGLIN, former construction bridge engineer for the South Dakota Highway Commission, has resigned to engage in private practice.

CARLOS W. DEL PLAINE, a civil engineer of Minneapolis, Minn., has joined the League of Minnesota Municipalities as field agent, according to a recent announcement by the executive committee.

E. M. HASTINGS, principal assistant engineer of the Richmond, Fredericksburg & Potomac R.R. Co. since March, 1920, has been made chief engineer. His appointment was effective Aug. 15. Prior to being appointed principal assistant he was resident engineer for the road.

D. M. FERLET, assistant engineer of the Terrell Independent Road District, Terrell, Tex., has been made resident engineer, succeeding T. B. TARTT, who has returned to Central America to engage in railroad work.

S. F. FERGUSON has withdrawn from the firm of Nicholas S. Hill Jr. and S. F. Ferguson, consulting engineers, New York, the partnership being dissolved Aug. 31. The firm's consulting practice will be continued by Mr. Hill.

OBITUARY

ALPHEUS P. HANSON, who served four terms as surveyor-general of the state of Wyoming, died in Hollywood, Cal., Aug. 21, aged 66 years.

PROF. AXEL E. BERGGREN, of the department of steam and gas engineering of the University of Wisconsin College of Engineering, died Aug. 10 as the result of injuries received in an automobile accident. Prof. Berggren had been connected with the college of engineering since 1910. He was a graduate of Iowa State College.

HARRY S. RENKERT, president of the Metropolitan Paving Brick Co., of Canton, Ohio, died in Geneva, Switzerland, Aug. 20.

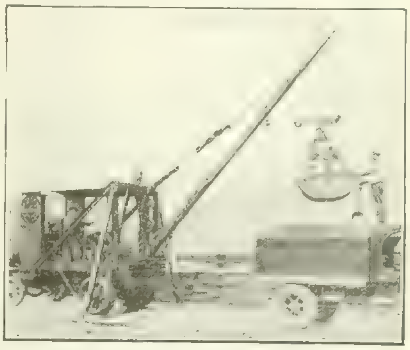
GEORGE J. SATTERLEE, of Brooklyn, N. Y., for the past several years employed by the Department of Water Supply, Gas and Electricity of New York City, at the Gravesend pumping station, died suddenly in Brooklyn, Aug. 21, aged 53 years.

WINSLOW BARNES WATSON, who served as a captain in the 27th Division during the World War, was drowned recently near Plattsburgh, N. Y. He was a graduate of Union College and had been engaged in engineering work on the Panama Canal, and later the construction of the New York State Barge Canal. At the time of his death he was supervising a dam-construction project for the Bluff Point Stone Co. on Mead Brook. He was 42 years of age.

EQUIPMENT AND MATERIALS

Mounts Crane on Truck Chassis

To increase the movability of small cranes the Byers Machine Co., Ravenna, Ohio, has brought out the "Truckrane," which consists of a crane weighing 6 tons mounted on a truck chassis. The



crane has a 30-hp. gas engine and ½-yd. bucket and is similar to the Byers auto-crane model 1 except that it has no wheels, jack shaft, differential or drive chains.

Out-of-the-Ordinary Trade Publications

Freight Elevator Doors—THE PEELLE Co., New York, in a 48-page illustrated catalog, presents the advantages of its counterbalanced freight-elevator doors, safety appliances and interlocking systems. The door consists of a tin-covered wood core and is divided horizontally in the center. The two panels, one moving up and the other down inside the hatch, save floor space and afford full clearance for loading. When the door is open a heavy "truckable" steel bar on top of the lower panel and flush with the floor closes the 4-in. gap between the door-opening saddle and the elevator car, allowing loads to be wheeled over it without impact. The company manufactures also a self-sealing smoke-proof pass type door, approved by the Underwriters' Laboratories. It is designed for buildings where story-heights are limited. In this type one leaf slides over the other on rails and guide shoes and forms a smoke-tight seal. The catalog also describes corrugated steel counterbalanced doors and panel types of various kinds.

Turntable — THE CHAMPION ENGINEERING CO. has issued a leaflet illustrating by photographs the uses of its automatic turntable for handling motor trucks on road construction. The feature of the equipment is its automatic operation. The truck drives up on the turntable and without stopping the motor or changing gears its rear wheels are made to rotate tread wheels which propel the upper structure of the turntable. Locking devices insure safety of operation. The turntable will handle trucks weighing 15 tons and with a wheelbase of 166 in. Transfer rollers are provided for towing the turntable short distances while detachable wheels are furnished for long-distance movements.

Screw Insert Plugs — THE RAWLPLUG CO., New York, describes in an illustrated folder its jute fiber insert plugs for holding screws in any material, such as a brick, concrete or tile wall. The "rawlplugs," as they are called, are cylindrical in shape with a hole through the center, and are manufactured in a variety of lengths and diameters. The company also makes a drill for forming holes into which the plugs are inserted. Standard wood screws are then screwed in, their entrance expanding the jute fiber, compressing it against the sides of the bore and forming a tight fit.

Concrete Block Machinery—THE J. B. FOOTE FOUNDRY CO., Fredericktown, Ohio, sets forth details of its line of Panama concrete and block-manufacturing machinery in a 40-page illustrated catalog. Both hand-power and machine-driven batch and continuous mixers are described, with capacities varying from 3 cu.ft. upward. Molds for ornamental block of a number of styles are pictured and the process of block manufacture with the company's machine is illustrated. The text contains practical suggestions on the use of concrete block for residential buildings, garages and silos.

Fumes in Mining—THE HERCULES POWDER CO., Wilmington, Del., is distributing in the form of a 43-page multigraphed pamphlet a paper by J. Barab entitled, "Fumes Encountered in Mining Operations and Handling of Explosives." It is a compendium of valuable information from many sources, dealing with coal and metal mines and rock tunnels. The text discusses fully the products of explosion and the physiological effects of gases, and curative measures.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Senate Tariff Duties on Construction Materials

Rates Generally Higher Than Under Existing Law But Lower Than Those Imposed by House

Construction material of nearly all classes bears a lower rate of duty in the tariff bill as passed by the Senate than the rates which were provided by the House, but generally higher than under existing law. The Senate put common brick on the free list, whereas the House had provided a 10 per cent ad valorem duty. The Senate imposed a duty of 25 per cent on fire brick, chrome brick and bath brick and a duty of ¾c. per lb. and 10 per cent ad valorem on magnesite brick, which figures are reductions under the House rates, but are materially greater than the duties under the existing Underwood tariff.

Under the Senate bill, tiles will bear a duty of from 5c. per sq.ft. to 50 per cent ad valorem, according to value, which are about the same rates as fixed by the House and are approximately double the rates of the existing law.

While the Senate retained all building cements on the free list, the House bill provided a duty of 5c. per 100 lb. on Portland, Roman and other hydraulic cement in packages and 4c. if in bulk, and a duty of 17 per cent ad valorem on other cements. No change was made by the Senate in plaster cements, so that the House rates will stand in the bill. The Senate, however, placed plaster rock or gypsum in the crude on the free list, whereas the House bill had provided 25c. per ton duty. The rates in the bill, which will be unchanged in conference, are $1.40 per ton on ground or calcined plaster rock or gypsum; 8c. per 100 lb. on white non-staining Portland cement, and $3.50 to $14 per ton, according to value, on Keene's cement and others of which gypsum is the component material of chief value.

Rates on comon window glass are fixed in the pending bill, the Senate having made no change in the House figures, which vary from 1¼@4c. per lb., according to the size. No change was made in the House rates on fluted or other rough plate glass used for sky-lights, fire windows and similar construction, the rates starting at ¾c. per sq.ft. for not exceeding 184 sq.in. and advancing progressively according to both size and weight. The Senate, however, increased the House rates on cast polished plate glass for office buildings and similar uses, the minimum being 12½c. per sq.ft. and the maximum 17½c., while if containing a wire netting the rates range from 15 to 20c. per sq.ft.

A reduction was made by the Senate on granite, freestone, sandstone and other building stone, except marble, breccia and onyx, if dressed or polished. The Senate rate is 50 per cent, which is lower than the House rate of 40 per cent, because it is based on foreign valuation while the House basis was American valuation. The rate on the rough is 15c. per cu.ft. House rates on marble, breccia and onyx were not changed and these will stand in the new tariff law, being 65c. per cu.ft. if in the rough and from 8 to 10c. per superficial foot if in slabs.

The new rates on lime also are definitely known, as the Senate made no change in the House figures and these will stand in the new tariff. The rate on crude limestone, crushed but not pulverized, is 5c. per 100 lb.; common lime, 10c., hydrated lime, 12c. per 100 lb.

Rates on slate, including all manufactures of slate, were reduced by the Senate from 17 to 15 per cent ad valorem, which is a greater reduction than the figures indicate because of the change also from American to foreign valuation.

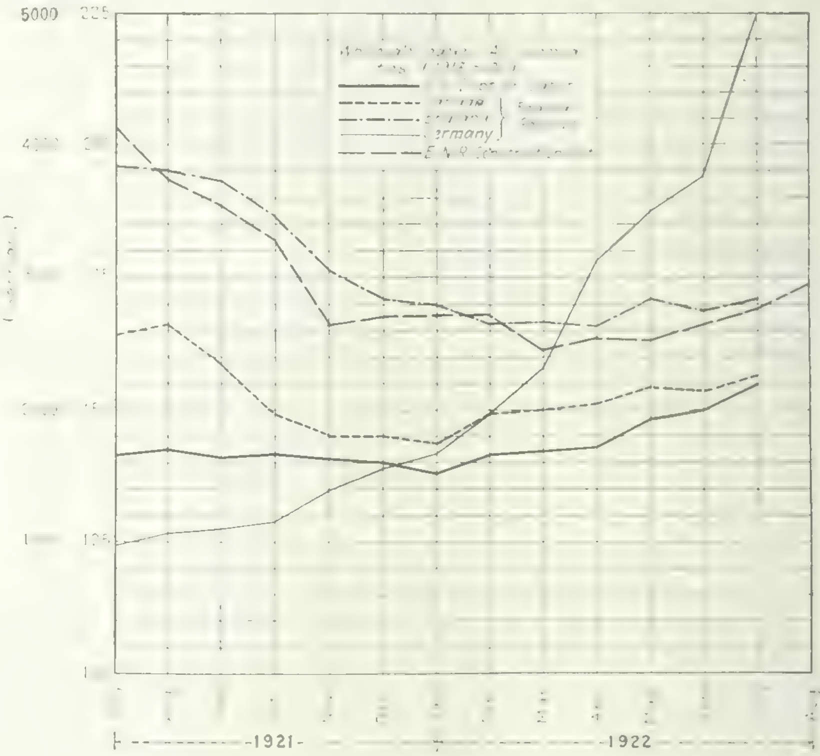
Lumber was left on the free list by the Senate, which also sent to the free list hewn timber, 8 in. or more, on which the House had imposed a duty of ½c. per cu.ft., and logs of fir, spruce, cedar or Western hemlock, on which the House had adopted a duty of $1 per M. ft. b.m. While logs of veneer woods remain on the free list, the Senate wrote into the bill a duty of 15 per cent on them if sawed into boards or otherwise advanced, and imposed a duty of 20 per cent on veneers. Shingles, on which the House had imposed a rate of 50c. per thousand, were placed on the free list by the Senate.

In the last week the tariff bill was under consideration in the Senate, the finance committee reduced the rate on structural steel and iron, if not advanced beyond hammering, from the House rate of $\frac{3}{20}$@¼c. per lb., and reduced to 20 per cent ad valorem the

Trend of Wholesale Prices Upward Since June

Indexes of "All Commodities" In U. S., Canada, England and Germany Point to Higher Levels

The trend of wholesale prices of all commodities continued upward throughout July, according to information gathered in representative markets of the country by the U. S. Bureau of Labor Statistics. Based on 404 commodities, or series of quotations, the Bureau's weighted index number rose from 150 in June to 155 in July, a gain of 3⅓ per cent. The increase from May to June was 1⅓ per cent.



The Federal Reserve index number of wholesale prices in Canada, constructed for the purpose of international comparisons, showed an increase of four points or 2.6 per cent during July (100 in 1913) and now stands at 157. This shows Canadian prices to be running somewhat lower than American prices in terms of the respective currencies.

The index number of wholesale prices in England, constructed by the Federal Reserve Board, returned in July to the May level of 171, by an increase of two points. Using 1913 as a base, prices in England are slightly higher than American prices in terms of the respective currencies. When converted to a gold basis, English prices for the last three months have ranged from 2 to 5 per cent lower than American prices.

The Federal Reserve Board has received a wireless from the American Commissioner in Germany, giving July wholesale and retail price indexes of the German Federal Statistical Office

Bituminous Coal Prices Showing Downward Trend

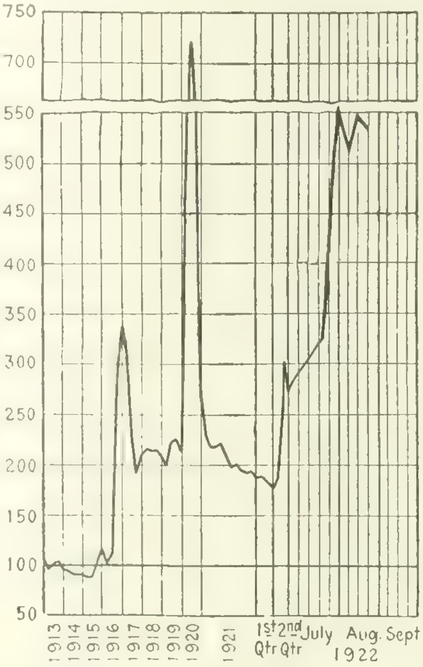
The trend of bituminous coal prices is shown in the *Coal Age* index chart here reproduced. This diagram shows the relative, not the actual, prices on fourteen coals, representative of nearly 90 per cent of the total output of the United States, weighted in accordance first with respect to the proportions each of slack, prepared and run-of-mine normally shipped and second, with respect to the tonnage of each normally produced. The average thus obtained was compared with the average for the twelve months ended June, 1914, as 100, after the manner adopted in the report on "Prices of Coal and Coke, 1913-1918," published by the Geological Survey and the War Industries Board.

Bituminous prices, which soared during the height of the strike, are now on the decline with the heavier offerings, and the end is not yet. They will not, however, recede much further, as industry must replenish its reserve, depleted through the twenty-one weeks of the bituminous coal tie-up.

From Monday, Aug. 21, to Thursday, Aug. 24, inclusive, coal loadings totaled 73,768 cars, an increase of 19,082, or 35 per cent, over the total for the first four days of the week preceding. This represented the largest number of cars loaded with coal during any four day period since the miners' strike began on April 1, last. At this rate, production would be approximately 6,000,000 tons per week or 725,000 tons in excess of the best previous week, which was in June, when there was no strike of railway shopmen in effect.

The increase in coal loadings was due principally to a resumption of mining in the Ohio bituminous fields, resulting from the agreement recently reached by the miners and the operators at their conference in Cleveland. Shipments also increased in the Eastern and Allegheny region, where agreements have been reached by union officials and certain coal operators.

Anthracite, the ideal domestic fuel,



is used almost exclusively as such in the sections within a reasonable freighting distance of the hard-coal mines. Anthracite mining has been paralyzed since April 1. A substitute fuel is therefore necessary, until anthracite production is resumed and the coal begins to seep through, to the householder. Coke will be utilized as well as soft coal.

Twenty-five Big Contracts Total $26,797,892

$15,390,897 For Building Construction Alone—Six Industrial Projects Reach $6,000,000

A list of twenty-six important jobs awarded in February and March was published in the Searchlight Advertising section of the April 20 issue of *Engineering News-Record*. Following this, a table showing fifty big projects placed under contract from March to June, and aggregating $81,960,860, was published in the July 27 issue, p. 169.

The accompanying table shows twenty-five big contracts awarded since June, representing a total value of $26,797,892, over 57 per cent or $15,390,897 of which was for building construction.

There were six industrial projects, aggregating $6,000,000 or 23 per cent of the total for these twenty-five contracts.

Three bridge jobs reach $1,138,410, and three water-works contracts, $2,325,000.

The total value of large engineering contracts let, throughout the United States and Canada, for the week ending Aug. 17, amounted to $34,300,000. Buildings alone totaled $17,307,000 with streets and roads second with $9,605,000.

Industrial projects amounted to $3,387,000 and water-works $1,014,000.

Contracts valued at $9,363,000 were awarded in the Middle West, with $8,793,000 for the Middle Atlantic States. The Southern States came third with $5,004,000 and lettings to the value of $4,547,000 were located in the group west of the Mississippi. Figures for the entire month will be published in the Sept. 7 issue.

ESSENTIAL DATA ON LARGE CONTRACTS AWARDED SINCE JUNE

Place	Work	Size	Price	Successful Contractors
Bahamas, Nassau...	Hotel		$1,000,000	Purdy & Henderson, 45 E. 17th St., New York.
Calif., Palmdale.......	Dam	700 ft. long, 145 ft. high	500,000	Bent Bros., 1714 Eagle St., Los Angeles, Calif.
Calif., San Diego	Theatre and Office	7 stories	1,054,000	Lange & Bergstorm, Tinker Bldg., San Diego, Calif.
Calif., Watts	Sewerage system		442,775	A. W. Phillips, 573 North Hoover St., Los Angeles, Calif.
Conn., Stamford	Water-works		750,000	H. Steers Corp., 17 Battery Pl., New York.
Conn., Thompsonville	Plant		1,000,000	L. E. Locke & Sons Co., South Union St., Lawrence, Mass.
Ill., Chicago	Apartment	10 story, 140 x 170 ft.	2,000,000	Mueller Constr. Co., 179 West Washington St., Chicago, Ill.
Ill., Chicago......	Apartment	10 story, 102 x 230 ft.	1,500,000	Schmidt Bros. Constr. Co., 22 East Huron St., Chicago, Ill.
Ill., Chicago	Plant	6 story, 120 x 280 ft.	1,000,000	G. A. Fuller & Co., 140 S. Dearborn St., Chicago, Ill.
Ind., Ft. Wayne....	Bank	12 story	900,000	M. Irmacher & Son, 118 W. Berry St., Ft. Wayne, Ind.
Ind., Michigan City	Factory	400 x 500 ft.	1,000,000	Witherspoon-Engler Co., 53 W. Jackson St., Chicago, Ill.
Mass., Boston.....	Bridge	790 ft. long	599,150	Crandall Eng. Co., [illegible] Boston, Mass.
Mass., Lawrence...	Plant	6 story, 100 x 500 ft.	500,000	Turner Constr. Co., 178 Tremont St., Boston, Mass.
Mich., Detroit...	Theatre & Office		2,000,000	J. Finn & Son, 708 Amsterdam Ave., Detroit, Mich.
Minn., Duluth	Plant & Warehouse	6 story, 200 x 500 ft.	1,000,000	Jacobson Bros., 406 Columbia Bld., Duluth, Minn.
Minn., St. Paul........	Hotel	16 story, 99 x 112 ft.	1,600,000	Smith & Vandanaker, 501 Exchange Park Bldg., St. Paul, Minn.
N. J., Jersey City	Warehouse	6 story	2,000,000	Lynch Constr. Co., 52 Vanderbilt Ave., New York.
N. Y., Brooklyn	School		1,336,897	Werner-Disken Co., 50 Court St., Brooklyn
N. Y., Green Island, (Troy P. O.)	Plant		2,000,000	F. T. Ley Co., 495 Main St., Springfield, Mass.
N. Y., Long Island City..........	Piers & Bridge		268,900	P. T. Cox Contg. Co., 154 Nassau St., New York
N. Y., New York..............	Department Store	9 story	2,000,000	Cauldwell-Wingate Co., 381 4th Ave., New York.
Pa., Moosic..............	Waterworks		1,000,000	Winston & Co., Amer. Bank Bldg., Richmond, Va.
Pa., Williamsport	Bridge	1500 ft. long	271,170	Bethlehem Steel Bridge Co., Bethlehem, Pa.
Que., Montreal..........	Water-works	25,000,000 gal. reservoir	575,000	E. G. M. Cape & Co., 10 Cartheart St., Montreal, Que.
W. Va., Ronceverte	Plant		500,000	J. G. White Eng. Co., 43 Exchange Pl., New York.
Total			$26,797,892	

Trend of Wholesale Prices

The price trend shown in the chart is weighted according to the consumption of a workman's family at present, including food, fuel, light and rent.

The *Engineering News-Record* Construction Cost Index Number is here shown in comparison with the All Commodities Index Numbers of four nations. The general upward trend of prices since the first of June is graphically illustrated in the five ascending curves.

For Bid Prices on Actual Jobs See Construction News

A correspondent writes that he wants actual cost data on all kinds of construction and asks where he can find such data. Of course every important engineer, contractor and architect will have a certain amount of information applying to specific jobs in which he was interested, but the most comprehensive public reservoir of actual bids and prices is probably the Construction News section of *Engineering News-Record*.

There each week are published the important contract awards in all classes of engineering construction. Wherever possible, on outstanding projects, the unit bids of the three lowest bidders are presented in tabular form. Correspondents are instructed to send in lists of unit bids whenever available. In addition to the tables are the bids included in the contract-award items.

In the last three months unit-bid tabulations have been published for the anchorages of the Philadelphia and Camden bridge (p. 305, Construction News); the Clifton, N. J., sewerage system, p. 326; water-works improvements at Wellsville, Ohio, pp. 328 and 329; a road at Berkeley Springs, W. Va., and a tunnel on the Hetch Hetchy project in California, p. 9, July 6; road work in Florida, p. 17; and for several projects in this week's issue.

(Concluded from p. 374)

duty on structural steel and iron if machined, fabricated for use, or otherwise advanced beyond hammering. The duty on high-speed steel was reduced 7 per cent below the original recommendations of the finance committee two days before the bill passed.

Duty on building forms, sashes and frames of steel or iron was reduced to 25 per cent.

Rates on structural steel in the pending tariff bill are materially higher than under the existing law, which provides a duty of 10 per cent ad valorem.

The Senate cut the House rate on pig iron from $1.25 to 75c. per ton and the rate on scrap iron and steel from $1 to 75c. per ton. These items are on the free list under the existing law.

The Senate reduced to 15 per cent the duty on steam engines.

Weekly Construction Market

THIS [illegible] price list is published [illegible] for the purpose of giving [illegible] prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 3; the next, on September 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$2.[illegible]	$3.65	$4.20	$2.92½	+$3.05	$3.70	+$3.25	$3.75	$3.7[illegible]
Structural rivets, 100 lb.	3.[illegible]5	4.35	6.00	3.[illegible]	3.52½	4.80	4.25	3.75	6.50
Reinforcing bars, ½ in. up, 100 lb.	2.83	3.50	3.50	2.82½	+2.[illegible]	3.[illegible]½	+3.00	3.60	2.90
Steel pipe, black, 2½ to 6 in. lap, discount	[illegible]57%	61.15%	45%	5[illegible]½%	+58.1-5[illegible]%	4[illegible]%	+45.7@49.1%	50%	30.00
Cast-iron pipe, 6 in. and over, ton...	53.30	49.00	51.50	45.20	52.00	57.00	51.00	53.00	50.00
Concreting Material:									
Cement without bags, bbl.	2.[illegible]	2.50	2.25	2.05	2.39	2.[illegible]	2.71	2.90	2.78
Gravel, ¾ in., cu.yd.	1.75	1.85	2.25	12.00	+1.75	1.75	2.25	1.00	1.50
Sand, cu.yd.	1.00	1.15	2.25	12.00	1.00	0.75	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	1.65	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+53.00	40.00	40.00	47.00	40.00	50.00	+33.00	23.00	50.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.14½	1.80	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	—21.30@23.50	11.00	10.90	11.00	+18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	-.0[illegible]	.087	....	.11	.09
Hollow partition tile 4x12x12, per block	.1112	.0776	.115	.0808	....	.087	.108	.11	.0[illegible]
Linseed oil, raw, 5 bbl. lots, gal.	.91	.97	1.13	.99	−1.00	1.12	1.04	.86	1.12
Common Labor:									
Common labor, union, hour	.[illegible]	.35	....	.80	......	.50@.55	.5[illegible]¼	.50@.60	......
Common labor, non-union, hour	.44@.60	.30	.25	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the preceding discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago [illegible] 50-lb. [illegible] lump lime per 180-lb net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.[illegible] for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars; other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at [illegible] cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in. $30; 6-in., $110.

Changes Since Last Week

A 20 per cent wage advance in the steel mills, effective Sept. 1, bringing the rate to 36c. as against 30c. per hour, will also result in an advance of about $4 per ton in steel prices. Structurals are now quoted at $2@$2.10, f.o.b. Pittsburgh, with an absolute minimum of $1.90 for reinforcing bars, on all new business. Steel structurals are scarce; with fabricators quoting on no deliveries before the end of the last-quarter. Shape mills are mostly out of the market on current business. This week, San Francisco warehouses announce an advance of 15c. on steel shapes, followed by a rise of 10c. per 100 lb. on shapes and bars in Minneapolis. Last week, similar advances occurred in Chicago, Dallas and New York; Denver having quoted a rise during the preceding week. Wrought-steel pipe discounts dropped three points on black and two on galvanized on the new Pittsburgh basing card of Aug. 23. Accordingly, similar reductions in pipe discounts occurred in New York, Minneapolis and San Francisco warehouses.

Reports received up to Aug. 24, by the National Lumber Manufacturing Association, show many mills already beginning to decline orders, car shortage [illegible] to run as much as 16 per cent below production, despite the fact that August is the second best lumber month in the year. Long leaf yellow pine, base sizes, quoted in New York at $53 as against $51@$52 and Douglas fir at $33 as compared with $31 per M. ft. b.m. in San Francisco.

Common brick now $18@$20 in New York as against $20 per M., alongside dock, indicating a gradual downward trend in this market. Minneapolis, however, quotes an advance of $1 per M., over the week end. The decrease in New York is due to a slight falling off in demand rather than an increase in production. In view of the present fuel emergency, brickmakers in the districts supplying New York have tried a combination of coke and anthracite coal, finishing with bituminous. Imperfect brick turned out by this process have sold, in odd lots, as low as $17 per M.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

Engineering News-Record

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 89 — NEW YORK, SEPTEMBER 7, 1922. — Number 10

An Enemy of the People

GOMPERS has often maintained that labor should not be limited by the law. And he always runs true to form. The government demands protection of workers against violence and intimidation. Gompers counters with talk of a general strike. The government asks only that illegitimate action be enjoined. Gompers threatens to punish the whole country if it is.

When are we going to be free from his poisonous, justice-destroying rant? He should be supporting the government's efforts. Did he not see red whenever a labor matter is in the courts he would know that his best road to public favor is by quashing the dynamiters, the thugs, the murderers and the intimidators in his own ranks. These are the people who block the labor movement and raise up enemies against it among even the people who are naturally favorable toward the wage earner—the farmers and the people in commercial life, who have no direct contact with industry, mining or the railroads.

But Gompers was raised on rant—and lives by it. The Federation needs a leader who, besides being a hard fighter and an able champion, is clear-headed and strong enough to force his own people to square their conduct with the rights of others. A Theodore Roosevelt in labor's ranks would be a God-send to labor and to the country.

The Temporary Injunction

BUT WHILE condemning Mr. Gompers' outburst we also entertain grave doubts as to the wisdom of enjoining free speech—and that the temporary injunction would seem to do. We realize that simple persuasion easily becomes intimidation, but we must lean over backward when fundamental rights are in question. Nevertheless, that does not condone Mr. Gompers' tirade. He will have his day in court Sept. 11. His present violent expression not only prejudices labor's case but breeds disrespect for the law.

Water-Works Problems and Practice

THE NUMBER and diversity of problems and practice in the water-works field is illustrated by the articles on succeeding pages published in recognition of the convention of the New England Water Works Convention at New Bedford, next week. As time goes on and the arts and sciences tributary to the efficient design, construction and operation of water-works advance, the demand for engineers, chemists, biologists and managers in this great field will also increase, and the increased demand for trained men will be in more than an even ratio with the advance in the tributary arts and sciences, because with the latter there will be an accelerating public demand for water of higher quality and for better and surer service.

A Sign and a Promise

AN INDEX of our civilization that is both a cause for regret and a promise of better things is the motorized laboratory for work among summer resorts operated by the Michigan State Board of Health. "Vacation typhoid" has long been a familiar term of indictment of rural and resort sanitation. A man from Mars would exclaim at the anomaly of city dwellers going to the mountains, the riverside, the seashore or "the good old farm" for their health and thus contracting typhoid. Happily this risk is lessening, thanks to an increase in general intelligence in town and country and to organized public health work, but unhappily there is still much need of improvement.

Why Hartford Chose Slow Filters

NEW ENGLAND has clung to relatively pure sources of supply rather than adopt water treatment and when treatment has been considered advisable, slow sand rather than mechanical filtration has been the rule. This has caused outcry elsewhere but the New Englanders go placidly on. Moreover, they advance reasons, based on regional conditions and local preferences and supported by statistical and other data, that deserve consideration. Witness Mr. Saville's exposition of why Hartford recently built slow sand rather than mechanical filters and his comparison of the cost of the Hartford slow and Cambridge rapid filters. Eventually the strong feeling against mechanical filtration may disappear in New England, as it has in most other parts of America. Until then—and probably until other local conditions than sentiment have also changed—the New England tradition against mechanical filtration and against chlorination as well, will be given weight by engineers who realize the need for recognizing local conditions—particularly the human factor.

Cement Prices

FRANKNESS is, after all, the best approach to controversial subjects. For several years there has been much question as to the reasonableness of cement prices. In particular, a contractors' group, under the leadership of the A.G.C., has declared that they have been too high. Now comes Mr. Burch, of the Atlas Portland Cement Co., and in a frank inquiry lays the pertinent facts on the table. The exposition is satisfying. He studies prices from three different angles: the earnings of the cement companies, the cost of production, and the comparison of prices of cement with those of other building materials. Nor does he dodge in his study of earnings. He plots the returns of the two most profitable eastern companies and of the two worst losers. In giving details of cost of production he shows profit, too. Of course, everyone knows that there is great latitude in what different people might

include in costs, with the consequent effect on profit, but it must be remembered that accounts are now under federal income-tax scrutiny and the percentages written off for depreciation and amortization definitely set. In other words, today's industrial figures are not subject to the variation of personal opinion as they were ten years ago. Mr. Burch's frankness should have more frequent imitation. The public's confidence is the best assurance of business stability and freedom from public persecution. Confidence can be won in large part through such frankness as that displayed in Mr. Burch's inquiry.

Cement-Lined Cast-Iron Pipe

THE use of cement lining to protect the interior of ten miles of cast-iron water mains at Charleston, S. C., promises to be a happy union of a lining and a pipe which, independently, have stood the test of time. For cast-iron pipe leads the materials used for water mains in point of long and universal use and for many decades cement has been extensively used to protect wrought-iron and steel pipe. In fact, cement-protected wrought-iron pipe, both in point of invention and use, antedates tar-coated cast iron by a decade or more. Thus, although a United States patent for cement lining was granted to Jonathan Ball in 1843 and cement-lined wrought-iron pipe was laid by Jersey City, N. J., and by Rockville, Conn., in 1845, it was not until 1849 that Dr. Angus Smith developed his tar coating in England and not until 1858 that it was introduced in America by James Kirkwood. With this lead for protection of wrought-iron pipe, why cement was not used to line cast-iron pipe until 1922 is an interesting question.

The answer lies largely in the fact that cement lining for sheet-metal pipes came into use because for many years these pipes were much cheaper than cast iron but would soon be destroyed without the cement lining and exterior coating invented by Ball and improved later on by Phipps and others. Already in 1858, when Kirkwood introduced Smith's coating, cast iron, *uncoated*, had been in continuous service in this country for a half century and much longer in England and France, and was destined to have a further life not yet determined. In some waters the uncoated pipe rapidly lost carrying capacity through corrosion or incrustation but the physical integrity of the pipe remained. When the tar and linseed-oil coating developed by Angus Smith here, came to the front and for years afterward, it was cheap and of such a quality as to be generally efficient. As the decades passed and water-works and the population they supplied increased rapidly, less desirable sources of water supply were pressed into service. Some of these waters were highly corrosive, so that the lessening diameter, smoothness and carrying capacity of water mains, due to corrosion, combined with the increased demand for water from the same mains, created a need for a better coating than tar and linseed oil. The need is now all the more acute because the general substitution of water gas for coal gas and the increasing industrial demands for tar have resulted in poorer tar coatings than in earlier days. The great increase in water treatment in the past decade or two has added to the corrosion problem, through increasing the corroding and incrusting qualities of some waters.

Cement-lined pipe, first with wrought-iron and latterly with steel as the sheet metal used, soon demonstrated and has since maintained its superiority to tar-coated cast-iron pipe so far as ensuring undiminished interior diameter and smoothness, and thus constant carrying capacity, is concerned. At least this is true where good workmanship in the lining process and neat *natural* cement instead of cement mortar of a possibly nondescript character have been the rule. Poor material carelessly applied leads to failure of the cement lining in spots if not in large areas, thus giving the water access to the thin sheets of wrought iron originally used and the cement-lined steel customarily employed for some two or three decades past. These and other causes brought cement-lined sheet-metal pipe into general disrepute many years ago, except under favorable local conditions and where the pipe was made by improved methods—as at Plymouth, Mass., by the town and for use elsewhere by a pipe manufacturing company. Those who wish to pursue further the history of cement-lined sheet-metal pipe will find a long and valuable paper, by Leonard Metcalf, supplemented by an extended discussion, in the *Journal* of the New England Water-Works Association for January, 1909.

The chief weakness of a combination of cement and sheet iron or steel would be absent in a combination of cement and cast iron. The principal weakness of cement-lined sheet iron or steel was—its weakness; in other words, the thinness of the metal and the fact that the cement was for protection rather than added strength. The argument for cement-lined cast-iron pipe lies, first, in the thickness and ample strength of the metal and, second, in the proved value of cement when properly applied to the water-exposed and friction-causing interior surface of wrought iron and steel. True, there is as yet no experience as to the lasting adhesion of the cement to the cast iron, but there seems to be no reason why it should not adhere at least as well to cast as to rolled metal.

Considering costs, it should be noted that the cost of lining the interior of cast-iron pipe with cement will be much larger than of coating both the interior and exterior with tar; so much larger that the tar coating might be much improved as to the material itself, its preparation and its application, and the cost still be much less than that of cement lining. Against the increased cost for cement lining must be placed the greater carrying capacity of the pipe after a longer or shorter time of service. This, in turn, will depend largely upon the corroding or incrusting character of the water being conveyed.

Reverting to Charleston, the water there is so very corrosive as to cause a rapid decrease in carrying capacity of tar-coated cast-iron pipe; a decrease speedily repeated after the pipe is cleaned. Under such conditions heroic measures are demanded and even a costly preventive of the trouble is warranted.

When and where to resort to water treatment to prevent corrosion or incrustation of water mains, how far to depend upon cleaning as a palliative, to what extent a choice among pipe materials and pipe coatings will avert trouble, and what combinations of these possibilities may prove wise are questions which in the future will more and more frequently confront the water-works engineer. Today, thanks are due the engineers and other officials of Charleston and the co-operating pipe manufacturers for the large-scale trial of cement lining for cast-iron pipe upon which that city is entering.

Publicity Run Mad

SEVERAL weeks ago we questioned the wisdom of reliance on the press-agent to win for the engineering profession that measure of public standing which so many feel is its due. We dwelt then upon its futility. The matter has, however, a darker aspect which recently has become more and more pronounced, until now it is so obvious that it can no longer be overlooked. This is the positive danger that is incurred by a professional society that embarks upon a policy of instigated publicity.

No one can object to a press-service or to the press-agent so long as he is restricted to his legitimate function of purveying the genuine and uncolored news of a technical society. This is a real service, of value alike to the society, to the press and to the public at large. No one can object, moreover, to a society press-service that under the curb of technical guidance and restraint submits for publication news of popular interest concerning engineering developments aside from the doings of an individual society or group. Legitimate technical publicity work has been defined as "doing something and then telling about it," and so long as the telling is honestly done we have not the slightest quarrel with such a practice. The dangers lie in the perversions of this legitimate and worth-while activity. These at first may seem quite harmless but eventually they will strike at the root of the professional standards that are in the keeping of the professional societies.

These perversions take three forms. The first is the relatively venial offense of making much ado about nothing. Sometimes the unfortunate press-agent feels that he must make bricks without straw; he must "tell about it" even though his society-employer has not "done something." This comes about, of course, because he is judged by the frequency with which he "lands," that is to say, gets into the press some mention of the organization that is paying him. His constant temptation, therefore, is to invest with a fictitious importance the most commonplace incidents in the affairs of the society and to palm them off upon the napping editor as "news" worthy of a place in his journal. What are the results? The editor and the public are harmlessly fooled, the vanity of the society is measurably tickled, and the press-agent carefully preserves the clippings against the day that he shall be called to account for his stewardship and perchance negotiate a new retainer. But the observant will smile, the society will look silly to those who really matter, and the judicious will grieve that a professional society should be willing to be made ridiculous.

This tendency, harmless enough in itself perhaps, often leads to the second and more serious offense of misrepresentation. This usually does not take the form of flat misstatement, although there are not lacking instances even of that, due in most cases, more to inadvertence than to intent. We mean rather the deliberate and subtle creation of false impressions in the public mind. Truly these may be of little moment to the public and may inflict upon it no material injury of any description. But they are nevertheless deceitful, and in proportion as they mean little to the public, their publication means little to the society or to the profession it affects to represent. For example: In connection with a dinner held recently under the auspices of a professional engineering society, advance press notices circulated under the name of the society, announced that "distinguished engineers, publicists and educators from many cities will attend." Among the "invited guests" were listed some twenty-two names including Charles M. Schwab, General George W. Goethals, Henry R. Towne, Gerard Swope, and General E. O. Squier. As a matter of fact, fifteen of the twenty-two invited guests including these five, were not at the dinner. In another instance notices similarly supplied to the press were so framed as to create the impression that an officer of the society in question was included in an official party headed by a cabinet officer. It was so effectively done that at least one daily newspaper featured that statement in its headlines.

These are typical press-agent stunts. No more classic dodge is known to the newspaper craft than to tie up, by hook or by crook, with the names of celebrities having news value.

But, it may be asked, what harm has been done? How has the public been injured by being thus imposed on? That is not the point. The injury is inflicted upon the society and upon the profession it is supposed to represent. No profession seeking to win and retain public confidence ever will achieve it through imposition and deception, however carefully it may be sugar-coated and however harmless may be the immediate effect.

The third and perhaps the most vicious of the dangers we have in mind is the perversion of the press-service activities to unfair propaganda. This sometimes takes the form of boosting the society that employs it to the prejudice of others in the same field. This is particularly noticeable in connection with joint undertakings, when the loyal and discriminating press-agent is prone to supply "news" that plays up the part of his employers and subordinates or ignores entirely the contribution of those who may be associated with them. An even more hateful variety of this perversion is the promotion of individuals who may for one reason or another, be close to the source of publicity. An obvious characteristic of much technical press-service is to play up strongly the names of individuals, focusing attention by devices well known to newspaper men. A regular perusal of some of this material, moreover, will impress upon even the casual reader, the names of a very few who are regularly "among those present." This also will bear watching, to the end that an organization press-service may not become the instrument of individual ambition.

All these are very real dangers that lurk in the channels now being followed by a number of technical and professional societies. We point to them without the slightest intention to criticise or to discourage the dissemination by such societies of technical and society information, provided this be done accurately, honestly and with dignity, having in view always the real needs of the community and the establishment in the public confidence of the ideals and practice of the profession. The public cannot know too much about the work of engineers and the service rendered by the societies. But every professional society—especially those that publish codes of ethics for the guidance of their members—should examine closely and critically the activities of their press-services and square them with the principles laid down in those codes. Is not this a fair standard? Or are professional societies now to be devoted to circumventing in behalf of the group, the ethical obligations that they seek to impose upon the individual?

Slow Sand Filtration Plant for Hartford, Conn

Slow Rather than Rapid Filters Chosen After Careful Study in Which Color Was Chief Mooted Question —Costs Compared with Rapid Filters at Cambridge

By Caleb Mills Saville
Manager and Chief Engineer Water Department, Hartford, Conn.

HARTFORD, CONN., put in operation in February of this year a slow sand filter plant having a capacity of 17.5 m.g.d. which has since given satisfactory service. The plant is notable because it is one of the latest and larger slow sand filters in this country, decided upon after careful study of the relative merits of slow and rapid filters at a time when slow filters for new plants are not often built. It therefore seems desirable to put on record the reasons why slow sand filtration was adopted at Hartford and to outline the main features of the design of the plant. At the close of the article the unit costs of the Hartford slow sand filters and of the new rapid sand filters for Cambridge, Mass., which are nearly as large (14 m.g.d.) are compared. It may be added that the possibility of producing a water of a color satisfactory to the people of Hartford was the one question really at issue at Hartford in deciding which type of filter to adopt, so strong was the local sentiment in favor of slow sand filtration and of avoiding the use of chemicals. The opinion of several experts was sought. Much weight was given to the color forecasts and opinion of the late Frederic P. Stearns.

AERATOR AT HARTFORD SLOW SAND FILTRATION PLANT. THE BASIN IS ABOUT 40 FT. IN DIAMETER

The Hartford Water Supply—Hartford has two independent but interconnected sources of water supply. One, which is the major portion of the older system, drains from the easterly slopes of Talcott Mountain and is about six miles distant from the center of the city. Here there are four collecting reservoirs with a total capacity of about 1,200,000,000 gal. in which is stored the runoff from about 5.5 sq. miles of collecting area. Three of these reservoirs drain into the fourth, known as No. 5, which also acts as a receiving and balancing basin for both systems.

The second supply source is the new one recently completed, called the Nepaug. This is located about 10 miles northwest of the older supply, near the Village of Collinsville, Conn. Here there has been built a reservoir of about 9,560,000,000 gal. capacity which receives the runoff from about 32 sq. miles of very sparsely inhabited upland the major part of which is covered with forests.

The estimated safe yield of this source is 32 m.g.d. The water is brought to West Hartford through about 10 miles of aqueduct consisting of cast-iron pipes, concrete grade conduit, tunnel and concrete pressure pipe, having a present capacity of about 30 m.g.d. This conduit also discharges into Reservoir No. 5, the receiving basin spoken of above.

The purification plant is located about one-third of a mile south of Reservoir No. 5 and the supply of water for the plant is taken from the pressure conduit through a gate chamber so arranged that water may be taken at will from either source or from both at the same time in any proportion desired. The object of this is to permit of using the best water from all of the sources.

The control is so arranged that when water is being drawn from the Nepaug source any surplus will automatically discharge into Reservoir No. 5, and in case of break in the conduit supply, water from that reservoir will automatically be supplied to the filters for the city consumption.

Amount of Water Required—Hartford is now using about 13.5 m.g.d. With the present rate of increase the rated capacity of the filter beds now built will be reached in about seven years. High construction costs made it seem inadvisable to build for further into the future, but provision was made to double the filter capacity now available, which would bring this portion of the plant up to the estimated safe capacity present sources, with the additions made by separate units as required. Still further growth has also been anticipated in a general plan for expansion, when the present plant can be duplicated or combinations made with other methods if future developments in water purification should make such a course advisable.

The average daily per capita use of water in Hartford now is about 81.5 gal. for all purposes. Possibly this consumption can be somewhat reduced.

The supply of water safely available from the combined sources, estimated from the yield of those periods of low rainfall that come once in half a century or more, is put at about 37 m.g.d. Such an amount, at present rates of increase in consumption, will be sufficient until about 1950, at which time the final payments will have been made for retiring the bond issue that provided the funds for financing the new supply. In this way the generation having the use of the water will pay for it, leaving no burden on the future for a plant that has reached its life.

Ordinarily it is planned to use water from the Nepaug source, holding in reserve the water in the older reservoirs for use in case of accident to the conduit or other interruption of this supply, which would be sufficient for about three months' service at present rates.

Character of the Water—The older water gathering

source was on the slope of a basalt dyke which had broken through the triassic sandstone and shale formation that now flank its sides. Due to the mineral content of this area the water, although soft compared with that used in many parts of the country, was relatively hard in comparison with surface water flowing from areas where the metamorphic rocks and the glacial gravels predominate. The water supplied from this source showed a color of from 11 to 50 p.p.m. for about 83 per cent of the time, with monthly means ranging from 24 to 45 and an annual average of about 33. For turbidity the median of the several years studied was 8 p.p.m. with a monthly range of 4 to 14. Mean monthly hardness ranged from 29 to 38 p.p.m. with an annual average of 34.

For the new supply the color averages about 26; turbidity, 2 to 4; hardness, about 16. The reservoir from which the water comes was unstripped and was filled for the first time about November, 1917. What would be the color, turbidity and hardness of the new water was unknown when the first studies were made for the purification plant, the report with recommendation being also made the first part of the same month and year that the reservoir was first filled.

At first, a rapid sand plant only was considered, but after careful study of the character of the water to be expected from this source and after consultation with many of the best-known specialists in the country, half of whom were firmly of the opinion that the rapid sand type of filter would give the most satisfactory results, it was finally decided to install slow sand filters. It is only fair to say, however, that those in favor of the rapid type freely acknowledged that the slow sand filter under Hartford conditions would probably give a satisfactory water most of the time.

The late Frederic P. Stearns, who had acted as consultant throughout the whole of the additional supply work, was firmly of the opinion that the slow sand type was the most suitable for Hartford conditions. Mr. Stearns was particularly interested in the color phase of the problem and brought to it the whole force of his keen analytical mind. As a result of his studies of the problem, Mr. Stearns prepared the accompanying table of monthly colors that might be expected in the water from the Nepaug reservoir for the period 1917 to 1923 and gave his opinion of the probable color that would be likely after the reservoir had been in use for 8 or 10 years and had become conditioned. The close agreement of these figures with those from actual observation since is only one more testimonial of the remarkable grasp of condition and of the prescience shown by Mr. Stearns in all of the work which he undertook.

In regard to these colors Mr. Stearns said: "The conclusion which I reach from the further study I have made of the probable colors in the Nepaug Reservoir, after it has reached its normal and permanent condition as regards color, is that the maximum color will vary only a few points, generally not more than 3 or 4 from the average of the year."

In the consideration of the type of filter to be installed, the matter of the ultimate color of the water to be supplied to consumers became finally the principal one to influence decision, and this was debated at length by the commission. The specialists who favored the rapid sand process were united in their opinion that a water for domestic use should have a color not much exceeding 10, and that with proper operation of a rapid sand plant, including constant use of one or more chemicals under continual trained technical supervision, such a water was possible of attainment.

As regards slow sand filtration, with some reservations for unusual occurrences, the concensus of opinion among the consultants was that with Hartford water the reduction of color attainable would be about one-third of the applied water.

HARTFORD SLOW SAND FILTERS UNDER CONSTRUCTION
Concrete pouring plant and filter structure in rear. Office foundation in foreground.

Four of the reservoirs of the older system were retained in use, and the characteristics of the waters of these were carefully considered as to the possibilities of mixture with the new supply in order to send as low colored raw water as possible to the filters. Reservoir No. 2, with a storage of 284 m.g., and a drainage area of 1.4 sq miles, has an average color of 26, a minimum of 13, and an ordinary maximum of 36, exceeding this on one monthly examination in ten years with 54. Reservoir No. 6, with a storage of 800 m.g., and a drainage area of 2.4 sq. miles, has an average color of

TABLE I. STEARNS' NEPAUG WATER COLOR FORECAST, P.P.M.

Year	Average Annual Color	Monthly Range
1917	38	24 to 58
1918	36	28 to 44
1919	30	27 to 37
1920	27	23 to 31
1921	25	21 to 29
1922	24	20 to 28
1928	16	17 to 24

19, a minimum of 11 and an ordinary maximum of 28.

A summary of the estimates made by the specialists of what colors might reasonably be expected with Hartford water, slow sand filtration, reduction of color one-third and no chemicals is shown by Table II. G. W. Fuller, however, feared that in some years the annual

TABLE II—[illegible] WATER COLOR ESTIMATES MADE BY STEARNS, FULLER AND WESTON (P.P.M.)

	Average Annual			Maximum [illegible]		
Year	F. P. Stearns G. W. Fuller	R. S. Weston	F. P. Stearns	R. S. Weston	G. W. Fuller
1919	18	22	18	28	27
1920	17	[illegible]	18	[illegible]	26
1921	16	[illegible]	17	[illegible]	24
1922	15	18	17	22	23
1923	14	17	[illegible]	21	21
1928	11	[illegible]	14	20	

average might be 30 per cent above the ordinary average. That is a color of 14 instead of 11 after 1928, and possibly under exceptional conditions and for short periods even this color might be exceeded 50 per cent, giving a color of 21. On the other hand, Morris Knowles was firmly of the opinion that the slow sand type would best suit Hartford conditions of water while James A. Newlands was as confidently of the opinion that the rapid type was to be preferred.

The practical agreement of three acknowledged authorities in water supply work (Table II), each working independently of the other, was somewhat remarkable and inspired a confidence in their predictions not usual in forecasts of future conditions. All of them

TABLE III.—VARIATIONS IN COLOR OF EFFLUENTS (P.P.M.) FROM SEVEN RAPID SAND FILTER PLANTS

Name of Plant	Average Annual	Monthly Maxima	Per Cent Monthly Maxima of Average
Little Falls, N. J.	9	15	67
Watertown, N. Y.	14	18	29
Newport, R. I.	10	14	40
Akron, Ohio..	12	26	112
Trenton, N. J.	10	20	100
Toledo, Ohio	16	36	125
Warren Bristol, R. I.	12	16	33

agreed that the average color to be expected in the effluent of a slow sand plant after the reservoirs became conditioned (9 or 10 years after filling) would be between 11 and 13, or a weighted average of less than 12, while the maximum color to be expected varied only by about 6 p.p.m. The highest color to be feared by any of them was 21 and this only in event of an unusual combination of circumstances. The average color expected by even the rapid sand advocates, after conditioning of the reservoirs, therefore, varied only by from one to three points from that color which was considered an ideal one, and such variation is ordinarily discernable only by trained observation in a laboratory.

To know what was the color of the water supplied from some of the rapid sand plants running under what may be considered as practical operating conditions, inquiries were sent to a number of such plants. The replies are summarized in Table III. The average monthly variation from the average in these plants is 72 per cent, with a range of from 29 to 125 per cent.

Daily color variations in these plants run much higher. For example, in one of them the deviation from the average was as shown in Table IV. It was reported by the Water Department at this place that there were no complaints from consumers nor any demand for a water of less color. At another plant producing an effluent of color 4 the daily maxima for the past five years (1913-18) had run to 30, an increase of 640 per cent, while at still another, with an annual average of 12, the daily average maximum often rises to 20.

Reports from 18 of the well-known rapid sand filtration plants of the country gave an average for the year of 11.2, a maximum of 24, and a minimum of 4. Referring to the predicted colors obtainable in the case of Hartford with slow sand filtration, an average of 11.7 and a rare maximum of 21, it would appear that with some New England waters, at least, color removal results to be obtained with the two types of filters are strictly comparable.

As is often the case, the general opinion of the consumers, who had long been accustomed to having their water drawn from several beautiful reservoirs attractively set in an uninhabited woodland park, the outspoken opinion was very much in favor of a "water just as nature supplied it filtered through sand" and without the several kinds of "dope" always necessary to a

TABLE IV.—COLOR VARIATIONS (P.P.M.) FROM AVERAGE IN EFFLUENT FROM ONE RAPID SAND FILTER PLANT

Color P.P.M.	Variation from Average, Per Cent	Duration During Year in Days	Per Cent of Year	Equivalent Weeks
6–11	63–31	35	9.6	5
12–15	25–0	228	62.5	34
16–25	0–56	47	12.9	7
Above 25	56 and over	45	12.3	6

greater or less degree with rapid sand plants. This opinion was the stronger because of the active backing it received generally from the physicians of the city. Hartford wanted a "pure and wholesome water" and Hartford in all its works has placed results above cost.

What are the requirements of such a water? In his book, "Value of Pure Water," Professor Whipple states that such a water should be free from poisonous substances, free from bacteria or other organisms carrying disease, must be practically clear, colorless, and odorless, and reasonably free from chemical salts in solution and from microscopical organisms in suspension. As a result of his study, Professor Whipple concluded that with a color of less than 20 or a turbidity less than 5 only one person in ten would object.

Careful inquiry among water-supply operators in close touch with consumers, and especially in cities of the size and importance of Hartford, failed to disclose what might be considered to be dissatisfaction or criticism if the color of the water supplied was 20 or less. On the other hand, those of the consultants who favored the rapid sand process of filtration were convinced that no water could be considered as satisfactory which had a color much exceeding 10.

As a result of the studies at Hartford it appeared that the majority of consumers would be content with a "polished" water the color of which ranged between 10 and 20, with an average most of the time about half way between.

To apply, then, the Whipple criteria to the water about to be supplied to Hartford: (1) There were no poisonous substances to be feared. (2) Either slow or rapid filters if properly operated would give freedom from organisms carrying disease. (3) Either slow or rapid filters properly operated would give a clear and clean water. (4) Either slow or rapid filters properly operated under Hartford conditions would give a clear and clean water. (5) Aëration (which is provided) would help in correcting odor difficulties and neither type seemed to take precedence in this matter.

In addition to the above: (1) From the evidence

and the arguments submitted and from a study of the results obtained elsewhere with both types of filters it seemed that at most after a short term of years either type of filter would supply an effluent which would be entirely satisfactory as to color; i.e., a water for domestic use with a color of from 11 to 13. (2) The slow sand filter appeared to be more "fool-proof" when operated by ordinary water-works labor, and for the major labor at the plant it is planned to draft men when needed from the permanent maintenance force of the department. (3) The character of the water is such that it is probable that with the rapid type several chemicals in combination would be required at certain periods and forever. (4) The turbidity in the applied water is practically negligible, the ordinary range being from 2 to 5 p.p.m., with a rare maximum of 5 or 6. (5) Due to the great elasticity of the reservoir system supplying the filters it is possible to derive considerable advantage by using or avoiding use of any one reservoir or by a combination of two or more to send raw water with a minimum of color to the filters and thus lighten the load on them. (6) It also appeared that the daily, monthly and seasonal variations from the average color are not more frequent or of longer duration with the slow than with the rapid type of filter.

The slow sand process seems to have some advantages over the rapid process: (1) The use of chemicals is not absolutely necessary in order to have a water of satisfactory color. (2) There is much less danger, with slow sand filtration, of conditions which may be deleterious to service pipes and to house plumbing. (3) There is no intricate mechanism to get out of order or to be replaced at considerable expense.

Such were some of the reasons for the choice of the slow sand type of filter for Hartford conditions, and it was fully realized at the time that Hartford conditions might be somewhat unique in favoring the use of this type here.

The Purification Works and accessories may be described under six heads, as follows:

1. The Gate House is located off the 48-in. concrete pressure conduit, in which are placed a number of gates in the main line and connections by means of which the supply of water to the filters is controlled.

2. The Aërator is a circular basin about 40 ft. in diameter into which the water falls after being exposed to the air in fountain-like jets.

3. Filter Beds—After aëration the water passes to eight ½-acre filter beds, grouped in sets of four, each group being controlled by apparatus in a single regulator house, the entire system being under main control at the administration house located at the head of the filter system. Here are located main gates on the influent and effluent pipes, together with the laboratories, superintendent's office, men's room, necessary and convenient toilet arrangements, the heating apparatus, wash-water pumps, switchboards and motors for the control of the electric power, and the other necessary equipment. The filter beds are of concrete groined-arch construction, with piers 13 ft. on centers, and there is about 2.5 ft. earth cover to guard against freezing. The beds have about a foot of gravel of proper sizes to support the sand, and 4 ft. of sand with an effective size of some 0.3 mm. and a uniformity coefficient of about 2. A depth of 4½ ft. of water will be carried over the sand.

4. The Clear Water Basin is rectangular in shape, about 1¼ acre in area. It has a maximum depth of 15 ft. and a capacity of about 6 m.g.—sufficient to compensate for hourly variations in draft and still maintain a reserve for fire protection. It is covered with groined arches of concrete.

5. The Hydro-Electric Plant will furnish electric current for all purposes required in lighting and operating the filter plant, besides lighting other buildings of the department and supplying some power for other department uses. The plant is located at the foot of one of the reservoirs which has been put out of service because of the new supply. Water is supplied from two former reservoirs of the old supply system and in case of need water also can be supplied from the conduit of the new supply. The whole plant is self-contained and so compactly arranged that in case of an emergency it can be fenced off and operated without recourse to outside help. In case of trouble that should put the power plant out of commission, emergency operation could be maintained for a long period by means of a portable steam plant and triplex pump.

6. Chlorine Plant—For use in case of the necessity of sending unfiltered water to the city a chlorine gas house has been provided in which is located both an automatic and a manually controlled apparatus so placed on the supply main that all water drawn for city use must pass by and if necessary may be sterilized.

Four buildings for housing all of the equipment are now being built of quarry faced trap rock from near-by sources.

The cost of the entire purification plant, from the raw-water inlet to the outlet of the clear-water basin, including all piping, power plant and engineering, was about $1,100,000, equivalent to $62,860 p.m.g.d. rated capacity, or about $6.65 per capita of population supplied.

Cost Comparisons with Cambridge Rapid Filters—The City of Cambridge, Mass., has recently installed a rapid sand plant which in many ways is comparable with the slow sand plant at Hartford, both as to purpose and aesthetic requirements. Each treats a New England surface water stored in reservoirs, with considerable opportunity for self-purification and color reduction. The rated capacity of the two plants is also nearly the same: Cambridge, 14 m.g. daily; Hartford, 17.5 m.g. daily. The contract cost of the Cambridge plant as given by Col. George A. Johnson, the consulting and supervising engineer (*Fire and Water Engineering*, May 10, 1922) was $723,900, equivalent to $51,000 p.m.g.d. rated capacity, or $6.60 per capita of population served. The work for the Cambridge plant was undertaken in June, 1921, when prices of labor and construction materials were at least 30 per cent less than they were in 1918 and 1919, when the larger contracts for the Hartford work were made. Allowing for this difference in price level, the cost of the Hartford plant would have been about $845,000, or $48,400 p.m.g.d. rated capacity, or $5.13 per capita of population served. On the basis of equal cost levels it would seem that with a water similar to that at Hartford, and with similar conditions of construction and size of plant, the first cost of plant is about the same for either the slow or the rapid type of filter.

All of the works outlined above were designed, and the work of construction supervised, by the Engineer-

ing Department of the Board of Water Commissioners of the City of Hartford. Too much credit cannot be given to the designing engineers for their whole-souled interest in the development of this work, which in some of its parts was without precedent, or to the hearty co-operation and attention to detail of the field supervisory and survey force. It was due to these conditions that the parts of the plant went together like clockwork and worked without a hitch when the plant was started.

For consultants, special details of the filter plant were passed on by Robert Spurr Weston; those of concrete design, by J. R. Worcester; and the studies leading up to the type of filter finally adopted, by the late Frederic P. Stearns.

The Sacramento Floating Type of Aerator Nozzle

Central Cone of Low-Head Aerator Floats on Issuing Water Film—Permits Passage of Trash and Gives Uniform Spray

By Harry N. Jenks
Formerly Special Assistant Engineer, Filtration Division, Sacramento, Cal., now Assistant Engineer Sanitary District of Chicago

A LOW-HEAD aerator nozzle with a central floating cone has been invented for use in the new water purification plant at Sacramento, Cal. This new nozzle, the underlying principle of which was discovered accidentally while the engineers were experimenting with a double-spray nozzle, has the following striking advantages: (1) Simplicity of design; (2) exceptional trash-passing ability; (3) uniformly excellent spray at all discharges; (4) adaptability to different head-discharge requirements, particularly for low heads; (5) hydraulic characteristics readily modified, chiefly by altering the weight of the central floating cone.

Service Requirements and Design Conditions—The Sacramento River, from which Sacramento is now supplied with water, will also be the source for the new works (*Engineering News-Record*, Sept. 12, 1920, p. 446, Jan. 27 and June 2, 1921, p. 162 and p. 924, and May 11, 1922, p. 782). During the late summer and fall months of very dry years, the river water is infested with algae, resulting in the production of tastes and odors, excessive dissolved oxygen content and hydrogen-ion concentration. In the course of the design of the new treatment works, it was realized that effective aeration of the water prior to coagulation, sedimentation and filtration would be necessary, or at any rate highly advantageous. An incidental advantage is a possible appreciable lowering of the temperature of the water supply.

FIG. 1—NOZZLES EXPERIMENTED WITH AT SACRAMENTO FILTRATION PLANT

A: Original double-spray nozzle of [illegible] B: Single [illegible] which cuts spray sheet. C: Simplified nozzle, with thin wedges at third points in the two annular openings. Dropping of wedges out of place led to their elimination and cones of perfect undivided spray self-adjusting.

All of the water delivered to the treatment plant must be lifted from the river by low-head centrifugal pumps, which must be definitely limited in head if high efficiency is to be maintained. From these pumps water

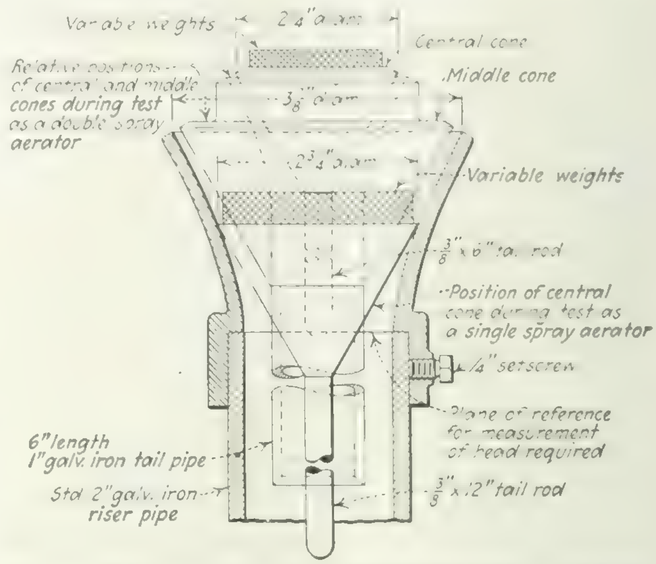


FIG. 2—SINGLE- AND DOUBLE-SPRAY NOZZLE ARRANGED WITH VARIABLE WEIGHTS FOR EXPERIMENTAL USES

will pass normally to a grit basin having a surface area of approximately 7,700 sq.ft. The conditions of design indicated that if aeration were to be practised the aerating devices should be installed above this basin, and the design should be such that the aerators could be placed in or out of service at will, as a whole or in groups. Each vertical foot of low-lift pumping head has been calculated to cost for power alone about $350 per annum with an average quantity pumped of 20 m.g.d. For other quantities the costs would be roughly proportional.

After considering all available aerating methods it became evident that best results as to cost, efficiency and ease of manipulation, as a whole or in units, would be secured with aerators of the nozzle type. Because of the cost of head, it was decided to limit the total loss of head in the aerator system to a maximum of 5 ft. On account of the limited space which the aerator system would occupy, it was determined to place the pipe lines supplying the nozzles and on which the nozzles would be mounted on 4-ft. centers with the nozzles 4 ft. apart, thus allowing 16 sq.ft. to each nozzle, with the anticipation that the sprays would overlap and interfere somewhat. With 420 nozzles covering an area of 7,700 sq.ft. and delivering at the rate of 48 m.g.d., each nozzle would have to discharge 80 gal. per minute.

History of Development—Since no nozzles of which the engineers were aware would fully meet the head-quantity and other conditions set forth above, Prof. Charles Gilman Hyde, consulting engineer in charge of the pumping and filtration project, determined to design a nozzle that should have the required quantity-

head characteristics. The result is a nozzle that apparently operates on an entirely new principle and one which is applicable to the design of nozzles for aerating or distributing, or appreciably cooling, water and sewage.

[The nozzle has not been patented and the engineers are hereby making known the results of their studies and designs for the use of other engineers and to preclude others from patenting the nozzle.—*Editor.*]

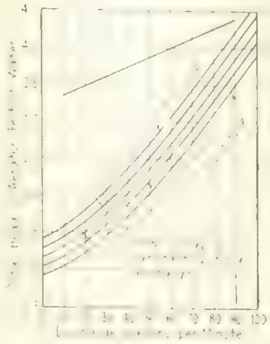
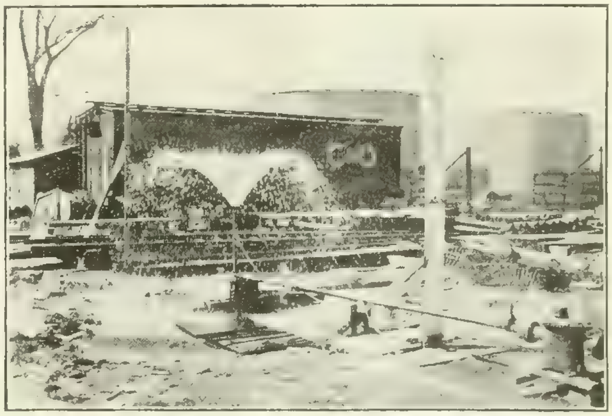


FIG. 3—HEAD-DISCHARGE CURVES FOR SINGLE-SPRAY TYPE OF AERATOR WITH FLOATING CONES OF VARIOUS WEIGHTS

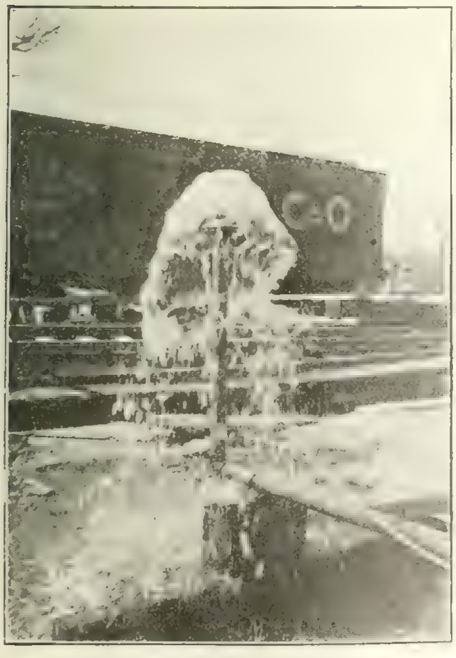
The prescribed capacity, in conjunction with the low head allowed, indicated the advantage of using a double-spray nozzle. The original nozzle of the fixed-opening type, Fig. 1, *A*, which Professor Hyde cast in lead, gave such results as warranted the construction of a similar nozzle in brass, Fig. 1, *B*, turned on a lathe and made adjustable, so that any desired variation in thickness of both the upper and lower sprays could be had during the test.

A thorough test of this nozzle established the proper widths of openings to satisfy the quantity-head requirements and produce a spray that in the judgment of the observers would result in excellent aeration. In this connection the value of the hydrogen-ion concentration as a criterion in measuring the effectiveness of aeration was recognized. Comparison of the P_H content of the water supplied to the aerator and after it had passed through the nozzle, showed a satisfactory reduction in the P_H concentration resulting from the release of carbon dioxide. Such a reduction of the CO_2 content may be taken as indicative of the similar release of the excess dissolved oxygen and volatile oils which in the present instance is the primary object of aerating the water supply.

The nozzle just considered was, however, somewhat complicated, especially in its fin-like exterior supports. A third nozzle, Fig. 1, *C*, was accordingly turned out with a view to simplifying the casting by substituting for the exterior fins thin webs placed at the third-points in the two annular openings. In the experimental nozzle these webs took the form of thin, removable wedges set in shallow guide grooves in the cones for adjusting the width of opening as before. It was at once observed that the webs would be an objectionable feature because of the fact that they completely separated the spray into three parts which failed to reunite, thus rendering ineffective a considerable area of the cones of spray.



FIGS. 4 AND 5—SINGLE-SPRAY FLOATING TYPE WITH 2.5-LB. CONE
The rate of nozzle discharge in Fig. 4 is 20 and Fig. 5 it is 80 gal. per minute



FIGS. 6 AND 7—DOUBLE SPRAY FIXED-OPENING TYPE
Nozzle discharge in Fig. 6 is 20 and in Fig. 7 it is 80 gal. per minute.

While working with the higher heads, both the central and middle cones were lifted by the current off their supporting wedges, which then fell down the standpipe. Upon shutting off the water the two inner cones dropped back into the outer shell or base casting, closing both annular openings. Without attempting to replace the wedges the water was again turned on and it issued from the openings in smooth, unbroken cones of spray, even with the lowest discharges. This was in contrast to the fixed-opening nozzle which at very low heads, merely spilled water over the edges of the openings. It was noted that both the central and middle

cones had lifted slightly and were floating freely, supported by the thin membrane of water forming the cones of spray. As the heads were increased a point considerably below the delivery required was reached, at which the floating cones began to chatter. Aside from the chattering, the aerator as it then stood gave results fully the equal of any heretofore obtained, and superior at low delivery, as already noted.

Further experiments proved it was possible to stabilize the central cone by attaching a tailpiece in the form of a small iron rod, while the middle cone was likewise

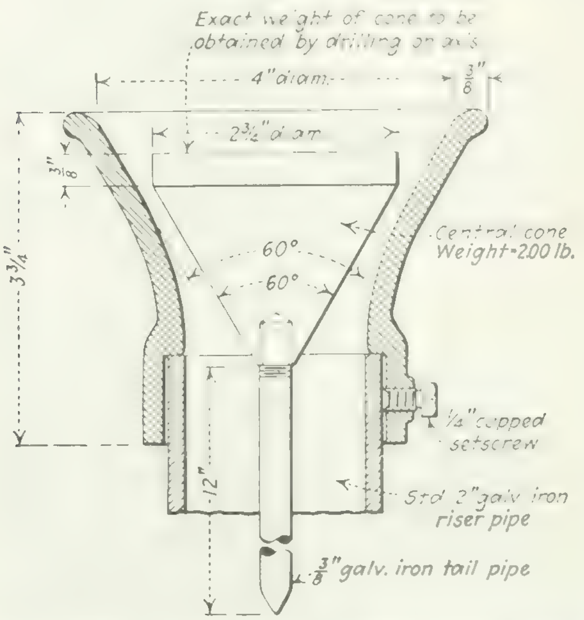


FIG. 8—THE "SACRAMENTO" SINGLE-SPRAY NOZZLE
Nozzle to be made of cast stove-iron. Weight of central cone includes tail rod.

stabilized by attaching a short length of 1-in. pipe which hung within the riser pipe and through which in turn passed the tail rod of the central cone (See Fig. 2). By these means a double spray, floating-type nozzle was evolved, superior in all respects to the former nozzles.

During the course of the tests observations were made on the general influence of the weights of the floating cones upon the head required. The investigation was continued to determine this effect quantitatively. To eliminate all the weight possible, the middle cone was removed and the nozzle was thereby reduced to a single-spray aerator. In respect to efficiency of aeration, fineness and distribution of spray the single-spray floating nozzle appeared to be fully the equal of the double-spray floating nozzle, while the head required by the former was considerably less. No chattering occurred and the spray was satisfactory at all heads. Experiments made to determine the optimum angle of the floating cone showed that a 60-deg. included angle gave the best results in conjunction with the size and shape of the base casting used in the tests, which had been designed for discharge at an angle of 60 deg. with the horizontal. Flatter cones of equal weight blew out even under low heads; steeper cones chattered under practically all heads.

Head-Discharge Curves for Floating-Type Nozzle—Final tests to determine the influence of varying weights of floating cone upon the head-discharge characteristics of the nozzle were made on an aerator comprising the base casting and 60-deg. floating cone with the 12x⅜-in. tail rod shown in Fig. 2. The discharge was measured by a 3-in. turbine-type water meter. Heads were read on a gauge board connected with a piezometer opening in the aerator riser pipe 12 in. below its top which was taken as a plane of reference. The head for each discharge rate recorded was referred to this datum plane by adding to each piezometer reading on the gage the corresponding velocity head and subtracting the corresponding friction head due to the 1-ft. length of riser pipe between the piezometer opening and the datum. The ordinates, therefore, of the curves in Fig. 3 represent the total pressure-plus-velocity head required to produce the discharges shown by the abscissae. In the upper part of the diagram a curve has been drawn to show the maximum diameter of circle over which the spray was distributed between the discharges of 10 to 90 gal. per minute. This maximum reach of spray was found to be practically proportional to the discharge regardless of the weight of the central cone.

The various nozzles in action are shown in Figs. 4 to 7.

In Fig. 8 is shown the final design for the Sacramento aerator nozzles. These nozzles are to be made of cast stove-iron because of the inexpensiveness of this material and the exceptionally smooth castings that result from its use. The nozzle consists of two extremely simple castings, the central one and the base casting or outer shell. The latter will fit over the 2-in. riser pipe and be held firmly in place by a ¼-in. cupped set-screw. The outside of the riser at the top will be smeared with bitumen or white lead to insure watertightness at the base of the nozzle. The tail rod will be screwed into the central cone, thus providing for ready replacement or substitution by a rod of a different length.

The experiments leading to the development of the "Sacramento" floating-type aerator nozzle were made by the writer in co-operation with C. G. Gillespie, resident engineer, and Prof. Charles Gilman Hyde, chief consulting engineer, whose original nozzle design furnished the basis for the present investigation.

Palestine Has Efficient Railway System

Communications have been so greatly improved within the past year that today Palestine enjoys probably the best railway service in the Near East.

An efficient railway system in Palestine is a heritage of the war. In their military operations the British built the line from Kantara on the Suez Canal to a point near Gaza, connecting there with the old pre-war narrow-gage system. The gage was broadened and an extension built into Haifa. The system, now 500 kilometers in length, connects with the Egyptian State railways at Kantara and with the Syrian railways in the north.

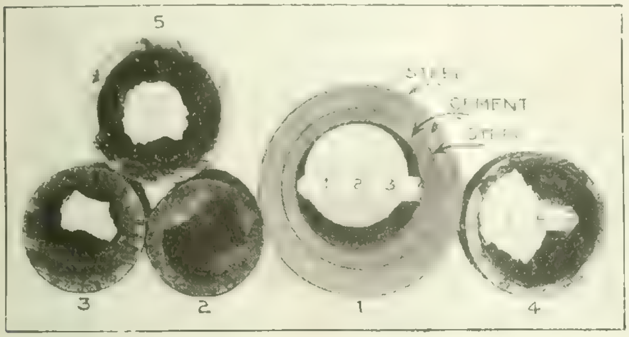
The motive power and rolling stock is in first-class condition. American locomotives built in 1918 for the British War Department are used, having evidently been turned over to the Palestine railways. A few mountain saddle-tank type locomotives built in Leeds, England, have been added recently. A number of new passenger coaches from England, together with international sleeping cars afford good accommodations to travelers. Daily passenger and mail service are proving beneficial to business.—*Commerce Reports.*

Cement-Lined Cast-Iron Pipe at Charleston, S. C.

Tuberculation of Tar-Coated Cast-Iron Pipe at Charleston and Elsewhere—70 Years' Experience With Cement-Lined Sheet Pipe in Many Cities Suggests Cement Lining for Cast Iron—Lining Method

By J. E. Gibson
Manager and Engineer Water Department, Charleston, S. C.

THE Water Department of Charleston, S. C., is now laying some ten miles of 4- to 24-in. cement-lined cast-iron pipe. Of this, 7 miles is 6- and 8-in., 2½ miles is 16-in., and the remainder is 4-, 12- and 24-in. pipe. After reviewing the reasons for adopting cement as a substitute for the ordinary tar coating, this article will describe the cement-lining process and related matters. The review just mentioned will include an account of the decline in carrying capacity of cast-iron pipe at Charleston and the quick recurrence of this decline after cleaning the pipe; the character of the Charleston water; a few of many possible instances of tuberculation or incrustation of cast-iron pipe elsewhere; and a resumé of the use of cement-lined wrought-iron or steel pipe in a considerable portion of the United States during the past seventy years. These experiences, many of them under my direct observation, and all satisfactory as regards the prevention of the loss of carrying capacity through tuberculation or incrustation of the pipe, have seemed to give full warrant for the extensive trial of cement lining for cast-iron pipe now being made at Charleston.



CEMENT-LINED SHEET AND STANDARD CAST-IRON PIPE AFTER 22 YEARS' SERVICE
No. 1, cement-lined, Nos. 2-5, cast-iron. All 4-in.

Loss of Capacity in Tar-Coated Cast-Iron Pipe—Water-works engineers and superintendents have long realized that the carrying capacity of cast-iron pipe protected with the so-called tar coating begins to fall off in some cases soon after the pipe is put in service. Recognition of this condition is found in nearly all hydraulic tables, constants being given for pipe of different ages. This allowance for age is proper, but the constants are only approximately correct for general use.

Those living along the Atlantic and Gulf seaboard from Maine to Mexico are familiar with the highly colored peaty waters of that section, and it is this class of water that seems to cause the greatest trouble from tuberculation or incrustation. At least that has been my observation. As to why this should be so, I can only suggest that usually this water is very soft, being either swamp water or else water naturally stored in a freestone formation and in either case normally low in alkalinity. It carries comparatively large amounts of vegetable acids, leached from the leaves and roots of the trees growing on the drainage area. These waters are alkaline to methyl-orange or erythrosine, but acid to hydrogen-ion tests.

Charleston Conditions and Experience—Including the Capacity Loss in Standard-Lined Cast-Iron Pipe—Charleston is located on a peninsula formed by the junction of the Ashley and Cooper Rivers. The average elevation of the city is probably not over 10 ft. above mean high tide. The soil is composed of an alluvial sand and blue clay shell deposits, highly charged with organic and saline matter that rapidly corrodes wrought-iron and steel pipe.

The water supply of Charleston is obtained from Goose Creek, an estuary of the Cooper River, the water being pumped through some 60,000 ft. of 24-in. cast-iron main laid in 1903. This main was well laid and for a number of years little trouble was experienced in maintaining ample pressure in the city. However, as the city's demand increased, the water company had difficulty in maintaining a satisfactory pressure, although the economical capacity of the main was not exceeded. Upon investigation it was found that the friction loss per 1,000 ft. of main was about double that given in the recognized hydraulic tables, even when an allowance for the age of the pipe was made.

After a thorough investigation of its condition the main was cleaned in February, 1915, with the result that the friction loss was reduced to approximately that of new pipe; but in about three months the friction loss had increased practically to that previous to cleaning. The main was then cleaned a second time, in April, 1916, with the same result recurring.

In 1917 Charleston bought the plant from the Charleston Light & Water Co., and I was placed in charge as manager and engineer. As a first step in an effort to improve the pressure and service, it was decided to clean some of the mains in the downtown or older section of the city. Tests were made before and after cleaning to determine the friction losses per 1,000 ft. of main. The average result observed on a 6-in. main laid in 1886 gave a value of the coefficient "C" in Chezy's formula ($V = C \sqrt{RS}$) of 34 before and of 90 immediately after cleaning. Tests fourteen months later showed a fall of "C" to an average of 61.

Cast-Iron Main Again Cleaned—The demand for water, incident to the war activities, being greatly reduced after the armistice was signed, more time became available after 1919 for improving the general service and effecting economies in operation. The friction loss in our 24-in. main necessitated too high a pressure at the pumping station in order to provide satisfactory pressure in the city and it was decided to clean it. Before cleaning the friction loss was 4 ft. per 1,000 ft. when pumping at the rate of 6.5 m.g.d. and the value of "C" was 72, against a theoretical friction loss of about 1.6 ft. per 1,000, using Weston's or Williams and Hazen's tables, coefficient 120.

Tests made immediately after cleaning the main in April, 1921, showed a value of "C" (Chezy) of 106.5. Tests made thirty days later gave "C" as 90; or the effect of cleaning had been practically lost within thirty days. Needless to say, this was a great surprise to us, and we at once began to study means for improving conditions, especially for new mains. Our experience in Charleston has been that the loss in the carrying capacity of standard-lined cast-iron pipe is approximately 20 per cent within three years, and that the results of cleaning do not last more than four or five months at best.

Cement-Lined Wrought-Iron or Steel Pipe—Comparisons with Cast-Iron Pipe—From 1897 to 1917 I was principal assistant engineer to J. W. Ledoux, then chief engineer of the American Pipe & Construction Co., Philadelphia, and while so engaged became thoroughly familiar with the use of cement-lined wrought-iron or steel pipe. The company named laid hundreds of miles of this pipe under the Phipp's patents. I had occasion to remove and examine sections of pipe in use as long as 20 to 25 years and cannot recall ever having seen a piece of cement-lined pipe that had tuberculated or incrusted. Tests made by us on cast-iron and on cement-lined pipe laid from 20 to 30 years never showed any loss of carrying capacity of cement-lined pipe, but in all cases which came to my attention there was a loss with the ordinary cast-iron pipe.

A test of a 4-in. cast-iron main at Mount Vernon, N. Y., that had been in use for about 25 years, gave a value of "C" of only 25 before and 107 after cleaning. A 6-in. main in the same city gave a value of "C" of only 29 before and 125 after cleaning. A piece of 4-in. cement-lined wrought-iron pipe removed from the mains of the Springfield Consolidated Water Co., Ridley Park, Pa., laid in 1889, showed no internal deterioration of incrustation whatever, but a piece of 4-in. cast-iron pipe laid in the same system and about the same time in the Landsdowns, Pa., distribution system, was very badly tuberculated.

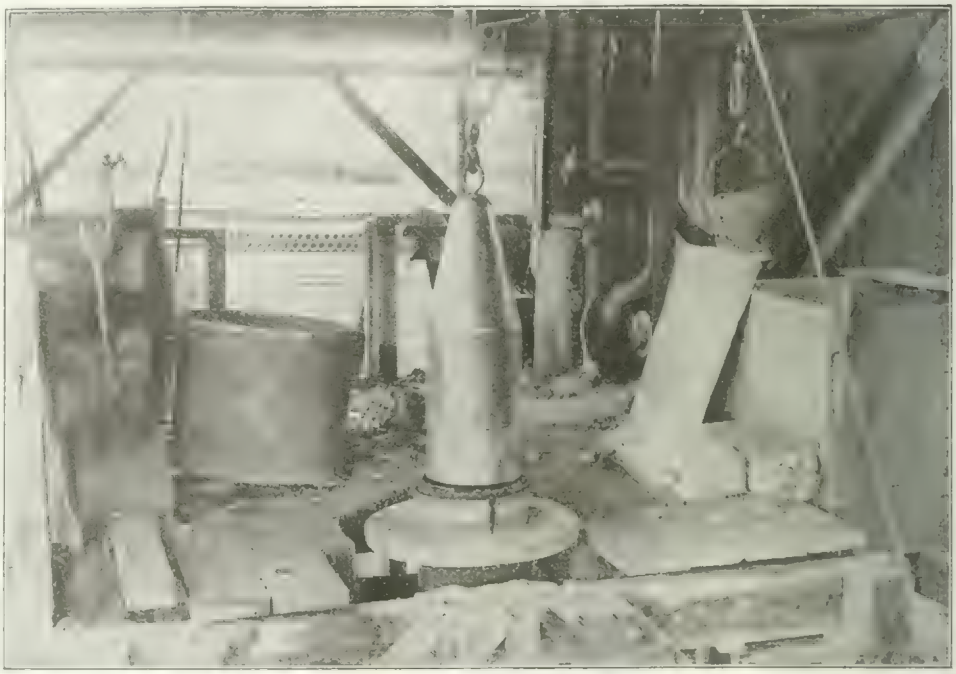
Mr. Haydock, engineer of the Mountain Water Supply Co., of Philadelphia, reports that cast-iron pipe in many parts of their system lost more than 20 per cent of its carrying capacity in the first ten years it was in use, due to tuberculation. All their water is very soft and low in solids.

Experience of the Two Normans—Bradford Norman, president of the Newport (R. I.) Water-Works Co., in a recent letter writes:

Cement-lined pipe was furnished George H. Norman by the Jersey City or New Jersey Patent Water & Gas Pipe Co., during the period from about 1865 to 1877, after which Mr. Norman began to make it for the work he was then doing, as the patent right had expired. Cement-lined pipe was in use in New York State earlier than on Mr. Norman's work. [George H. Norman, father of Bradford Norman, was admitted to the American Society of Civil Engineers as member in 1869, and died in 1900. He built many water-works in New England, using cement-lined pipe.—EDITOR.] There were other concerns making pipe during the period between 1865 and 1875: one Dr. Phipps, somewhere in Connecticut, I think Bridgeport, and also a firm called Goodhue & Birney [of Springfield, Mass.—EDITOR].

In regard to the fouling of cement-lined wrought-iron pipe, I have yet to see any tuberculation or incrustation of any part that had a coating of cement. The cast-iron gates, branches, etc., were the only parts that ever showed any signs of tuberculation or incrustation. (These cast-iron parts were not coated with cement.)

Newport has in its distribution system 88 miles of cement-lined pipe from 20- to 4-in. in size.



PLANT FOR LINING CAST-IRON PIPE WITH CEMENT
Lining cone being lowered into pipe. Neat natural cement is poured into space between cone and shell of pipe and the cone is then lifted, forming a lining to the pipe.

Plymouth, Mass., Still Makes Own Cement-Lined Pipe—A. E. Blackmer, superintendent of the Plymouth Water Works, Plymouth, Mass., writes:

We have now about 57 miles of 4- to 18-in. pipe in our system, all cement-lined. I estimate that about 65 per cent of this mileage is of the Phipps type and the balance is the old style. Our experience with this pipe has been very satisfactory. During the past season we made and laid about 2,000 ft. of 10-in. pipe to replace the same amount of 8-in. old style pipe that had been in continuous service since 1855. [See *Engineering News*, 1916, II., p. 300, for description of making and laying cement-lined sheet-steel pipe at Plymouth.—EDITOR.]

The Pennsylvania Pipe Co., of Philadelphia (now the American Pipe & Construction Co.), bought the patent rights of Dr. D. Goffe Phipps (engineer of the Bridgeport, Conn., Hydraulic Co.) for the United States, with the exception of New England, and continued the manufacture of this pipe, with certain improvements, up to about 1917. The company built many water-works throughout the Eastern United States and undoubtedly laid upwards of a thousand miles of this type of pipe. One of the earliest of these works was that of the Westmoreland Water Co., Greensburg, Pa., constructed in 1889. Shortly before his death five or six years ago,

Murray Forbes, then president of the Westmoreland Water Co., stated that the pipe was then in good condition and with the exception of some trouble which was experienced with the joints he had no complaint to make whatever.

The American Pipe & Construction Co. built the works of the Paris Mountain Water Co., Greenville, S. C., in 1890. A piece of cement-lined pipe taken out of the 12-in. gravity supply main of these works at the time of the construction of Camp Sevier showed that the interior surface was in perfect condition.

The water-works of Waukesha, Wis., constructed about 1887, used pipe manufactured under the method used by George H. Norman, above referred to. I personally removed sections of this pipe at the time of its valuation for purchase by the city about 1905 and found that its interior surface was in perfect condition and that there was no deterioration of the metal where the exterior coating was intact, although this pipe was made of one part Louisville cement and three parts sand. The better practice (followed by the American Pipe & Construction Co. and by the early cement-lined wrought-pipe manufacturers generally) was to use a mortar of neat cement—and that is what is being used to line cast-iron pipe for Charleston.

One Company Has 500 Miles of Cement-Lined Sheet Pipe—The Springfield Consolidated Water Co. which supplies the suburbs of Philadelphia, has in use upwards of 500 miles of 4- to 16-in. cement-lined wrought-iron pipe and is satisfied with its service. The company has no records of tuberculation or falling off in capacity.

Observation made on a piece of cement-lined pipe removed from Danvers, Mass., after 39 years' service, shows that the bore is much smoother than that of new pipe. This condition agrees with my own observation of pipe removed at other points; therefore, it is reasonable to conclude that the coefficient of cement-lined pipe will improve rather than deteriorate with age.

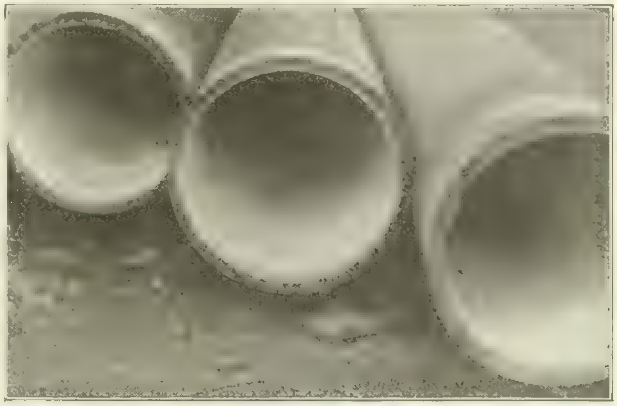
Besides the cities and companies already mentioned the following have a portion of their distribution systems or supply mains of cement-lined wrought-iron pipe: Moorestown (N. J.) Water Co.; Monmouth County Water Co. Asbury Park, N. J.; Riverton (N. J.) & Palmyra Water Co.; Westfield (N. J.) & Newbold Water Co.; Wildwood (N. J.) Water Co.; Norfolk (Va.) County Water Co.; Sumter (S. C.) Water Co.; Milledgeville (Ga.) Municipal Works; Tallahassee (Fla.) Water Co. So far as I have been able to learn, no one has seen a case of tuberculation or interior incrustation of cement-lined pipe.

In passing, it may be stated that in my opinion any difficulties experienced with cement-lined wrought-iron or steel pipe have been due to making joints and taps. I believe there are no joint difficulties where bell-and-spigot joints—the more recent practice—have been used, but the tapping difficulty still exists. It may be added that service taps are made by bolting a "hat" flange onto the pipe or by building one into the cement wall when the pipe is being made.

Charleston Adopts Cement-Lined Cast-Iron Pipe—The foregoing data seemed to warrant the adoption of cement-lined pipe by Charleston. In 1921, the question of furnishing some 30,000 ft. of 24- and 12,000 ft. of 12-in. cement-lined pipe was taken up with manufacturers. It was finally decided that on account of the corrosive quality of the Charleston soil, already mentioned, there was too much danger that the exterior portion of the cement in either cement-lined steel or in steel-reinforced cement pipe might be injured in such a way as to expose the steel and finally destroy the pipe. This was considered to be so serious a matter that it was decided to take up the question of obtaining cement-lined cast-iron pipe, thus using a material that had withstood the test of time so far as exterior deterioration and corrosion were concerned. Cast-iron pipe is known to have withstood soil corrosion for a hundred years or more.

In place of the eight miles of 24- and 12-in. pipe first proposed we are putting down ten miles of 24- to 4-in. pipe (mostly 6- and 8-in.), as stated near the beginning of this article.

It was first thought advisable to make a special size pipe so that when the lining was in position the nominal diameter would agree with the actual diameter, but as this entailed the manufacture of new flasks and pat-



VIEW OF 16-IN. CEMENT-LINED CAST-IRON PIPE

terns, special size valves and fittings, we decided to line only pipe made of standard pattern. The only difference is that we did not coat the pipe with the customary tar preparation.

While the cement lining slightly reduces the area of the pipe, the increased capacity due to the better surface and higher coefficient in a great measure offsets the reduction in cross-sectional area and the reduction is entirely offset where cast iron is subject to tuberculation. The thickness of cement linings are $\frac{3}{16}$ in. for pipe with nominal diameters of 4 to 10 in., and $\frac{1}{4}$ in. for diameters of from 12 to 24 in.

Manufacture—The method being used in lining cast-iron pipe with cement is the same as that employed in putting a similar lining in wrought-iron pipe. The cast-iron pipe is placed on end, after which a "bullet" or lining cone is lowered into the barrel to the bottom. The machine that up-ends the pipe automatically centers the lower or bell end of the pipe, and the upper end is similarly centered at the time of lowering the lining cone. The requisite quantity of neat *natural* cement, previously mixed by a special machine, is then poured into the upper end of the pipe, after which the bullet is immediately pulled up through the barrel of the pipe spreading the cement the same as a plasterer would spread a coat of plaster on a wall. The principal consideration in getting a good lining is to have the mortar of the proper consistency and at the proper point of setting, so that when the lining cone is pulled upward through the pipe the mortar will not slough down or, conversely, will not be pulled up through the pipe with the lining cone, due to its having set too hard.

Several different grades of cement were experimented

with, but in the end we returned to natural cement, as it has a quicker setting time and does not check or shrink as much as Portland cement.

Field-Work—The cement-lined cast-iron pipe is cut or tapped in the same manner as standard coated cast-iron pipe. When the point of the drill passes through the shell of the cast-iron pipe and enters the cement, the cement lining spalls off at an angle of about 45 deg., leaving a thin protection coating of cement at the edge of the drill hole.

In laying pipe the foreman must carefully inspect the spigot ends for splits and cracks, for no dependence can be placed on sounding the pipe, as in the case of unlined pipe, for the cement lining effectually destroys its resonance.

In cutting cement-lined pipe the same procedure is used as in unlined pipe. If reasonable care is taken no difficulty will be experienced with the cracking out of the thin cement lining. Should this occur, however, the damage can be easily repaired by patching with a little neat natural cement of the same brand as that used in lining.

The pipe joints are made in the usual way, with lead and jute or other customary joint materials, which materials do not come into contact with the cement lining.

I feel that in the combination of cast-iron with cement we have a product that is a decided step in advance for the Charleston water distribution systems and a combination of materials that will endure indefinitely.

All of the pipe being furnished the Charleston Water Department is being manufactured by the American Cast Iron Pipe Co., Birmingham, Ala., which has co-operated with the department in this new departure in the water-works pipe field.

Pollution of Coast Waters and Beaches With Oil and Tar

By C. M. Saville
Member Connecticut Stream Pollution Commission, Hartford, Conn.

ELIMINATION of oil and tar pollution from beaches and coast waters was the subject of a conference at Atlantic City, N. J., Aug. 10 and 11, attended by representatives of a number of seaboard states and cities and of other interests. This form of pollution is a growing menace to seaside resorts and fishing and boating interests along miles of coast. It is said to have cut the former large fish yield along the northern New Jersey coast to a few barrels. Waters are made offensive to bathers and boatmen, boats damaged, beaches polluted, fish and shellfish killed and water fowl seriously injured.

The pollution comes from the discharge by tankers and oil-burning craft of oil and tar wastes and oily bilge water and ballast just before making port and from the wastes of oil refineries, gas works and asphalt plants located on tidewater.

Federal control seems necessary if this nuisance is to be stopped. Existing laws would give at least some relief if only there were funds for their enforcement. It has been suggested that clearances should be denied to all tankers and oil-burning craft unless they can prove to the satisfaction of the authorities that their process of cleaning out oil residue, other oil wastes and water ballast, while in port is so conducted as not to cause detriment to the waters. Two preventive measures that have been found to be more or less efficacious are: (1) Discharging the wastes into suitable vessels alongside in the harbor and carrying the wastes to suitable reservoirs where the oil would be recovered by separation from the water and made useful for several purposes, such as for fuel when mixed with powdered coal, or for road work after proper preparation; (2) separators on the vessels themselves. It is said that abroad oil wastes are not permitted to be discharged where they will cause damage; also that in England and Holland the first method named is in use and that Japanese vessels are equipped with apparatus for the second.

Several bills designed to eliminate the oil pollution evil are now before Congress. The one proposed by Hon. T. Frank Appleby (H. R. 10,956, 67th Congress 2nd Session) seems to contain the best provisions and to offer the most satisfactory means of preventing continuance of the polluting causes. This bill was endorsed by the convention, many hitherto objectionable features relating to inland waters in the first draft having been eliminated. Besides this, a petition endorsed by the President of the United States has been presented to the Senate and to Congress by the officers and members of the "Interstate Committee of One Hundred on Pollution of Coast Waters and Beaches" representing various municipalities and coast resorts of New York and New Jersey calling attention to the urgency of the matter and praying for adequate federal aid to enforce the present laws.

Among the officers elected by the Atlantic City conference were: President, Gifford Pinchot, of Pennsylvania; secretary, Sidney H. Phinney, Trenton, N. J.; an executive committee of nine members, including S. DeM. Gage, chemist and sanitary engineer, Rhode Island State Board of Health, Providence; and the writer.

Light-Colored Joint Filler Developed for Concrete Roads

A cement-colored filler has been developed in the laboratories of the U. S. Bureau of Public Roads for filling cracks and joints in concrete pavements to eliminate the unsightly appearance of the black lines resulting from the use of the bituminous fillers commonly employed. No particular advantage over other good materials is claimed for the preparation other than its color and it is probable that the cost will be somewhat higher but not prohibitive. For several weeks a section of road with expansion joints of this material has been under observation and the results are entirely satisfactory but a longer test will be necessary before it can be recommended for general use.

The mixture consists of approximately 12 parts rosin, 1 part crude rubber with sufficient barium sulphate to give the desired color. In preparation the rubber is dissolved in gasoline and the rosin is then mixed in with an application of heat, the coloring material being added as required. Any desired consistency can be obtained by varying the proportions. A material with remarkable adhesive properties is produced and which can be heated so that it will flow into the cracks and joints.

Prechlorination-Alum Treatment of Soft, Colored Waters

Experiments and Seven Years' Working Results Show Low Colored Mechanical-Filter Effluent Nearly Non-Corrosive

By Arthur L. Gammage

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Water purification has reached a state where soft, colored waters may have the color and suspended dirt removed economically and the water made nearly non-corrosive. Sanitary engineers have agreed that the soft, colored waters of the coastal region, both East and West, are difficult to purify by methods which have been effective in improving the harder waters of the Middle Atlantic States and the waters of the Great Lakes section, and that these soft, colored waters may be corrosive to pipes after filtration.

TABLE I. EXPERIMENTS MADE ON RAW WATER FROM PLANT

Alum and soda used given in parts per million

	Run of Plant, Dec. 2			Run of Plant, Dec. 4			
	Raw Water	Alum 29.2 Soda 13.2	Alum 29.2 Soda 10.4	Raw Water	Alum 31.9 Soda 9.8	Alum 29.2 Soda 8.4	Alum 29.2 Soda 6.0
Color	50	15	8	50	8	6	5
Turbidity	10	1	1	10	0	0	1
Alkalinity	3.5	5.9	3.8	2.8	3.2	3.2	3.4
Carbon dioxide	1.9	8.1	9.8	1.7	10.3	10.6	9.8

Whether these waters should be purified by slow sand filters alone, or mechanical filters preceded by alum coagulation, or chlorine alone or some combination of these methods should depend on the average and variable quality of the water to be treated and the final water desired by the consumers.

Measured by work done in relation to cost of doing it, the slow sand filter is very inefficient when used to remove bacteria, color or suspended matter. For work done at low cost in safeguarding a water supply, chlorine leads. Chlorine alone cannot remove much turbidity or color. But there is a way that chlorine can assist filter alum in coagulation and color removal which has been very little appreciated and very little used. It is the use of chlorination and alum coagulation preceding mechanical filtration.

Experiments at Belfast, Me.—In early December, 1914, the writer made an inspection of the water purification plant of the Belfast Water Co. (described by Robert Spurr Weston in *Engineering News*, July 23, 1914, p. 180). As the water was very cold and the color removal appeared poor for the amount of chemicals added, only a few experiments were made. The methods which will be described have been used at Belfast, Me., and Exeter, N. H., and at Acadia Mills, Lawrence, Mass., for over seven years. It is well known that cold temperature retards chemical action. These experiments were made as a result of observations on cotton and woolen mill use of caustic soda, soda ash, lime, sulphuric acid, and bleach to remove dirt and coloring matter from the materials in the process of manufacture. They were made entirely at the writer's suggestion for the Belfast Water Co., whose plant was later sold to the Belfast Water District, which has given permission for the publication of the data.

Run-of-Plant Experiments—The first experiments were made in the ordinary plant run where we were feeding filter alum to coagulate the color and soda ash to supply alkalinity for coagulating the alum. Several experiments on decreasing the soda ash were made and, as expected, decreased color resulted, with decreased alkalinity and increased carbonic acid. (See Table I.)

Bottle Experiments—Two bottle experiments were made, using raw water from the pond like that shown by the analysis in Table I. (1) Alum, 2 grains per gallon, soda $\frac{1}{4}$ grain per gallon, bleach 2 p.p.m. or 0.66 p.p.m. available chlorine, gave color, 1; turbidity, 00; alkalinity, 1; carbon dioxide, 16.8 on 24 hours' reaction (2) Alum, $1\frac{1}{2}$ grains per gallon, soda $1\frac{1}{2}$ grains per gallon, gave color, 30; alkalinity, 9.9 p.p.m.; turbidity, 1; carbon dioxide, 6.3 p.p.m.

Further Plant Experiments—The raw water from the pond on another date showed color, 50; alkalinity, 2.8 p.p.m.; turbidity, 10; carbonic acid, 1.7 p.p.m. Three tests at the filter plant with different rates of treatment were made. (1) 31.9 p.p.m. alum and 9.8 p.p.m. soda gave (after filtration) color, 8; alkalinity, 3.2 p.p.m.; turbidity, 0; carbon dioxide, 10.3 p.p.m. One grain per gallon of soda added to the filtered water made the color 12. (2) 29.2 p.p.m. alum and 8.4 p.p.m. soda gave a filtered water of color, 6; alkalinity, 3.2 p.p.m.; turbidity, 0; carbon dioxide, 10.6 p.p.m. (3) 29.2 p.p.m. alum and 6 p.p.m. soda gave filtered water of color, 5; alkalinity, 3 p.p.m.; turbidity, 1; carbon dioxide, 9.8 p.p.m. There is close agreement between the bottle experiments with four hours' coagulation and the plant tests with $1\frac{3}{4}$ grains of alum and four hours in the coagulating basin.

Effect of Additional Soda—Using the same raw water as noted in the preceding paragraph, bottle experiments with four hours' coagulation were made to show the effect of additional soda on color, alkalinity and carbon dioxide. Samples thus treated and then filtered gave the results shown by Table II.

TABLE II. EFFECT OF ADDITIONAL SODA ASH ON COAGULATED WATER

Soda Ash Grains per Gal.	Color	Alkalinity P.P.M.	Turbidity	Carbon Dioxide P.P.M.
0	5	0.6	1	15.1
0.25	5	0.7	1	13.5
0.50	5	0.7	0	11.6
0.75	7	0.8	1	9.3
1.00	12	4.5	1	7.6
1.50	14	8.5	1	6.1

The experiment was tried of increasing the soda alone, and with increasing amounts of bleach. Table III shows the increase in color due to additional soda, overcome by additional bleach, also the reduction in carbon dioxide caused by bleach, and increase in alkalinity. None of these samples showed additional precipitation with soda, and no additional precipitation on standing alone.

Up to the limit to which it can be used without causing taste, bleach with filter alum has been found to be more efficient than filter alum alone, in reducing color and assisting the coagulation as well as in destroying organic matter and assisting to keep the filter sand in good condition.

It was believed that at Belfast, 2 p.p.m. bleach (0.66 p.p.m. available chlorine) would give a lower color to the water with a given alum treatment, reduce the iron in the filtered water and keep the filters and coagulation basin cleaner of organic matter which undergoes some decomposition wherever found. Plant experi-

TABLE III EXPERIMENTS ON INCREASING SODA ALONE, AND WITH INCREASING RATES OF BLEACH

Alum, Grains per Gal	Soda Ash, Grains per Gal	Bleach P.P.M.	Available Chlorine	Color	Turbidity	Alkalinity P.P.M.	Carbon Dioxide P.P.M.
[illegible]	[illegible]			8	1	1.5	10.1
[illegible]	[illegible]			10	1	1.8	9.9
[illegible]	[illegible]			15	2	2.2	9.8
[illegible]	[illegible]	1.0	0.33	[illegible]	1	1.5	[illegible]
[illegible]	[illegible]	2.0	0.66	4	0	1.8	9.1
[illegible]	[illegible]	3.0	1.00	2	0	2.4	8.4

ments confirmed these results, and there was no free chlorine in the filtered water.

These experiments show that on this water decreased alkalinity and increased carbonic acid give better color removal; also that chlorine can improve the color removal and overcome the effect of increasing alkali in the water naturally or added artificially. It is the writer's opinion that it does this by chlorination of certain compounds and by hydrolysis of certain other compounds, besides making the whole reaction more one in which color and alum hydrate and organic colloids precipitate rather than dissolve.

The reservoir from which this water was drawn had been deforested shortly before the purification plant was built. The water therefrom contained a large amount of new coloring matter which was difficult to remove. A portion of this coloring matter, judging from its action with chlorine, appeared to be electropositive, but when the alkalinity of the water was low and the carbonic acid high, or when chlorine was used, even less than any excess, the color removal was excellent, and no uncoagulated alum sulphate or colloidal alum hydrate went through the filters when running these experiments.

The chlorine or bleach can form saturated compounds of the tannates of almost all classes, and the alum treatment can remove these. The chlorine can accomplish several other chemical reactions, some of which are too complicated for many water experts to understand without further study. Chlorine in water can be made to work rapidly or slowly, depending on how it is introduced into the water. Overcoming the effect of soda with chlorine produces an apparent lowering of OH ions in alum coagulation without a reduction actually taking place, thus increasing the efficiency of alum treatment, or saving alum.

At Belfast, bleach was used with alum and worked rapidly on the water, like free chlorine, because of the interaction of these chemicals. Gravimetric tests showed that all the alum added to the water at Belfast was removed by filtration, and sometimes some alum was removed which was naturally present in the water.

There is not much doubt among chemists but what lowering the alkalinity and increasing the carbonic acid will increase the corrosiveness or aggressive action of the water on metals, such as filter underdrains of metal or metal supply pipes, but the filter underdrains at Belfast are of concrete.

The use of chlorine will increase the corrosiveness of the water still more, but all the free chlorine can be used up in the filtering system and much of it removed by the coagulation and filtration. The floc formation is more satisfactory by forming smaller clear-cut (not milky) coagulation, and the floc subsides more quickly and the water filters more rapidly, besides which the filter sand is kept cleaner of accumulations of organic matter which in many cases form mud balls in the sand.

In these experiments, the alkalinity tests were made with erythrosine in accordance with the Standard Methods of Water Analysis of the American Public Health Association, and the carbonic acid tests were made according to the same standard methods. The alkalinity, when low, tested by erythrosine gives slightly higher results, usually about 2 p.p.m., as carbonate of lime ($CaCO_3$), than the methyl red indicator, which has a P_H range of 4.4 to 6 acid red to alkaline yellow. This ties up the alkalinity results on this water to the H-ion determination, and the P_H is very low, much less than 7. The corrosiveness of the water is tied up to the H-ion determination, using phenolphthalein as indicator, and numerous experiments have shown that if the water is neutral to phenolphthalein with low alkainity it is about as non-corrosive as it can be made practically, and will likely have a P_H near 7; but if the alkalinity is higher say 40 to 60 p.p.m., it might have $P_H 7$ and still be corrosive, due to excess carbonic acid.

If the filtered waters resulting from the above treatments are too corrosive for the distribution system used, they may be corrected by lime or soda ash, or even caustic soda in certain cases, after filtration, and the color increase will be much less than if an attempt was made to remove color, produce good coagulation and rapid filtration by the best floc and correct the corrosiveness, all in the coagulating basin. Aeration after filtration will reduce carbonic acid and lessen the alkali necessary for neutralizing carbonic acid.

The carbon dioxide test, as made on these waters, is really the resultant of CO_2 or H-ions free to act, and probably depends partly on the half-bound carbon dioxide when it is so low as well as the free carbon dioxide, just as the alkalinity result is probably a resultant of the free carbon dioxide (CO_2) acting against the alkaline bicarbonate to form a resultant alkalinity which is likely lower than it would be if there were no CO_2 present.

In this water, as in many such soft waters, the color is double at certain times what it is at others. In these plants the operators had to be taught to increase and decrease the filter alum and bleach with changes in color and add enough soda ash to have always some residual alkalinity after treatment. In one plant even caustic soda was used to reduce corrosiveness.

Other places may have waters of more or less color, more or less variation in the amount and kind of color, and may have suspended matter and variable alkalinity as well as variable corrosiveness. However, it is the writer's opinion that with a plant carefully designed for the water to be treated and with careful supervision, the water will have the degree of safety and good appearance which the public should demand.

Conclusion—Low alkalinity and comparatively high carbon dioxide give better color removal than simply a final alkalinity of 10 parts or more per million as generally used on coagulated waters. Prechlorination lowers the color with the same amount of alum, or by inference saves alum to obtain the same resulting color. Chlorine used with alum gives the effect of better color removal with higher alkalinity and lower carbon dioxide. Soft corrosive waters may be treated with lime or soda after mechanical filtration rather than with coagulation in the treating basins before filtration to secure much better removal of color and equal removal of carbon dioxide to obtain the lowest practical corrosive action with the purified water.

Laying 30-in. Submerged Pipe for Norfolk Water-Works

Integral Flexible-Joint Cast-Iron Pipe Laid From Cradle Suspended Between Two Barges—Bells Heated, Pipe Length Lifted to Cradle, Bells Reheated, Joints Poured From Special Pot, Rig Moved Forward

By David A. Decker
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and

John O. Miller
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FLEXIBLE-JOINT cast-iron pipe laid from a curved timber cradle suspended between two barges was used for the three most important submerged crossings on the twenty-mile supply main from the Lake Prince reservoir to the water-works distribution system of Norfolk, Va. These streams were the Nansemond River with a width of 2,000 ft. and a maximum depth of 30 ft.; Craney Island Creek, 1,400 ft. wide and 20 ft. deep; and the Elizabeth River, 6,500 ft. wide with a maximum depth in the 750-ft. ship channel of 58 ft. and varying depths of from 47 to 85 ft. from channel to pier head lines.

Flexible-Joint Pipe—After careful consideration of the various types of flexible-joint pipe, it was decided

PIPE CRADLE USED ON ELIZABETH RIVER CROSSING
Length, 150 ft. Made of timber

to use 30-in. cast-iron pipe of the Ward joint type but with certain modifications. These were: (1) The shrinking of a 1-in. by 4-in. steel band around the bell end of the pipe; (2) machining of the spigot end spherical and a uniformly turned shoulder immediately back of the spherical machined spigot; (3) the casting of an extra lead groove within the bell. The steel band was used to insure extra strength to the bell during handling and shipment, and to resist any strains from undue deflection or excessive caulking. The purpose of the extra lead groove was to insure a more perfect bond between the iron and lead after pouring and for the admitted value of extra rabbeting. The shoulder on the outside, in case of excess bending, comes in contact with the cast portion of the bell outside of the lead, taking the strain, and preventing any deformation of the lead by crushing. The spherical lead gasket, cast and locked into the bell, insured at any angle of deflection a full lead joint 8 in. deep. Whereas, when the lead is fixed to the spigot end, the maximum deflection reduces the depth of the joint to 3½ in., and proportionately with the lesser angles, for the gasket leaves the bell on the convex side and recesses in the concave side of the joint in proportion to the leading.

A detailed description of the pipe used on these crossings, written by William Hammerstrom, chief engineer of the Lynchburg Foundry Co., appeared in *Engineering News-Record*, May 11, 1922, p. 780.

General Methods Employed—To conform with the requirements of the United States Army Engineers, and to protect the pipe after laying from possible damage by shipping or dredging operations, trenches were dug across the various streams. In the channel of the Elizabeth River this trench was excavated to a depth of 58 ft. below mean low water, thus giving a cover of 12 ft. over the top of the pipe after the trench is backfilled with sand. To eliminate abrupt irregularities by cutting down the bumps and filling the holes, a rectangular drag weighing approximately three tons, and built of 24-in. I-beams 16 ft. long, was suspended at the required depth from a derrick scow and pulled by cables along the bottom of the trench to the Craney Island shore from the opposite side of the channel.

The submerged portion of the Nansemond River Crossing is 900 ft. long, with vertical risers having flanged fittings each side of the channel. There are two creosoted pile trestles from each shore to the vertical risers. For a short distance upon each trestle from the edge of the channel, flexible-joint pipe was laid, and upon the remaining 900 ft. of trestle, Class B cast-iron pipe was laid.

Craney Island Creek was crossed entirely with flexible-joint pipe. The pipe was jointed in the cradle and launched shoreward through the Craney Island bulkhead to a point above low water, sloping gradually down to the bottom, then across the stream to the opposite bank on the sloping sand beach to high water, and there connected to the previously laid Class B, cast-iron pipe.

On the west bank of the Elizabeth River the flexible pipe was pulled from the end of the cradle shoreward through the Craney Island bulkhead on an inclined skidway to and above the high-water mark. The east end of the 4,100-ft. submerged portion was laid on a sloping grade from the bottom of a 25-ft. dredged cut, up and onto the pipe trestle with reverse vertical curves, avoiding the use of bends or specials. The flexible pipe is run along the trestle for 100 ft. shoreward and there connected with lock-joint concrete pressure pipe, which extends from this point to the shore and thence to the 37th St. filtration plant.

Work by City Forces—The Nansemond River and Craney Island Creek crossings were laid by city forces, employing day labor and working in daylight only. A 100-ft. curved timber-trussed cradle was suspended between two barges: one a flat deck barge, 35 x 110 ft., and the other a derrick scow, 30 x 90 ft. The upper and lower chords of the cradle were built up of 2 x 8-in. heart pine, making two laminated members, 8 x 12 in. each, the struts and diagonals being one piece 10 x 12-in. heart pine timbers. The pipe skidway was constructed of 2 x 8-in.

heart pine, built up to 8 x 8-in. sections, upon which were bolted ½ x 4-in. steel plates as a base for 30-lb. railroad rails set normal to the barrel of the pipe.

The cradle was curved and slung so that the lower end could be kept, at all times, tangential to the river bottom, whatever the depth by raising or lowering the purchase blocks and tackle by which it was suspended.

Contract Work, Elizabeth River Crossing—The Elizabeth River crossing was laid by Sanford & Brooks Co., Norfolk, Va., using a cradle similar in design, furnished by the city, but 150 ft. long. It was slung in the same manner, except that a 40 x 100-ft. derrick scow was used in the place of the smaller one. In each case the cradle was hung from 12 x 12-in. A-frame trusses, built up on the decks of the barges. Large five sheave purchase blocks and tackle attached to the upper end of the A-frames and to predetermined panel points of the lower chords of the cradle furnished easy means of control. To regulate the submerged end of the cradle, two sets of double sheave blocks were attached to a timber placed across the stern of the barges and lower end of cradle.

Six sets of ranges, lighted at night with electric lights, were placed on each side of the river, the center sets marking the center line of the dredged cut and pipe line, and the side sets warning shipping not to anchor within the sector. The United States Coast Guard maintained an efficient patrol at the site of operation, and controlled speed of vessels, thus eliminating danger of injury to the pipe and laying rig from heavy swells.

The pipe was delivered upon lighters to the laying rig from the storage yard on the water front. Careful inspection was made by an experienced pipe man, furnished by the foundry, before the pipe was placed upon the lighters, and again just before it was placed in the cradle, to guard against any possibility of defective pipe getting into the line.

Bells Heated—Prior to laying, the bells of the pipe were heated to about 400 deg. F. by the use of a specially constructed device for three reasons: (1) To enlarge the bell; (2) to guard against too sudden a chill of the lead; (3) and to permit the removal of the pitch in the lead space of the bell. Asbestos bulkheads (metal lined), about 8 in. apart, one fitted against the machine ring in the bell and the other against the outside of the bell, confined the heat to the portion that was to be filled with lead.

Through the outside bulkheads were cut four 2½-in. holes into which were placed the nozzles of 5-gal. gasoline torches. After heating, the pipe coating of pitch on the inside of the bell was thoroughly scraped out and the metal left clean, insuring close fit and contact between lead and iron. The machined spigot, which had been coated at the foundry with a mixture of white lead and tallow, was also cleaned and oiled.

Immediately before the pipe was lifted into the cradle with the derrick boom, the bell was again heated to about 400 deg. F. Under usual working conditions, a pipe was laid every thirty minutes so that the bell did not cool materially before the next pipe was placed. As soon as a pipe was "belled," the gasket was put in position and a "mud" gate made ready for pouring the lead joint. The machined spigot fitted the ring in the bell so perfectly that no jute nor inside gasket were necessary.

Special Lead Pouring Pots—Lead pouring pots of sufficient size to hold enough metal to fill a joint requiring approximately 275 lb., and provided with a special bottom valve, were designed by the department and built at a local foundry. They were similar to any ordinary lead melting pot, except for a tapering hole machined in the bottom, into which a tapering rod with hand-wheel control fitted.

PIPE LENGTH IN CRADLE READY FOR POURING JOINT

Upon the derrick barge, a stationary furnace, with twin melting pots large enough to hold the special pot, was built so that the boom could reach it. It was then an easy matter to swing the special pot from furnace to cradle and pour the joint.

As soon as the lead was poured and before the bell had cooled off the joint was carefully caulked. Then the joint was wrapped with blankets and thoroughly chilled with cold water. After the bell had been cooled, the joint was "broken" (deflected) to allow the pipe to conform to the curve of the cradle and to any irregularities in the river bottom. The "breaking" was accomplished by the use of a 12 x 12-in. timber fulcrum bolted to the struts of the trusses at right angles to the pipe skidway, about 4 in. above the bell of the pipe as it lay on the skidway. A sling, arranged to pull normal to the axis of the pipe, and attached to the boom, then deflected the pipe about 10 deg. out of line. The joints were so stiff that it was necessary to pull the pipe down again to the skidway after the first operation.

Use of Pipe Cradle—The "breaking" operation having been completed, the whole pipe-laying rig was then moved forward 12 ft. preparatory to laying the next

pipe. This was accomplished by pulling on a forward anchor line which exerted a direct motion to the cradle through a bridle line. At the same time the snatch lines attached to the last joint laid in the cradle were slacked off and the pipe allowed to slip down the skidway as the cradle moved ahead. Also the stern and breast lines were controled, as necessary, to hold the cradle in line with the ranges. Care was taken to push the pipe out of the cradle rather than to exert a pull on it as the cradle moved forward to avoid unnecessary stresses upon the lead in the joint.

The experience gained from these operations proved the value of extreme care in considering the details of design, arrangement, and rigging of the pipe laying plant. Unless this care is exercised many important details may be overlooked or discounted for once the work is under way, alteration or correction in either design or rigging is very difficult.

While various methods of approach were used on the several crossings, the most satisfactory was that of

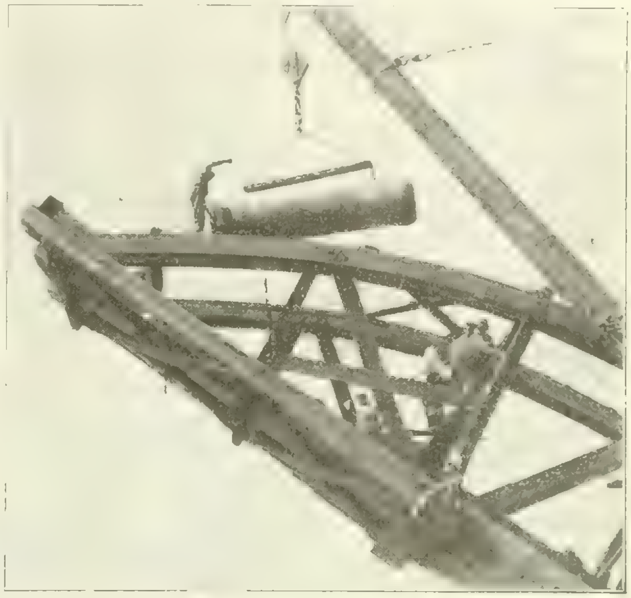
POURING JOINT ON CRADLE FROM SPECIAL LEAD POT
Hand wheel controls tapering [illegible] discharge hole
Pot holds about 275 lb of lead

connecting the submerged pipe directly to the shore lines with gradual curves without the use of vertical "risers" or "bends." This eliminates the danger of side thrust due to pressure in the pipe line.

The heating of the bells brought out the fact that care must be taken in raising them to a moderate temperature only so that it does not interfere with the malleability of the lead after solidification or with cooling the joint within a reasonable time. It was found that when the bells were moderately heated, the joints were considerably stiffer than those poured at either extreme. Cooling of the iron with the resulting contraction of the bells increases the pressure on the lead around the spigot.

During the progress of the work, on all jobs, a careful inspection of the pipe below the water was kept up. At least once during each eight hours the inspector was lowered to a point back of the lower point of the cradle.

Leakage Tests—Preliminary tests under pressures up to the maximum heads for which the pipe was designed do not indicate a leakage in excess of 100 gal. per inch diameter per mile of pipe per 24 hours. These tests are satisfactory proof that the methods employed in these



READY TO MOVE AHEAD A PIPE LENGTH

operations, while permitting an excellent rate of speed, were sufficiently careful to insure good results. The several crossings averaged twenty-one 12-ft. joints or 252 lin.ft. per 24-hour day. The maximum laid during any one 24-hour period was 33 joints in the channel of the Elizabeth River at a depth of 58 ft.

Unit Cost—The Nansemond River and Craney Island Creek crossings were laid by city forces during winter weather at a cost of $10.54 per lineal foot, including cradle construction and rental of floating equipment, but excluding the cost of lead and pipe. The Elizabeth River Crossing was laid by Sanford & Brooks Co., general contractors, at a contract price of $16.17 per lineal foot, including cradle construction and equipment and excluding the cost of lead and pipe. The work was begun July 10 and completed July 29, 1922, making 19 working days of 24 hours each. The work was performed under the direction of Walter H. Taylor, 3rd, city engineer, David A. Decker, as principal assistant engineer, and John O. Miller, resident engineer.

Tree Planting Costs on California Highways

About 8,000 trees have recently been planted along the state highways in California, distributed through six counties. A large number of varieties of trees are used, selection being made on advice of the forestry board to suit local soil and climatic conditions. Of 2,920 trees planted in Yolo County, using nursery stock furnished free by the forestry board at its nursery, the total cost in place was 42 cents per tree. The maintenance cost varies from $50 per annum per mile in the valley sections to over $300 per annum per mile in the desert, according to a bulletin issued by the state highway commission.

Testing Hollow Building Tile

Differences in Test Results Believed to be Mainly in Variation in Apparatus and Technique

By Wm. B. Newhall
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Wide differences in test results on hollow building tiles as reported by different laboratories led to a comparative study, some months ago, of the methods of testing used. This study, carried out by the writer as consulting engineer for the Northwestern Clay Products Co., showed the differences in results to be due to differences in apparatus and technique. It developed also that the entire subject is still under observation and test in the American Society for Testing Materials, where an authoritative standard might be looked for. Following are some suggestions deduced from this study.

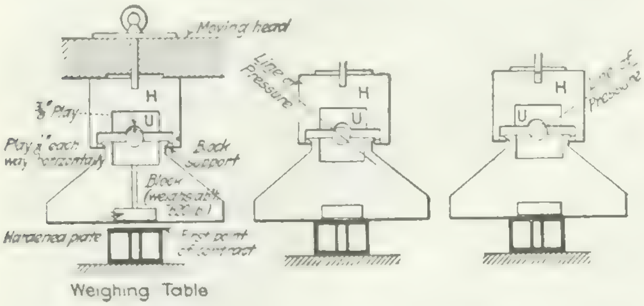


FIG. 1. ORDINARY COMPRESSION BLOCK SEATING ON SLIGHTLY INCLINED SURFACE OF TILE

Left-hand sketch, suspended block about to come into bearing at high corner of tile. Middle sketch, block simply lowered on tile, rotating about high point at corner; line of pressure becomes inclined. Right-hand sketch, result of adjusting block by hand while lowering to bearing, so that bearing face is parallel to top of tile, center of rotation at *c*, near top of block, and pressure line inclined.

Hollow building tile, being a rough product, varies rather widely in strength. This fact tends to induce a carelessness in routine testing that is unfair to the tile. In the testing machine a tile does not have the support it would have in a wall where cross-walls, brick facing, and cement-mortar joints hold it against overturning. Hence the specimen tested to destruction is entitled to be properly bedded, properly placed, and properly loaded in the machine.

Compression tests actually observed bring out three important points:

First, the load applied through the usual form of suspended ball-bearing compression block is usually out of plumb; that is, the compression block introduces a side push not indicated by the machine and of sufficient force to affect the results.

Second, the usual bed of plaster of paris fails before the tile fails, and by flowing sidewise causes the tile to crack first in its horizontal members, by bending, showing the load to be concentrated over the openings.

Third, only those tests that make the vertical webs fail in diagonal shear can be said to have properly developed the strength of the tile. The tile should fail suddenly, all vertical webs at once; not in rotation.

Hollow building tile, being vitrified, can easily be broken by impact, and being hollow can more easily be destroyed when the load is applied at an angle than when applied in the direction of the webs that resist the load. The material is very strong only in straight compression, and should not be subjected to bending or tension or impact.

In Fig. 1 is illustrated the suspended ball-bearing compression block now in constant use on the 400,000-lb. testing machine in the laboratory of the Minneapolis city building inspector. Similar blocks, but of smaller size and much lighter weight, and with almost no play between the suspended part and the upper part, are in use in the laboratory at the University of Minnesota, and probably also in every other laboratory equipped with the usual machinery for compression testing. The design of this block was approved by a committee of the American Society of Civil Engineers and the American Society for Testing Materials, and is illustrated in the 1915 *Year Book* of the A. T. S. M., in the appendix to the standard specifications for portland cement. The block can be made to work perfectly on test specimens having the upper and lower faces exactly parallel, but with the hollow-tile specimens this condition is fulfilled only by accident.

When the block is simply lowered upon the test piece the first point of contact becomes the center of rotation of the block, the ball is thrown out of center, and a side push is introduced and transmitted through the ball to the test piece. When the block is adjusted carefully by hand while being lowered, so as to come down parallel to the inclined top of the test piece, contact occurs over the entire top surface of the test piece at once, but again a side push is introduced because the center of rotation of the block when supported on the flange made for the purpose is above the center of the ball.

Improvement of this condition could be obtained by making the upper cup *U* free from the hood *H*, and allowing it to rest on the ball at all times. Let *H* be turned out enough to allow free side motion for *U*. Then *U* will seat itself automatically against *H* directly over the center of the ball before pressure is transmitted through the ball to the test piece. The side push introduced by the block does not seriously affect solid compression specimens or even tiles with very short thick vertical webs. These fail by diagonal shear, but tiles with ordinary or thin vertical webs nearly always have the webs laid over sidewise without developing their strength. and the weighing levers of the machine indicate only the vertical component of the load applied. A difference of ⅛ in. in the height of a 5 x 8 x 12-in. tile is enough to develop the maximum side push. An angle between the resultant line of pressure and the vertical or true direction of the resisting webs of only ⅛ in. in 5 in. will reduce the total load 20 per cent or more.

In Fig. 2 is shown a simple free ball with two cups. This device is cheaper, easier to handle and more reliable on hollow tile than the ordinary compression block.

According to the A. S. T. M. tentative specifications for testing tile, specimens may be bedded in plaster, either in or out of the machine. The importance of a hard, thin bed is recognized, but no easy way to get it in hasty routine work is suggested. The strength in compression of plaster is much less than that of the tile. This disadvantage is partly overcome by making the bed very thin. If anything stronger and equally convenient to use were known it would be substituted.

Our tests disclosed the fact that when bedding outside the machine on a smooth steel plate, the addition to the plaster of about 10 per cent of portland cement and allowing the bed to dry out over night gives a much harder bed and a better test. More complete experi-

ments along this line are now progressing at the U. S. Bureau of Standards in co-operation with the Hollow Tile Committee of the A. S. T. M.

Our best results were obtained by bedding the tile outside the testing machine between two thick cast-iron plates. The operator can then easily see that he has a thin bed, with the tile properly placed, vertical webs straight up. The plates with the tile between are pushed on to the center of the weighing table, a small free ball bearing is placed on top directly under the center of the moving head, and the load is applied

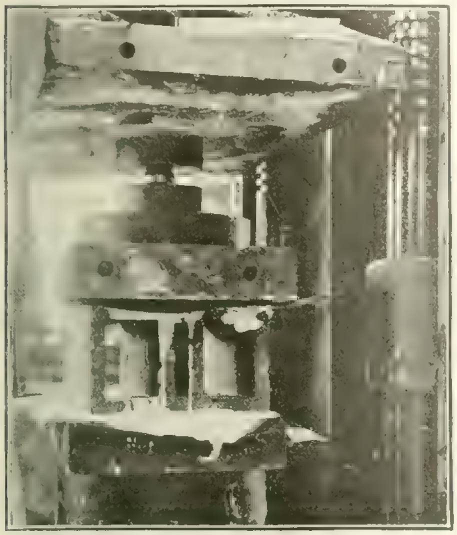


FIG. 2. FREE BALL COMPRESSION BLOCK

5 x 8 x 12-in. tile properly bedded between cast-iron plates; a thin sheet of paper smeared with oil keeps the bedding plaster from sticking to the plates.

FIG. 3. SHEAR FAILURE OF WEBS

Same tile after testing. Parts of the tile have been removed. The upper part of the two middle webs has been lifted off and set down at left. All vertical webs failed at the same time.

(Fig. 2). This method is quick and easy. Ordinary plaster allowed to set 30 minutes has been used with success, the specimens failing by diagonal shear in the vertical web members every time (Fig. 3). The cast-iron plates used are 2 in. thick and weigh between 40 and 50 lb. It would probably be better to have them thicker for greater stiffness and to core out some openings along the sides to reduce the weight. A good hard-burned tile 5 x 8 x 12 in. weighing less than 13½ lb. can be made to carry a 100,000-lb. load, but it must be properly loaded.

It is hoped that the technique for testing hollow tile will soon be perfected and standard methods published by recognized authorities.

Improvements in Railway Coaling Stations

That the design of coaling stations is in the development stage is stated in a brief report presented at the recent annual meeting of the International Railway Fuel Association in Chicago. One line of improvement is to provide for the necessity of handling large quantities of coal economically, and so handling and distributing it that it will not deteriorate in grade. For stations where small quantities of fuel are handled, several forms of equipment are available whereby time and man power are greatly reduced. For large stations, considerable attention is being given to greater storage capacity, particularly regarding the storage adjacent to the plant containing the overhead or supply storage.

Pavement Maintenance Experience in Wichita, Kansas

Cost Given for Five Standard Types — Some Changes in Specifications Appear to Be Desirable

By P. L. Brockway
City Engineer, Wichita, Kansas

MANY paved streets actually receive so little traffic that internal stresses set up by varying temperature and moisture content must be regarded as the real destructive agents. Even the heavier traveled streets last many years and natural destructive agencies have an effect on the pavement that can never be duplicated in an accelerated test. The best proof, after all, is the wearing out of pavement under normal conditions.

Maintenance Costs — The table below has been compiled covering actual maintenance costs of standard types of pavement in Wichita, Kan. Those listed as asphalt include both sheet asphalt and a close asphaltic concrete, together with a compromise mixture, as explained later. Almost none of the asphaltic concrete is more than 4 years old. All of the brick more than 10 years old is repressed block, except some of the oldest, which is of the brick size. All of the brick younger than 10 years is vertical fiber which has required no maintenance except from an occasional crack in the base caused by shifting subsoil. All the pavements listed are on concrete base except the macadam, which is hand-poured asphaltic binder on a sand-filled macadam base.

PAVEMENT MAINTENANCE COSTS IN WICHITA, KAN

Kind	Area	Total Year-Yards	Aver. Age, Years	Cost per Yd Per Year
Asphalt	972,622	9,767,413	10.5	$0.0013
Brick	957,524	7,515,630	8.0	0.00015
Concrete	251,812	762,414	3.0	0.0012
Bitulithic	130,136	1,762,068	13.5	0.0018
Macadam	31,552	235,607	7.5	0.00098

The figures in the above table are approximately correct, but like many other tabulations are misleading without explanation.

Asphalt—The oldest asphalt pavement is 32 years and 80 per cent of it is still in use. However, 38,000 yd. 31 years old, 28,000 yd. 28 years old, and 30,000 yd. 18 years old have been replaced within the last few years. All of this pavement was maintained 10 years by the contractors and later allowed to wear out with very little maintenance.

All asphalt pavements 17 years old and less are still in use, but contractors maintained for 10 years pavements from 13 to 17 years old, for 5 years pavements from 4 to 13 years old, for 2 years pavements less than 4 years old. Nearly 40 per cent of all the pavement is

11 and 12 years old and now requires 80 per cent of the maintenance work. About 400,000 yd. of that age, representing varying traffic conditions from about 1,000 vehicles per day on a 26-ft. roadway to 8,000 per day on a useful width of 20 ft., cost $3,200 to maintain in a reasonably good condition last year or $0.008 per yard per year.

Most of this expense is incurred in removing humps and waves in the sheet asphalt. Minor damages are skin-patched during hot weather by simply filling the depression partly full of top mix, trimming off the ridge with a foot-adze and ironing over the whole surface. This is much cheaper than cutting out the whole area and refilling it, as must be done in the worst places.

Characteristic maintenance of the older asphaltic concrete surface is the sealing of cracks. The sheet asphalt surface seems to offer too little resistance to the hammering of heavy traffic and the asphaltic concrete too much resistance to temperature stresses. Of the two failures the cracks are much easier and cheaper to repair. Cracks sealed 5 years ago by cleaning out, pouring full of hot asphalt and annealing with smoothing irons are in 90 per cent perfect repair today.

Brick—The oldest brick pavement is 31 years old, all of it on light-traffic cross streets and nearly all of it resurfaced with sheet asphalt, which is charged to pavement construction rather than maintenance. Brick pavement is difficult to maintain after it begins to wear unevenly because new brick set in worn places do not sufficiently match those adjacent. Practically the only maintenance attempted is the smoothing up of the worst depressions with an asphaltic concrete mix on the old surface. On the other hand the pavement, when it becomes worn so badly that the brick begins to ravel out, has a high salvage value, because it is only necessary to level up the surface with a binder course and cover with a standard sheet or asphaltic concrete surface.

A brick pavement 12 years old on one street covering 48,000 sq.yd. and carrying 10,000 vehicles per day of which about 10 per cent are heavy loads is rapidly deteriorating so that even now it is disagreeably rough. It will probably have to be resurfaced within three or four years. The maintenance per yard per year before that time will probably not exceed the figure in the table. This pavement is now worn enough to illustrate clearly a point which is entirely disregarded in any specification we have seen published. That is, if the brick are laid at an angle of 30 to 45 deg. to the direction of traffic the pavement will remain in a satisfactory condition 50 per cent longer than if laid at right angles. This is a strong statement. It is theoretically correct that rolling contact between surfaces is lighter than square moving contact; practically all high-speed gears are helical. As applied to joints in a brick pavement, the same theory holds and is supported by actual practice.

Concrete—The oldest concrete pavement is 11 years and has had no more maintenance than some only 2 years old. The oldest concrete pavement under concentrated traffic carries 3,000 to 5,000 vehicles per day of mixed traffic, is 9 years old and has very light maintenance. In fact the only maintenance required has been the repair of one joint buckled by expansion and the sealing of cracks with a fat mixture of asphaltic cement and hot sand. We do not know how long that will last, but the oldest seal has been in place 5 years.

Much of the necessary maintenance was on 50,000 yd. laid in 1920 without cross-contraction joints, in line with general practice, with the expectation of sealing the cracks when they developed. We promptly discontinued that practice on account of the psychologic reaction of property owners who cannot believe that pavement that breaks up in a year or two is what they should receive. From an economic standpoint alone it is right to repair the cracks as they develop, but it is discouraging to an owner to ask him to build a concrete pavement when he can walk a block and see it broken at rather frequent intervals with ugly, irregular cracks. That problem, like many others, must recognize the human element. Road engineers and builders must adopt the business slogan "Satisfaction Guaranteed" in order to merit the confidence that any successful business must enjoy. Much adverse criticism of concrete pavement could be avoided by making the cracks straight when it is built.

From our experience we have no doubt that concrete pavement can be maintained in satisfactory condition under any ordinary traffic up to 1,000 tons per day per foot of width used for not to exceed $0.0005 per yard per year for at least 15 years. We have one-half mile of concrete pavement 2 years old carrying an almost solid string of trucks and wagons hauling sand during the construction season on which the belt-finish marks are not yet worn off.

The type of joint we are using has not cost one cent for maintenance and is in just as good condition for traffic as when laid. It consists of creosoted wood blocks of 2-in. commercial thickness set with the grain vertical in the concrete.

Bitulithic—The oldest Bithulithic pavement was built 15 years ago and was replaced this year. It carried about 25,000 tons per day over an effective width of about 35 ft. for the last few years and was in generally unsatisfactory condition for the last five years. Traffic followed one track in each direction on account of the rough condition of the surface. This track developed a rut each summer which was repaired by skin patching at small expense.

No attempt was made to maintain the surface as a whole except in the worst holes, as nothing short of resurfacing the whole street would have been effective during the latter third of the life of the pavement. It was discovered, on removing the surface, that much of the pitch used in the original mixture had settled down onto the base. This is an indication that the old Bitulithic mixture did not carry sufficient filler to hold the bituminous cement properly. The characteristic failure of Bitulithic surface as it wears out is a gathering of the material into round hummocks which produce accelerated deterioration due to impact

A reasonable theory for this peculiarity is that, owing to the lack of filler, the bitumen is not uniformly distributed throughout the mass and the coarser particles in the mixture are therefore unevenly bound together even in separate shovelfuls as the material is spread. Many of the hummocks, when they first appear, are not much larger than the space covered by a shovelful of

material. If this is true, the advocates of mixtures containing 50 per cent or more of material retained on the ¾-in. screen, with barely enough matrix to fill the voids so that it becomes necessary to use a squeegee coat to produce a smooth surface, are on the wrong trail.

Compromise Asphalt Mixture—Sheet asphalt pavements with a dense bituminous matrix have demonstrated their wearing qualities time and again. They, however, do not have internal frictional resistance in extremely high temperatures to resist the shoving action of modern traffic because there is not enough large material in the mass to impede its flow. The pull of even a heavy passenger automobile with the wheels sliding in an emergency stop actually drags the paving material along if it will flow at all. This produces the ridges already mentioned. If the surfacing will not flow some of its is torn off, the amount depending, of course, on its resistance to abrasion. An asphaltic surface with plenty of bitumen to hold the filler is not easily carried away in this manner.

The apparent solution, therefore, is to start with the ordinary dense sheet-asphalt mixture with all the bitumen which it will carry and stiffen it by adding a small percentage of material retained in a ½-in. screen, (15 to 25 per cent). By using asphalt of low penetration (40 to 45 in this climate) to add to internal resistance, enough may be used so that the surface will acquire a shiny appearance under heavy traffic. This prevents the carrying away of particles by abrasion even though they become dislodged. If this practice is correct the best specification is a compromise between the ordinary sheet-asphalt and asphaltic-concrete specifications. We are so thoroughly convinced that this reasoning is correct that we paved some of our heaviest-traffic streets in this way in 1919 and are continuing to do so in such locations. While of course it is early yet to reach any real conclusion, there is no indication of either cracking or rolling even under the heavy traffic along a large ice and cold storage plant.

Inasmuch as there is no general backing for the addition of large amounts of coarse material in a sheet-asphalt mixture we are discouraging its use. Asphaltic concrete is, so far, a more or less general term which applies to almost any mixture of aggregate with asphaltic cement which is heated and mixed hot in a mechanical mixer and spread on the street and rolled in place while hot. There is, therefore, plenty of precedent under that title to vary the mixture to suit varying conditions.

Asphaltic Macadam—The asphaltic-macadam pavement was nearly all constructed in 1913 by the penetration method and hand-pouring. While the maintenance cost has been only $0.001 per yard per year this amount has been insufficient to keep the pavement in proper condition. One street carrying about 1,200 vehicles per day is so worn down that it would be possible to put a 2-in. top over it without disturbing the gutters. This means that in not over 5 years more the surface will disintegrate beyond any hope of maintenance. The obvious thing to do would be to cover the whole street with either an asphaltic-concrete surface or with a 2-in. surface of plant-mixed macadam, or a plant mixture of hard limestone, from ¾ in. down, with all the dust retained and all the 96 penetration asphalt it will carry, spread and rolled while hot and covered with a squeegee coat of asphalt and hot sand. The latter surface would not cost over $1.25 per square yard, including all necessary plugging of holes.

In another neighborhood the same kind of pavement, which has deteriorated more from weathering than traffic, could have its useful life doubled simply by giving it a squeegee coat of asphalt and rolling in hot sand. This should not cost over $0.25 per yard. It seems scarcely just to do this work at the expense of the city when the property owners asked for and paid for a cheap surface which was known to be inferior when it was constructed. On account of these maintenance difficulties we are discouraging the construction of this type of pavement.

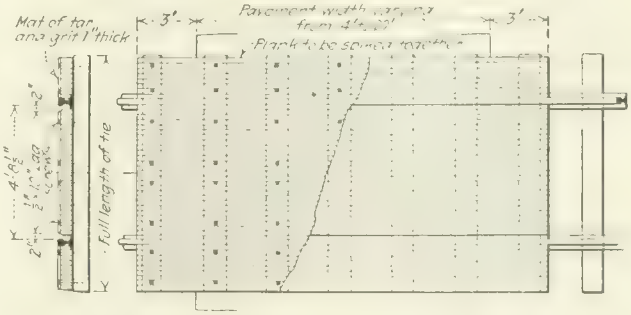
We are, however, encouraging the use of a plant-mixed macadam surface over some of the old water-bound, oil-treated park drives. This is being made by heating a good quality of limestone, all passing a 1-in. screen and with all the dust retained. It is mixed with sufficient asphalt of 96 penetration to make a rather sloppy mass while hot. The mixture has about the analysis shown in the following table.

Opening in Inches	Retained, Per Cent
0.742	10 to 15
0.371	10 to 15
0.185	10 to 15
0.093	10 to 15
0.046	10 to 15
0.0232	10 to 15
0.0116	15 to 20
0.0058	7 to 10
Passing 0.0058	10 to 15

After being rolled a squeegee coat of asphalt, (96 penetration) is placed over the surface requiring about 6 lb. per square yard. This is covered with hot sand and thoroughly rolled. The surface thus produced is much superior to penetration macadam and costs only a little more.

Standard Highway Grade Crossing Ohio State Roads

A SOLID timber flooring the full length of the cross-ties and covered with a tar and grit mat 1 in. thick has met favor with railway officials in Ohio. The drawing shows this crossing as designed by the engineers of the Ohio State Highway Department. As indicated the 2-in. planks are set on edge and firmly spiked together and are fastened down by means of eight lug-screws to each tie. E. C. Blosser, Columbus, Ohio, is state highway engineer.



PLANK GRADE CROSSING OHIO STATE ROADS

Recent Railway Developments in Eastern Africa

Nile and Lakes Linked with East Coast—Labor Gangs of 1,000 Natives on 200-Mile Line—Zambesi Ry. Opened

TWO important railway advances for opening up rich districts in the interior of Africa are the Uasin-Gishu Ry., a 205-mile extension of the Uganda Ry., and the 175-mile Trans-Zambesi Ry., linking an interior line with the coast. Of these railways, shown in Fig. 1, the former is under construction and the latter was completed recently. Further, the former requires heavy construction work while the latter is in relatively easy country.

Uganda Ry—Railway development in East Africa involves heavy grades, curvature and earthwork in order to overcome the sharp rises or terraces which step up from the coast and the deep clefts or inland valleys caused by the subsidence of the earth's crust as a result of volcanic activities. Notable among these

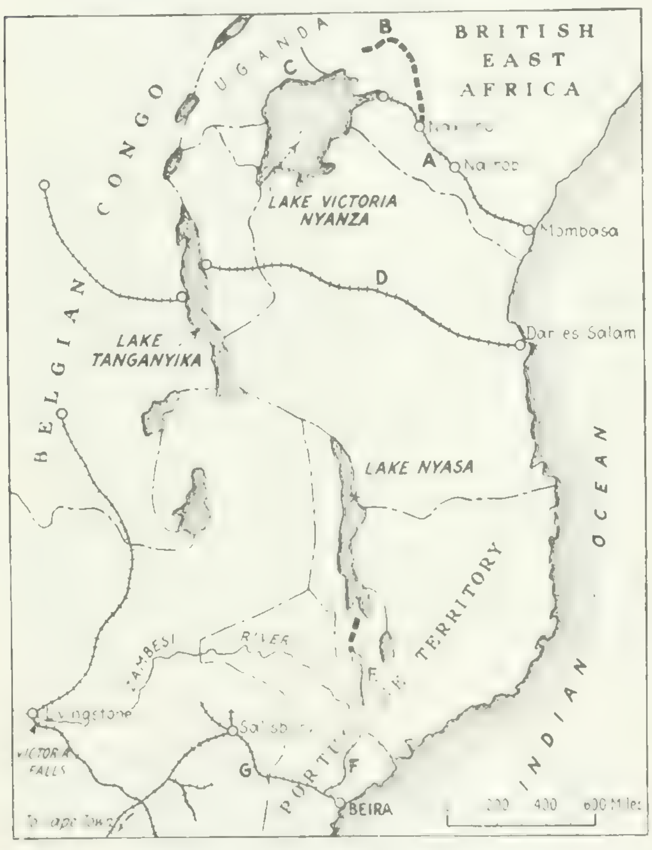


FIG. 1. RAILWAYS IN EAST AFRICA

A, Uganda Ry.; B, Uasin-Gishu Ry.; C, Busoga Ry.; D, East Africa Ry.; E, Central Africa.; F, Trans-Zambesia Ry.; G, Beira Ry.

clefts is the Great Rift, which runs from Lake Nyasa through Lake Tanganyika northeast of the Gulf of Aden and through the Red Sea into the Jordan Valley. This rift, 30 to 50 miles wide, is bounded by lofty precipitous escarpments. At its southern end, the floor is 2,500 ft. above sea level, rising to 6,300 ft. at Naivasha (just south of Nakuru, Fig. 2) and then dropping gradually to the north.

The Uganda Ry. starting from the port of Mombasa rises steadily until it reaches the Kikuyu Escarpment

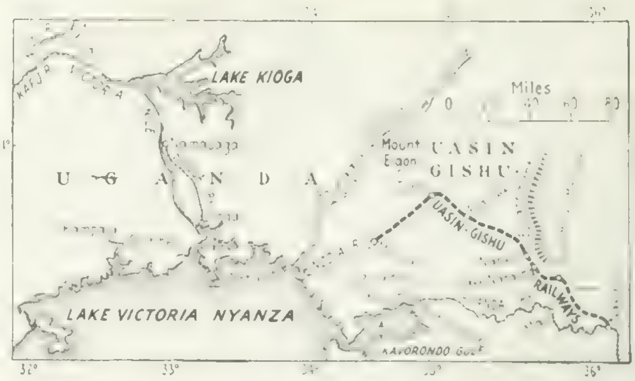


FIG. 2. UASIN-GISHU RY. (EXTENSION OF THE UGANDA RY.)

station, 346 miles, on the eastern wall of the Rift, at El. 7,400 ft. Thence it drops down the steep slopes to Naivasha, El. 6,011 ft., at 391 miles, and follows the bottom of the valley to Nakuru, whence it climbs the western wall to Mau Summit, 484 miles, at El. 8,350 ft. Then the line falls to El. 3,720 at Kisumu (Port Florence), 584 miles from Mombasa on a shallow backwater of the Victoria Nyanza, known as Kavorondo Gulf. Since Mombasa is not well situated for shipping accommodation its real port is at Kilindini, a little distance to the south. A $5,000,000 contract has been let to Pauling & Co., London, for deep-water piers at this latter place.

The railway was commenced in 1896 and completed in 1903, the work being done by Indian coolies under a government commission. It is a meter-gage line with ruling grade of 2 per cent, uncompensated, and was so located as to require a minimum of earthwork. Its curvature and rise and fall are very considerable. Steel viaducts across the gorges are numerous and were built by an American company (see *Engineering News*, March 14, 1904, p. 345). The track is laid with 50-lb. flange rails on 75-lb. steel ties spaced 2,112 per mile. Up to 1904 the construction cost was $26,585,000, or $45,525, per mile, but in 1910 the capital expenditure had increased to $48,265 per mile. These figures are based on the former normal rate of exchange.

Communication between the railway and the Uganda Protectorate is by steamers on the lake (El. 3,720) but the railway owns two isolated lines in Uganda: (1) Busoga Ry., 60 miles down the Victoria Nile from Jinja (El. 3,750) to Namasagali (El. 3,600), passing a section of the river which has rapids preventing navigation; (2) a 10-mile line from Kampala (El. 3,800) down to Port Bell, at the head of an inlet on the lake. In addition to this east coast route there is a route from Cairo to the Victoria Nyanza by rail and steamer, except for a distance of about 100 miles. On this stretch there is a cleared track which can be traversed by small motor vehicles, rest houses being provided at intervals.

Uasin-Gishu Railway—With the growing importance of the Uganda exports due to native developments and the settlement by Europeans of the highland country to the north of the railway, it became desirable to extend the Uganda line across the Uasin-Gishu plateau (Fig. 2.) Of two routes from Mau Summit and from Nakuru the latter was adopted although it involves a second climb out of the Rift valley. The ruling grade of the extension is 1.5 per cent, compensated for cur-

vature, and the existing line from Nakuru to Mau would have had to be rebuilt to reduce its grades to this limit.

Beginning at Nakuru, 448 miles from Mombasa and at El. 6,070, the new line runs northwest, reaching El. 6,800 ft. at 40 miles and then beginning a heavy climb to the plateau elevation of 8,520 ft. at 76 miles. The summit is near Narasha, El. 9,300 ft. Thence the line crosses the plateau to Eldoret, 122½ miles, El. 6,860 ft., and then bears west to Turbo, on the Nzoia River, at El. 5,800, beyond which the country rises gradually to the foothills of Mount Elgon. From Turbo the line will turn southwest down the river to a terminal at Mumias, 205 miles and El. 4,270. The whole plateau north of Eldoret is settled and in the Trans-Nzoia district several thousand square miles have been allotted under the British government's project providing settlements for the soldiers of the World War.

Earthwork on the new railway is very heavy and the curvature is considerable, with sharpest curves of 10 deg. As the rivers are small, no long spans will be required, but numerous deep gorges will be crossed

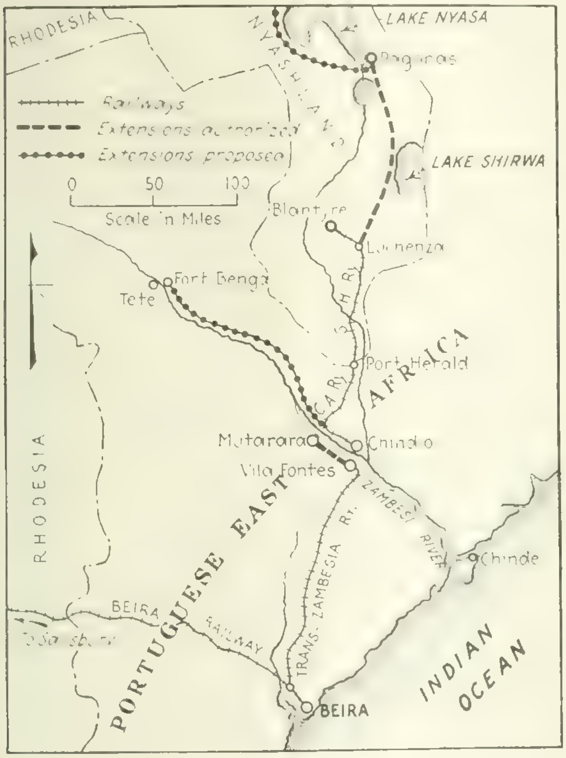


FIG. 3. TRANS-ZAMBESIA RAILWAY AND CONNECTIONS

by steel viaducts, the longest of which are as follows: Sabatia viaduct, 880 ft. with 29 spans of 40 and 20 ft., Nabkoi viaduct, 640 ft., and Sameta viaduct, 450 ft. The line is of meter gage with 50-lb. rails on steel ties of peapod shape.

Unskilled labor is plentiful, but inefficient. Nevertheless, it is not intended to use excavating machinery to any great extent. Skilled labor could be obtained from India, but owing to the prejudice against Asiatics it is probable that such labor will be imported from the south or west of Africa. Since small contractors of a type common in South Africa are not found in this section, the work will be carried on by labor gangs of about 1,000 men, each with its complement of engineers, skilled workmen and medical staff. To each gang will be assigned a length of line sufficient for about two month's work and when this is completed the gang will be shifted to another section. The contractors are Griffiths & Co., London, England, with local headquarters at Nairobi, on the Uganda Ry. Robert J. Halliday is chief engineer for this company.

Trans-Zambesia Ry—This new 175-mile railway completes a 350-mile rail route south from the rich highlands near Lake Nyasa to the seaport of Beira (see Fig 3). Its construction was necessitated by a great change in the Zambesi River. Originally this river was navigable for ocean steamers for about 100 miles to Chindio at the mouth of the Shirè River, from which point the Central Africa Ry. (61 miles) and the Shirè Highlands Ry. (114 miles) form a continuous line of 175 miles north to Blantyre. In recent years, however, the Shirè River ceased to be the main outlet of Lake Nyasa with the result that the level of the Zambesi fell to such an extent that the river is now navigable only by vessels of 5 to 6 ft.-draft.

To overcome this difficulty it was decided to get rail access to the seaport of Beira, the line being a British enterprise but crossing Portuguese territory. The Trans-Zambesia Ry. leaves the Beira & Mashonaland Ry. (running west to Salisbury) about 20 miles from the port and runs practically northward to a point opposite Chindio, where a 2½-mile ferry is in operation. Later the line will be extended a few miles up the south bank to Mutarara, where a bridge will be built. The line is mainly in highly rolling forested country and reaches a summit elevation of about 1,000 ft. at Mile 111, whence it drops by easy grades to 70 ft. at the bridge over the Zangue River. This is the only large structure and consists of five 90-ft. spans. Track is laid with 60-lb. rails and all the lines are on the South African gage of 3½ ft.

A 270-mile extension is proposed westward along the Zambesi to the coal fields of the Tete district. Meanwhile contracts have been placed for a 125-mile extension of the Shirè Highlands Ry. north from Luchenza to Pagonas to connect with steamer service on Lake Nyasa, which is 360 miles long. Work on the Trans-Zambesia Ry. was commenced in September, 1920, and completed in May, 1922, at a cost of about $4,000,000. Sir Douglas Fox & Co. and Sir Charles Metcalfe were the consulting engineers, and Pauling & Co., London, England, were the contractors.

11,017 Miles of Federal-Aid Roads Built

The U. S. Bureau of Public Roads reports that on March 31 there had been completed (since 1916) 11,017 miles of federal-aid road and gives the mileage of each type and the average cost per mile. The figures are based on a large volume of work and are the most recent and reliable figures giving average costs for the whole of the United States. The figures cover the entire cost of construction excluding large bridges and in a few cases the cost of engineering is not included.

Type	Cost Per Mile	Miles Constructed
Graded and drained	$9,200	1,752
Sand-clay	6,850	1,338
Gravel	9,230	4,389
Water-bound macadam	14,000	294
Bituminous macadam	25,720	382
Bituminous concrete	43,500	511
Concrete	36,600	2,104
Brick	46,875	224

These figures are based on the entire period of operation of federal aid but the major portion of the work has been done since 1918.

An Unusual Flood of Eighty Years Ago

Local Scientists Furnish Data for Computing Discharges Amounting to 1,000 Sec.-Ft. per Square Mile

By Ivan E. Houk
Formerly Assistant Engineer, Miami Conservancy District, now City Engineer, Dayton, Ohio

DURING a recent study of rainfall and run-off for the Morgan Engineering Co., the writer had occasion to investigate the records of one of the most unusual floods ever recorded anywhere in the United States; the flood of Aug. 5, 1843, in Delaware Co., Pennsylvania, southwest of Philadelphia. Records of the heaviest precipitation during this storm have been given in various books and papers on meteorology, hydrology and related subjects; but, so far as is known, no account of the storm, or of the flood it caused, has ever been printed in any very accessible publication.

The more unusual conditions connected with this remarkable phenomenon may be summarized as follows:

1. The most intense rainfall amounted to about 16 in. in three hours.
2. An average precipitation of as much as 10 in. in three hours must have fallen on an area of from 50 to 75 sq. miles.
3. Flood stages in Chester, Ridley, Crum and Darby Creeks were higher than during any other flood recorded in the last 175 years, in one instance being as much as 8 ft. higher.
4. A maximum rate of run-off of about 1,000 sec-ft. per square mile occurred from an area of about 62 sq. miles in the Chester Creek Valley.
5. Maximum rates of run-off nearly as great occurred from somewhat smaller areas in the Ridley, Crum and Darby Creek valleys.
6. Tornados occurred in different parts of the county.

Immediately after the flood, the Delaware County Institute of Science, Media, Pa., appointed a committee of three, of which Dr. George Smith was chairman to investigate and collect information regarding this unsual phenomenon. Their report, consisting of 52 closely-printed octavo pages, was published in pamphlet form. The original edition becoming exhausted a few years ago, the report was reprinted by the Institute in their proceedings of October, 1910 and January, 1911. The latter edition, supplemented by personal field investigations, furnishes the basis for the following discussion.

Apparently, this was one of the most unusual thunderstorms ever known. In fact, the descriptions of the local observers, recorded by the committee, lead one to believe that it was the result of two or more separate storms moving in different directions until they finally came together. That such was the case is also indicated by the tornados which occurred in different places and by the general wind movements during the intervals in which the heavy rain fell. Thunder and lightning were said to have been almost incessant.

The heavy rain lasted about 3 hours, beginning between 2 and 3 p.m. in the different part of the county and ending between 5 and 6 p.m. It was preceded by a comparatively light general precipitation which began about 7 a.m. and which amounted to only 0.5 or 0.75 in. During the period from 2 to 6 p.m. the rain seemed to fall in continuous showers of varying intensity, some of the showers being so intense that objects only a few yards away could not be seen. The most intense showers seemed to occur at different times in different places, the general movement being nearly parallel to the stream channls and from source to mouth, thus intensifying the run-off.

The unusually heavy rain fell mostly in Delaware Co., between Cobb's Creek on the east and Brandywine Creek on the west, thus including the territory drained by Darby, Crum, Ridley and Chester Creeks. While the storm extended short distances into Chester and Montgomery Counties and into the State of Delaware, the whole area which was inundated did not exceed in size the county of Delaware, about 185 sq. miles. The precipitation was not unusually heavy along the Delaware River.

In Newtown Twp. the heavy rain fell between 2 and 5 p.m. amounting to from 11 to 13 in. At Newtown Square, immediately before 5 p.m., 5.5 in. fell in 40 min. At Concord, Concord Twp., where the heaviest precipitation occurred, about 16 in. fell in the 3 hours beginning at 2:45 p.m. At Brandywine Hundred, Del., about 10 in. fell in 2 hours.

Unfortunately the above noted depths of rainfall were not measured in rain gages, no stations being maintained in those localities at that time. Consequently they are somewhat open to question. That the rainfall was very great, however, is indicated by the disastrous floods that occurred. In and near Philadelphia no serious flooding resulted although the rainfall, accurately measured in rain gages by trained observers, amounted to from 2 to 5.8 in. At Haverford School, Haverford Twp., a few miles northwest of Philadelphia, where the flooding was not at all abnormal, a depth of 5.82 in. was measured in a rain gage kept by that institution. A careful study of the descriptions given by the committee indicates that as much as 10 in. in 3 hours must have fallen over an area of from 50 to 75 sq. miles

The accounts of the floods in Chester, Ridley, Crum and Darby Creeks, and of the damages they caused, are about what one would expect after reading the descriptions of the storm. Maximum stages for a period of about 175 years occurred in many places, the heights at some sections being as much as 7 or 8 ft. higher than ever before known or than has occurred since. Conditions were worst in the lower part of the Chester Creek valley. One noteworthy circumstance connected with the flood was the almost instantaneous rise of from 5 to 10 ft. which occurred in several places. This took place after the creeks had overflowed their natural banks, so that the amount of water required to cause such a rise was unusually great.

Nineteen lives were lost; 30 dwelling houses, 8 factories, 7 mills and 20 other buildings were washed away; 53 mill dams were either entirely swept away or very seriously damaged, and 32 county bridges were either entirely destroyed or very seriously damaged. The total property loss was estimated at $238,000. Of course, the damage would have been much greater if the valleys had been more thickly populated. The towns and villages are all located above the flood plains.

The writer calculated the maximum rates of discharge for the locations where cross-sectional data had been secured by the committee. Velocities were estimated after a personal field inspection of the locations and a

study of the channel slopes. Drainage areas were measured on the U. S Geological Survey topographic quadrangles. The results of the calculation are as follows:

Stream	Drainage Area in. Sq Mi.	Rate of Run-off in Sec Ft per Sq. Mi.	In. per Hour
Chester Creek	[illegible]	1000	1 55
Ridley Creek..	[illegible]	750	1 16
Crum Creek..	[illegible]	410	0 64
Darby Creek..	[illegible]	580	0 90

While the above values are somewhat uncertain, it does not seem likely that they are as much as 50 per cent in error. It is believed that such errors as do exist are negative rather than positive; that is, that the values given are too small rather than too large. It is to be regreted that the run-off rates cannot be determined more accurately; but, considering the unusual magnitude of the floods, it is believed that the above data are worthy of presentation.

The work of the committee in measuring and recording flood heights, areas of cross-sections, head at bridges and other hydraulic conditions, cannot be too highly praised. While their methods were somewhat crude in comparison with present day surveys, and their deductions not always warranted, the thoroughness and care with which their work was done indicates that their data are not greatly in error.

English Now Firmly Established in Engineering Courses

Survey Shows Variety of Courses in Composition, Literature and Technical Writing—Recognized as Fundamental

By C. W. Park
Professor of English, College of Engineering and Commerce, University of Cincinnati

IT IS not many years since there was considerable discussion of the question, "Is English a fundamental subject for engineers?" The negative opinion was represented not so much by outspoken denial as by neglect either to make English a required subject, or to insure its effectiveness where it was required. Hence, the aim of those who advocated English for engineers was primarily to secure for it a larger proportion of time and a stronger administrative emphasis.

Whenever the question was fully discussed, there was substantial agreement as to the benefits which might be obtained from the study of English. These included: (1) A knowledge of correct form, in grammar, spelling, and the mechanics of expression—matters which, unfortunately, the majority of the preparatory schools have never adequately covered. (2) Training in thinking, through drill in logical definition and analysis. (3) Skill in the use of language as a tool, through the writing of notes, papers, magazine articles, and business letters, and the written or oral presentation of technical discussions: (4) A background of literary knowledge and appreciation, which would furnish not only private enjoyment but also a link between the professional and human interests of the engineer.

The achievement of these four objectives, or any of them must depend in large measure upon the total time given to the study of English. It is true that more rigid entrance requirements might enable the students in some colleges to start farther along, and that more efficient methods of instruction might enable them to make more rapid progress than in the average engineering school. Assuming entrance requirements and teaching efficiency to be approximately uniform for the various colleges, however, a valid common denominator for comparison would be the proportion of time given to English of all credit hours required for a degree.

Minimum Freshman English—As a typical case, assume a four-year course averaging 18 credits per semester and requiring total of 144 credit hours for the bachelor's degree. If English is required three hours a week for one year, or 6 credit hours, the proportion of the total time would be approximately 4.2 per cent. This appears to be the minimum allowance for the standard freshman course in English composition, which is given in all departments of practically every American college. Since this standard course rarely includes more than objects one and two, it is evident that a larger proportion of time is needed if any provision is to be made either for the technical applications of English or for the study of literature.

On the basis of the foregoing estimate, the status of Engineering in 65 engineering colleges in the United States is encouraging. Of this number, as shown by a survey recently made, 47, or 72 per cent, allot more than one year, and more than 4.2 per cent of the total time to English, and require instruction in either literature (31) or techincal composition (30) or both (13). In addition to these studies, public speaking is required in eight colleges. The average proportion of total time for English in the group is 5.8 per cent.

The figures given above refer only to studies required for the technical degree. Nineteen colleges offer electives which may include courses in English, and at least nine of these specify courses which are designed to appeal particularly to engineering students. Since the results obtained by elective courses vary from year to year and from school to school, a truer picture of conditions is gained from statistics on the required courses.

Although there is still room for improvement, particularly in the addition of courses dealing with general literature and with the applications of English to technical writing, the situation is more favorable than it has ever been. Many colleges have recently added courses in English for engineering students, and have identified the instruction in this subject more closely with the technical studies. From the lists of requirements for engineering degrees, it would appear that English is now very generally recognized as a fundamental subject. The present task of the teacher of English is not so much to propagandize as to make the most of the opportunity placed before him.

Rock-Fill Causeway at Singapore

To extend railway service into the city of Singapore and eliminate the present ferry service between the island and the mainland a rock-fill causeway across the Singapore Strait is being built by the Federated Malay States Rys. This embankment will be about 3,480 ft. long, in water about 47 ft. deep at low tide. It is of granite rubble construction with a top width of 60 ft. for a double-track railway and a 26½-ft. roadway, the latter having a concrete parapet wall on the outer side and a fence separating it from the railway. An opening for small craft will be left and as the water may be at different levels on opposite sides of the causeway there will be a lock 170x32 ft., with 10 ft. of water on the sills.

Cement Prices Not Unduly High

Analysis of Prices and Costs Based on Earnings, Elements of Cost, and Comparison with Other Building Materials

By Lowell R. Burch

Assistant to the President, Atlas Portland Cement Co., New York

THE issue of *Engineering News-Record* for June 1 contained an editorial in which appeared the following statement: "Brushing aside all generalities, what the cement consumer wants to know is whether he is paying more for cement than he ought to." Undoubtedly, the consumer should have authentic information on this point. We believe the actual facts as to the cost of manufacturing and the selling price of cement are of public importance. It is held by many that the suspicion that building costs are excessively high is preventing necessary construction and having a consequent effect on the prosperity of the country. Any

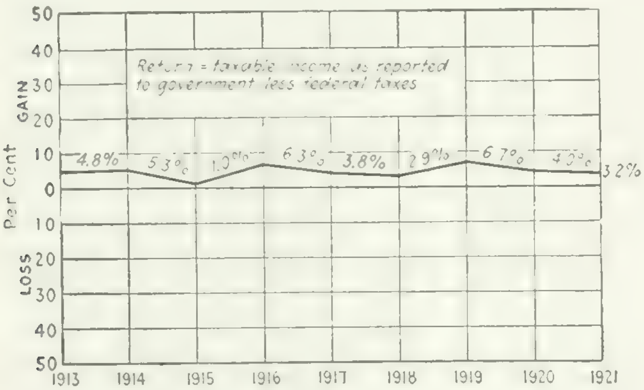


FIG. 1—RETURN ON INVESTMENT OF 19 COMPANIES

Average percentage earned on invested capital by 19 companies in northeastern states, based on income-tax returns.

light, therefore, that can be thrown on the subject should be of value.

It has always been difficult to collect figures and data concerning costs of building materials in general, but by delving into the publications of various government departments, culling over the reports made by the cement companies themselves during the several investigations of their industry, we have developed what we believe to be an accurate statement as to portland cement. In instances where sufficient data were not available from the above-mentioned sources, we have made use of the records of an individual cement company. The writer of this article being connected with the Atlas Portland Cement Co., that concern has been used.

The value of any figures, or statements derived from them, must depend upon the accuracy of such figures. For this reason the information collected here is believed to be especially valuable, because its accuracy is beyond question.

There are three natural approaches to this subject: One is to take earnings on investment as reported to the government for income-tax payments. The second is to build up the cost of actual operation; that is, show how much is secured from the sale of a barrel of cement and how that money is divided up. The third is, by comparison of cement with other products, such as its relationship to other materials in the "price curve." In order to make our survey complete, we shall utilize all three of these methods.

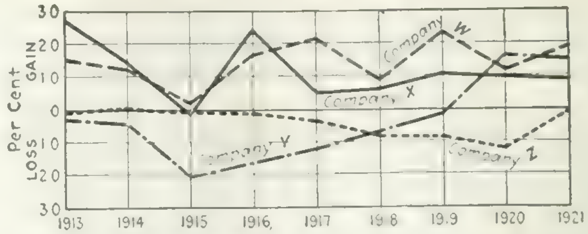


FIG. 2—RETURN ON INVESTMENT OF 4 COMPANIES

Individual earnings of two most profitable companies and losses of two heaviest losers.

Earnings on Investment—Fig. 1 shows the average percentage earned on invested capital by nineteen cement companies operating in the northeastern states from 1913 to 1921 inclusive. This is based upon reported income-tax returns of the respective companies. It will be seen that in the best year, 1919, the earnings were 6.7 per cent before dividends on stock had been paid; and it would be well to note particularly figures for 1920, because the 4 per cent shown there certainly indicates that the so-called profiteering of that year found no reflection in the cement companies' income.

Possibly, the chart will bring forth the comment that the total earnings are low, because a few companies show big losses, probably due to bad management, but that some companies must have made enormous profits. It is true, of course, that some companies made more money, much more in fact, than the averages shown on this chart, while some other companies showed substantial losses. Lest this impair the real value of the chart, another chart, Fig. 2, has been prepared showing the individual earnings of the two best money-makers and the losses of the two "worst" losers. The two companies showing the best earnings average only 13 per cent over the entire period under consideration. The best year for any individual company was in 1913 when company X shown on the chart earned 27 per cent on invested capital. The difference in profits is attributable mainly to natural advantage, although this is

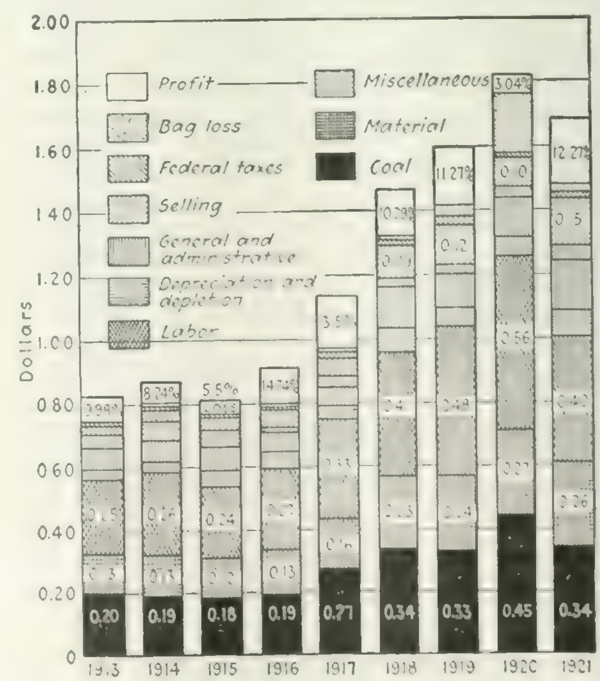


FIG. 3—ELEMENTS OF COST IN A BARREL OF CEMENT

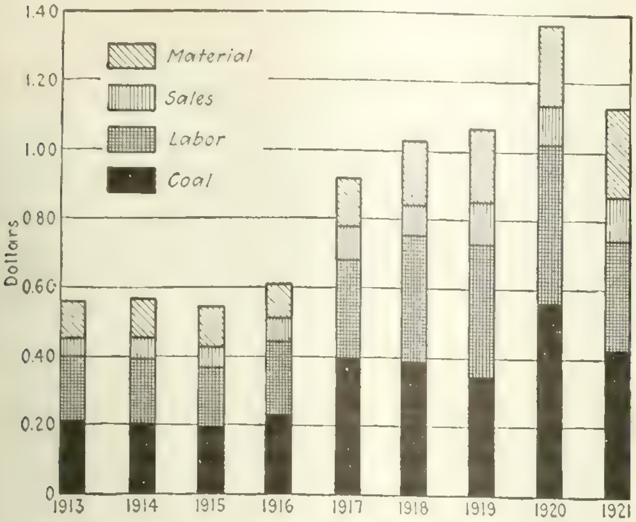


FIG. 4—THE FOUR PRINCIPAL ELEMENTS OF COST

Based on records of 17 Eastern companies and expressed in dollars per barrel.

not in any way meant to detract from the credit belonging to those responsible for good management.

This chart of the two best and two worst results is given only to counteract the impression that the remarkably low average figures might awaken. The vital fact is, that the average return on invested capital is low.

These figures have appeared in court and are accurate. They contain no subterfuge, earnings are not hidden by high salaries, and above all, the invested capital shown is much less than the replacement cost of the properties. Much information could be given to prove this statement, but we cannot cover all points in detail. The invested capital upon which Fig. 1 was based was less than eighty million dollars in 1921, having increased since 1913 only about fifteen million dollars.

It would be well to point out here that there are very few, if any, industries where the investment per unit of sales is so great. In the course of testimony given by an expert, it was brought out that it takes more than

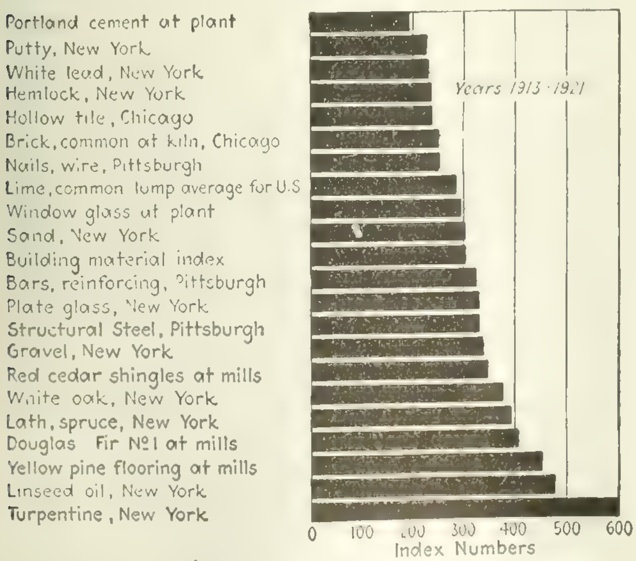


FIG. 5—PEAK PRICES OF MATERIALS, 1913 TO 1921

Maximum wholesale prices of building materials by index numbers based on 1913 average as 100.

$2.50 of capital investment per barrel of annual output. Thus, a million-barrel plant has an investment on the present replacement costs of substantially more than two and a half million dollars; and a ten-million barrel company has an investment which at the present time would have a replacement value over twenty-five million dollars.

This statement may be further clarified by quoting the Geological Survey: "The rate of turnover of capital is necessarily much faster in the iron industry than in the cement industry, in which the rate of turnover is practically slower than that of any other industry. In other words, if the profits per ton were 10 per cent of the selling price of both pig iron and cement, the returns to the producer in the case of the iron industry would be 15 to 20 per cent a year profit, while in the

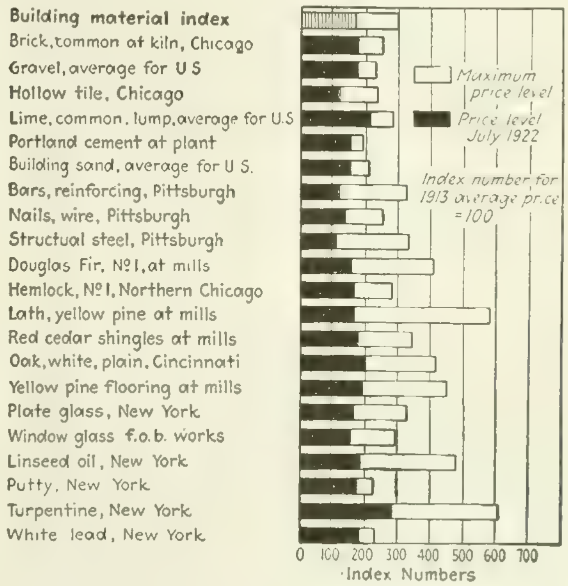


FIG. 6—RELATIVE PRICES OF MATERIALS FOR JULY, 1922

Wholesale prices of building materials by index numbers based on 1913 average as 100.

cement industry the same capital would produce only 5 per cent profit."

Analysis of Average Price Received—In covering point one we had a relatively simple problem. Point two, on the contrary, is so much involved that it is hardly possible to discuss it within the limits of a single article. A book could be written about cement costs; in fact, the costs in almost any commodity present such an involved problem that a thorough explanation is impossible within reasonable limits of space. To average every item for all the companies is out of the question, because no two companies have exactly the same system of accounting. Hence, we have limited ourselves to the complete cost sheets of a representative individual company.

Fig. 3 shows in detail the various elements that make up the price of a barrel of cement. Actual figures appear in the columns of the principal items. In the profit section of each column appears the percentage of profit on the average price received per barrel. Fig. 3 otherwise is as nearly self-explanatory as it is possible to make it.

Fig. 4 shows the four principal elements entering into the cost of cement, collected from records of seventeen Eastern companies, from 1913 to 1921 inclusive, the

items taken being coal, labor, material and selling. It is interesting to notice the increase in the cost of all of these. That there was not a greater increase in some of the items, coal for instance, was due to large purchases made at low prices.

It is perhaps well to mention here that when we read in a trade publication that cement is, let us say \$2.50 per barrel, which is about what the dealers in New York City were paying in June, it does not mean that

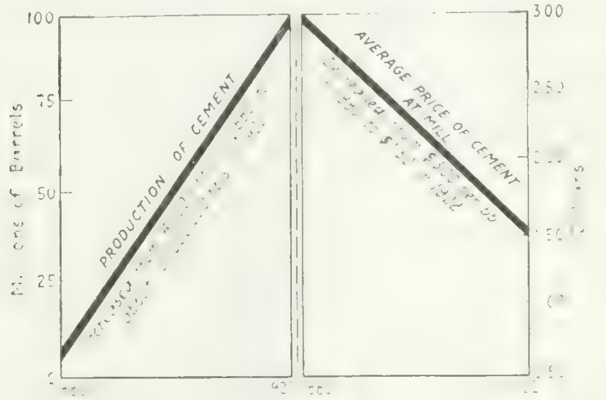


FIG. 7—OUTPUT COMPARED WITH PRICE, 1880 TO 1922

Data from 1880 to 1921 inclusive from U. S. Geological Survey. Figures for 1922 estimated.

the manufacturer actually received that price, or anything like it. We must deduct bags, freight and discount. Let us assume a freight rate of 38c., bags 40c., and discount 10c. This would bring the manufacturer's price down to \$1.62. The bags, it must be remembered, are returnable to the manufacturer at the price paid. Furthermore, prices quoted in these publications frequently include delivery, such as truckage, etc., to the job.

The U. S. Geological Survey publishes each year the average prices received by cement manufacturers for all their shipments. These government reports show that the average prices received by the mills in the Lehigh Valley District were: \$1.64 in 1919, \$1.91 in 1920 and \$1.72 in 1921. In the extreme peak of the building congestion it will be noted that the average price received was only \$1.91 which was the highest average price received during the last decade for the Lehigh Valley mills. While stories of profiteering are most certainly answered, so far as the cement industry is concerned, by this record, what profiteering there was can be traced to a few persons who speculated in cement. Undoubtedly, cement did not escape entirely the bad practices which were then rampant, but the manufacturers, as has been shown, did not participate. More than that, the records indicate that practically no manufacturer accepted anywhere near so high a price as he could have got had he so desired.

Relation to Other Materials—As to the third point: What is the actual relation of cement to other commodities? In this period of inflation how did cement perform? Fig. 5 shows the peak of prices of building materials between the years 1913 and 1921, inclusive. Cement has the best record of all. Fig. 6, which is of more immediate interest, shows where cement stands today, in relation to other building materials. The cement business after the war just began to come into its own. During 1917 and 1918 it was curtailed along with other building materials. However, building activity began early in the summer of 1919 and since then the demand for cement has been extremely heavy. The industry was not affected by the depression of 1920 and 1921 as was the country in general. In fact, 1920 was the record year in shipments with 1921 only a short way behind, while 1922 has broken, so far, all shipping records, with indications that if the strike permits, shipments will continue at the present unprecedented rate. In spite of this demand, prices are much lower now than at the peak, even though the cement peak was not nearly so high as the general commodity peak.

There are two other ways of approaching this question of the price comparisons of cement. Fig. 7 shows the increases in consumption of cement and the decreases in price since 1880, eliminating the yearly and seasonal fluctuations. If cement was a valuable commodity in its early stages—and it must have been or its use could not have so tremendously increased—it is vastly more so now.

Fig. 8 worked out by Edwin C. Eckel, formerly of the U. S. Geological Survey, shows the true price of cement. This is an interesting study, as it gives the price of cement in terms of actual comparative values, rather than in money.

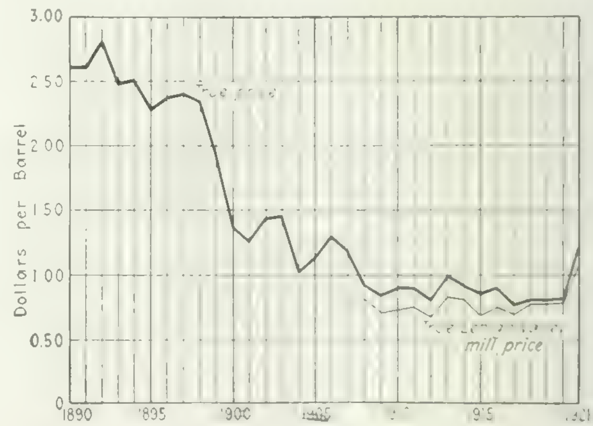


FIG. 8—TRUE PRICE OF PORTLAND CEMENT

Cement prices from 1890 to 1921 expressed in terms of other commodity prices, thereby eliminating fluctuations in currency value.

The basis used to establish this comparative price is the average of commodity prices during the period covered. What Mr. Eckel calls the "true" price is obtained by dividing the nominal or money price for each year by the average commodity price index-number. This method eliminates the variations caused by fluctuations in currency value. As Mr. Eckel points out, the price course of cement analyzed in this fashion shows that technical improvements and economies permitted a reduction in the price of cement as compared with other commodities for many years. When the full effect of improvements and economies had been realized, there was no longer a possibility of independent price reductions. From that time (1910) cement prices conform closely to the average of other commodities, as will be seen by following the price line from 1910 to 1921.

It will be seen from these charts that cement prices considered either from actual or comparative points of view, are extremely low. This becomes all the more

impressive in the light of the fact that the manufacture of cement is not simple, but is an involved process requiring a costly plant.

Considering the enormous amount of capital required to be invested, the rapid rate of deterioration and consequent high cost of upkeep, the multiplicity of operations through which the rock goes from the time it is quarried until portland cement is produced, the care required in grading, blending and testing to produce a uniform product meeting exacting specifications—considering all of these things—the real cause for wonderment is that cement should be the cheapest manufactured building material.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Highway Location Near Levees

Sir—Many miles of gravel road have been constructed in Louisiana immediately behind levees built to protect a large part of the state from overflow when the Mississippi, the Red, the Atchafalaya and other smaller rivers and bayous are in flood stage. These levees are almost invariably located in a series of tangents with angles that make it impossible to get any respectable alignment for the highways without cutting up the property behind the levee. In several places in Louisiana houses and buildings are so thick along rivers and bayous behind levees that a message could be called from place to place for upwards of 50 miles.

The time is rapidly approaching when our gravel roads will have to be replaced with a more durable type of pavement and the question of location becomes very important in the case of a pavement costing from $25,000 to $40,000 a mile. If the levees were located and laid out with tangents and curves of a minimum radius, it would then be possible to get a fairly good alignment for the highway immediately behind, but this would not materially help in the matter of distance where the levees follow the general directions of the rivers and bayous, crooked as they are. Such a levee location would, however, materially decrease the length of levees required and would effect a substantial saving in the land required to build the levee and for the borrow pits necessary to get material.

The problem of seepage water during flood stages can be successfully solved with a small parallel ditch between the highway and levee 1 ft. deep, not closer than 5 ft. to toe of levee, with adequate openings through the road every 500 to 1,000 ft. and with another larger parallel ditch on the land side of the road that will collect seepage and rain water and distribute it to ditches and canals leading away from the highway through the fields to the lower country. The grade line on a highway immediately behind the levee should not be less than 1½ ft. above the natural surface of the ground.

The question as to proper location can therefore finally be argued from two sides, one location immediately behind and paralleling levees and another location well back away from levees. The location alongside the levee would be longer, have more curvature, but would be more convenient to existing developments and contribute hugely to the safety and integrity of the levee system during stages of high water, such as we have just gone through this year. A location back and away from the levees would be much shorter and consequently cheaper and would not be subject to changes and reconstruction when it becomes necesssary to move a levee back on account of caving banks or channel change of the river or bayou. When our levees are moved back they generally occasion a very difficult condition to be met in locating or relocating a highway. Acute angles prevent a clear line of sight and many accidents have occurred in such places.

During the unprecedented stages of high water of 1922 the presence of improved highways close to the levees has proved of incalculable benefit and in more than one case the epochal fight of 1922 to save the levees could not have been won except for the presence of roads over which it was possible to haul men and materials when delays would have spelled disaster. With reasonable concessions from levee builders in the matter of alignment of their works, a good hard-surfaced highway following closely the lines of levees, except where the river or bayou makes a long detour, would constitute an indispensable asset to the integrity of the levee itself in times of high water.

When all levees have been brought up to commission grade and section they still require constant and careful inspection and attention during floods. Sand boils, sloughs, and wave wash will continue to be the order of the day and men, sacks, lumber and tools will be rushed to points of danger. This can be done quicker and more effectively on the land side than on the river side of a levee with a good road close by.

It would then seem that our highways should follow as closely as possible to the levees to form a second line of defense in time of flood, but not closer than is consistent with good alignment and reasonable distance.

Moreauville, La. L. A. SUMNER,
July 29. Construction Engineer, Louisiana Highway Commission.

Teachings of Bridge Failure

Sir—Your issue of August 10 contains an article, p. 238, entitled: "Bridge Abutment Crumbles, Wrecking Span," by C. S. Stewart, describing a failure which suggests three important lessons, two of which I would comment on as follows:

1. As the result of the fall of the pin-connected span, it is stated "The truss except for the last panel appears to have suffered little damage." Pin-connected construction has not received the credit which is its due in the light of experience, and I believe a more general use of it will follow proper considerations of economy and the superiority of connections fitted in the shop over those made in the field.

2. Some varieties of limestone of good appearance are liable to go to pieces in time, as in this abutment when used in the masonry of bridges. I have seen several that required replacement through the gradual development of innumerable cracks in the stone.

GEORGE H. PEGRAM,
New York, Aug. 24. Chief Engineer, Interborough Rapid Transit Co.

Pumping Plant on Incline Moved to Suit Water Level

Sir—In the *Engineering News-Record,* June 22, p. 1027, is an article "Pumping Plant on Incline Moved to Suit Water Level." This is not a new idea by any means as the Illinois Central R.R. Co. has had this type of pumping station in service for many years.

A pumping station with a capacity of more than 200,000 gal. per day built on an incline for raising and lowering pumps was established on the Cumberland River, Kentucky, in 1898, and abandoned in 1908 when the water station was moved from that point. The writer also built a pumping station of the same type at West Point, Ky., on the Salt River in 1902. This plant also had a pumping capacity of 200,000 gal. per day. It was built in 1902 and is still in service. An ice plant at Paducah on the Ohio River has had a plant of the same kind in service for more than 30 years.

C. R. KNOWLES
Chicago, July 14. Superintendent Water Service.

NEWS OF THE WEEK

New York, September 7, 1922

Release 34,000 Cars From Coal Preference on A.G.C. Plea

Washington Correspondence

Thirty-four thousand additional open-top railroad cars have been released from preferential loading with coal. This was accomplished by an amendment to the existing priority order which excludes from the cars on which the coal mines have first call those with sides 42 in. or less in height. Under the original priority order, open-top cars with sides less than 36 in. in height were exempted. Under that order 62,000 open-top cars were made available for loading with commodities other than coal. The exemptions apply only to cars with fixed bottoms. All hopper-bottomed cars are reserved for coal loading.

This action followed representations by the Associated General Contractors. That organization urged that more cars be made available for the movement of construction materials and the other commodities which require open-top cars. In a letter to General R. C. Marshall, Commissioner Aitchison among other things said:

"This action on the part of the Interstate Commerce Commission should not be taken as our final word on this subject, but with the present and necessary demands for coal, it is not felt that we consistently can go further at this time. We will continue, as we have in the past, to keep in daily touch with the situation and as soon as we feel that the situation warrants, action will be taken to relax our service order. We will be glad, in the meantime, if you will keep us informed of the general situation and of any exigencies which might require special attention."

Trade Commission Files Complaint Against Steel Merger

In a formal complaint issued Aug. 31 the Federal Trade Commission charges that the proposed merger of the Midvale, Republic and Inland steel companies, announced some time ago, is an unfair method of competition and in violation of Section 5 of the Federal Trade Commission Act. The Midvale Steel and Ordnance Co., Philadelphia, the Republic Iron and Steel Co., New York City, and the Inland Steel Co., Chicago, are named respondents in the complaint. They are given thirty days in which to file an answer.

The gist of the complaint is that the Commission, after a preliminary inquiry conducted by it, has reason to believe that the consolidation of these three competing companies, which will center the control of some 35 corporations in one group, will eliminate competition between the companies, and lessen competition, restrain trade and tend to create monopoly in iron and steel products in interstate commerce, particularly in Pennsylvania, Ohio, West Virginia, Kentucky, Indiana, Michigan and Illinois.

Price Inflation In Construction Industry Will Prove Boomerang, Says Roosevelt

President of American Construction Council Stresses Need of Stabilization in Letter to 200 National Organizations—

Having in mind the extraordinary advance in wages and prices which attended the boom in the building industry in 1919-20, Franklin D. Roosevelt, president of the newly organized American Construction Council, has addressed the presidents of about 200 national organizations in the construction industry with a view to preventing a secondary inflation which, he believes, would inevitably be followed by a slump in business such as that which occurred in 1921 and which would more than offset any profits from another period of skyrocketing. In addressing these national organizations Mr. Roosevelt, said:

"The extraordinary postwar era of prosperity which came to a peak in 1920 and was characterized by mounting prices, advancing wages and increasing volume of business went so far that the slump which followed it in 1920 was inevitable. Again, the great demand for products, and especially construction, has started us on an era of higher prices and higher wages. Inflation seems imminent. Will reaction follow?

"Wholesale prices have risen again from 138 to 150, building materials from 155 to 167. Wages did not go up as fast as prices in 1919 and 1920, but they gathered momentum as they went and continued upward after prices began to come down. Some reductions from the peak have been made, but again there is a tendency to advance. Expressed in simple terms this means: If we are to keep construction activity steady and stable for the next 5 years, in view of the volume of work which should be done, we must consciously avoid periods of sky-rocketing, either in prices or wages. While the demand for the moment may make possible unusual prices and wages, it will only prove a boomerang if the public decides to stop buying again. Isn't it better to forego temporary advantage if, by so doing, industry is kept moving at a steady, stable, healthy pace continuously?

"I urge your thoughtful consideration of these suggestions and request your co-operation in helping to maintain stability in the construction industry."

This note of warning has met with universal approval and it is being passed along the line by means of the official publications of the various organizations to the members. From the responses received the following are quoted:

American Farm Bureau Federation—"I congratulate you on your efforts to hold prices and wages in the construction industry within reasonable limits. It has been gratifying to note the revival in building, but the ensuing rise in prices is lamentable. If you can make the industry which you represent understand that agriculture is prostrate, that 30 per cent of our population cannot be normal customers of their industries, and that your industry should bend every energy toward an equitable readjustment of its affairs, you will be performing a high national service."

American Bankers Association—"The future stability of American business will not be enhanced by too great expansion at this time, either in production cost or selling prices. Labor, unfortunately, is apparently determined to, so far as possible, maintain wages at war-time levels, which tendency is putting too great a burden upon our great army of consumers, especially agricultural, whose incomes have been materially reduced since 1919."

American Face Brick Association—"While the clay-working profession has never been accused to any extent of profiteering, we wish to be sure that nothing is left undone by us that will in any way help to bring about a steady

Washington Sees Need for Change in St. Lawrence Project Plans

Washington Correspondence

That Canadian apathy in the matter of the development of the St. Lawrence cannot be overcome without some alteration in the plan proposed by the International Joint Commission is the belief held in official circles in Washington. The interest of the President in this project is so great that it is believed he will find some means of making the proposition more attractive to Canada.

Lack of interest in Canada is attributed to railroad facilities in excess of the country's immediate needs and to the abundance of water-power sites where power can be developed in small blocks at low costs. Such Canadian influence as is being asserted in favor of the St. Lawrence development is confined to the province of Ontario and the grain-producing provinces of western Canada which could take advantage of cheaper freight rates from the head of the lakes. Even in the provinces interested, the determination to secure the improvement is not sufficient to be regarded as of great political weight.

building demand at reasonable prices."

National Association of Building Trades Employers—"Your warning is very timely and should be given very careful consideration by all the component parts of business industry. One of the most serious dangers to the present revival of business activity seems to be the liklihood of manufacturers raising prices rather rapidly, due to the revival and encouraged further by the temporary shortage contributed to by the railroad and coal strikes. The tendency for us all to become opportunists, ready to take advantage of every condition, regardless of its effect upon the future, is a real menace to the permanent prosperity of our country, and your letter, therefore, seems particularly timely."

Concrete Mixer Association—"In spite of some increase in the cost of materials and labor, several of our members' companies have recently decreased the selling price of their product, which speaks for itself. You may rest assured that the concrete mixer industry will exert every possible effort to assist in stabilizing the construction industry."

Bates Road Tests Near Completion

With a load of 8,000 lb. on each rear truck-wheel, constituting the sixth load increment since tests were started, the day runs of traffic on the Bates experimental road were completed Aug. 11, according to a statement issued by the Illinois state highway department. Night traffic is now being sent over the road and 5,000 applications of the 8,000-lb wheel load will be made. This will conclude the traffic runs.

A survey of the sections at the end of the day runs with the sixth load increment showed only 11 of the 63 sections undamaged. Of these one consists of asphalt top on concrete base, one of bituminous-filled brick on concrete base and the other nine of concrete cf various thicknesses and designs. In almost every section where failure occurred the breaks were located at the cut joints, progressive breaking developing from the original failure.

Under the 8,000-lb. load a total of 75 breaks occurred, of which 60 were on the south side where trucks were run along the pavement edge. Plans for building a few more sections of special design to be tested during the most unfavorable conditions in the late fall and spring are being considered.

McGraw-Hill Editor Is Attending Rio Engineering Congress

Verne Leroy Havens, editor of *Ingeniería Internacional*, the monthly technical journal in Spanish published by the McGraw-Hill Co., Inc., is in Rio de Janeiro, Brazil. He has been made the temporary chairman of the joint committee appointed by the four national engineering societies to consider and act upon all matters arising from the participation of those societies in the International Congress of Engineering, which opens Sept 17. Mr. Havens is also the official representative of the American Society of Civil Engineers at the engineering congress.

Upon the termination of the congress, Mr. Havens will visit Uruguay and Argentina on business.

Roads Suffer as Coal Strike Boosts Truck Traffic

One of the ways in which the people of the country are paying for the coal and railroad strikes, Thomas H. MacDonald, chief of the Bureau of Public Roads, points out, is in the deterioration of highways. Because of the strikes, he says, a greatly increased truck traffic has been forced on to the highways at a time when the roads are necessarily under-maintained. Under existing conditions there is a tendency to overload trucks and drive them at greater speeds. Due to the inability to secure materials, highway maintenance already is being accompanied by difficulties which necessarily will grow worse as the surplus of open-top cars is absorbed for coal transportation.

A careful survey of the situation east of the Mississippi River leads Mr. MacDonald to believe that a major disturbance in national highway progress is inevitable.

Ask Bids on Heavy Bascule

Bids are being called for Sept. 29 by the Harbor Department of Los Angeles, Calif., on the superstructure of a bascule bridge on Badger Ave., to connect Terminal Island with the mainland. It is to be a three-truss double-leaf bascule of the Strauss type, 220 ft. in span between trunnions, carrying two railway tracks, two roadways and a sidewalk. It will comprise 4,540,000 lb. structural steel, 147,200 lb. castings and forgings, 155,000 lb. machinery, and 77,000 lb. reinforcing steel. Trestle approaches at either end are to be built by the city. The work is part of a large port-development program, under which 7,000 lin.ft. of wharf and several transit sheds are now being constructed.

Muscle Shoals Gets More Money

Washington Correspondence

The President has authorized the transfer of certain river and harbor funds making available an additional $600,000 to apply on the work at Muscle Shoals. This sum insures the maximum amount of work which can be done on the project at this time and adequately bridges the period prior to Oct. 1 when the $7,500,000 appropriation becomes available.

The struggle in the House to secure consideration of the Ford offer continues. Representative Garrett, of Tennessee, the acting minority leader, forced the majority to abandon its plan for three-day recesses. He is forcing roll calls on adjournment and resorting to all parliamentary tactics to speed the disposition of other business before the House with the idea that the majority then will be compelled to proceed to the consideration of the Ford offer.

Representative Mondell, of Wyoming, the majority leader, states that he has no disposition to block the consideration of the matter but contends that the legislative situation is such that it would be perfectly idle to call up the matter at this time.

Coal Operators Hostile to Federal Price-Control

Legislators Resent Stand of Producers Who Would Divert Attention from Prices to Transportation

Washington Correspondence

While the coal operators have maneuvered themselves into a position where they must support, outwardly at least, the fact-finding legislation which has passed the House and is now before the Senate, it is very evident that their support is not whole-hearted. Their opposition to the price-control and distribution bill is particularly active.

There is feeling on Capitol Hill and among some of the executive officers of the administration that the course of the coal operators shows a lack of vision. They are moving toward a greater struggle in 1923 than they had in 1922. If prices are high this winter, they will enter the 1923 strike bereft of support from the public and in fact will have to contend with an embittered public opinion. For that reason some argue that they should recognize that this is an emergency and tender their honest advice as to the plan that distribution should follow to get the best results. In some quarters the attitude of the operators and the wholesalers is being referred to as typical of their inability to unite on anything other than a policy of opposition. This policy in the past has alienated many of their friends.

Operators' Viewpoint

The position of the operators is that the administration is making the same blunders as did the Wilson administration in 1917 when attention was centered on prices rather than on transportation. The drastic Weaver law, it is pointed out, resulted in only a few score of indictments for profiteering. The experience with that legislation, the operators contend, should be sufficient proof that prices cannot be regulated satisfactorily by law. It matters little if the price of coal be $1 a ton if it cannot be obtained. The situation was even worse in 1921, the operators point out, because there is much less coal above ground now, than was the case then. It can be said that the direct opposition to the control bill is not limited to operators and wholesalers of coal. A large number of consumers, particularly the larger ones, are objecting to the delegation of authority to the Interstate Commerce Commission which will allow that body to cut them off from their supply of coal. There is also opposition to the measure from senators who do not believe it good policy to vest such power in the federal government.

Very evidently the tactics of the opposition to the pending coal legislation will be to secure delay. Every day that final action can be deferred will diminish the pressure behind the legislation. At the rate coal will be distributed until the surplus of cars is exhausted will do much to allay public apprehension. The public will not realize that the spurt of production made possible by the surplus of cars cannot be maintained. As the legislation progresses there probably will be a demand on the part of the Pennsylvania senators for separate machinery to handle anthracite. This will tend to complicate the situation and make it easier to sidetrack the legislation.

Reclamation Amendment Is Included in Bonus Bill

McNary Proposal Incorporated in Adjusted Compensation Measure Passed by Senate

Washington Correspondence

Supported vigorously by senators from all sections of the country, the McNary reclamation amendment was added to the adjusted compensation bill, the so-called ex-service men's bonus bill, by a vote of 43 to 26 in the Senate last week. The amendment contemplates reclamation of arid and wet lands by irrigation and drainage with preference given veterans of the armed forces of the country, "World War, Spanish-American war and civil war," but not excluding the general public from settlement if all the land is not taken by veterans.

The amendment was opposed strongly by Senator McCumber, chairman of the finance committee and manager of the bonus bill, on the ground that its provisions jeopardized the bonus measure.

Senator McNary, of Oregon, advocating his admendment, pointed out that while it carries an authorization for $350,000,000, this amount remains to be appropriated and will not all come within any single year. The project is good not only for the former service men, but for the country generally, the Oregon senator declared. There are 22,458,000 acres of arid land and 96,090,000 acres of wet land subject to reclamation, Senator McNary said, most of this in the South and West, but some in New England and other sections.

McNary Plan Provisions

The McNary plan provides that upon application of a state to the Secretary of the Interior for formation of a reclamation district, the federal government shall make a survey. If feasible, a district must be formed, with property owners pledging 80 per cent of their holdings which shall be sold by the Secretary of the Interior on terms agreed upon in advance. Bonds to cover the cost of the project are to be issued by the district and sold through the farm land bank, the bonds to carry not more than 5 per cent interest and to mature in 40 years. The entire cost of the work is to be paid by the district. Farms are not to exceed 160 acres. The federal government will operate the reclamation system for one year, to test it, and then turn it over to the district. The cost of the survey is to be repaid by the district, if the project is accepted; otherwise the federal government will bear the cost, and this cost of rejected projects, and the cost of administration, according to the plan, are to be the only net costs to the federal government ultimately.

Veterans are to be given preference in the work attached to the projects, and are to have 60 days preference in the right to file applications for homesteads under any project.

The bonus bill itself as passed last Thursday by that body by a vote of 47 to 22, provides three options for those whose bonus credit would exceed $50. Payments of less than that sum would be cash. These are: first, certificates payable in 20 years or sooner in case of death, with certain loan privileges meanwhile; second, vocational training aid at the rate of $1.75 per day up to a total of 140 per cent of the bonus credit; and third, aid to purchase a farm or home, the amount to range from 100 to 140 per cent of the bonus credit, depending on how soon the payment be asked. Credit will be given on the basis of $1 per day for domestic service and $1.25 per day for foreign service, less the $60 paid at discharge. No credit will be given to exceed $500 for domestic service and $625 for foreign service. The face value of the bonus certificates would be 25 per cent greater than the amount of the credit but loan privileges would be based on the latter sum.

As the bill makes no appropriation and provides no means for raising the necessary funds it is expected that the President will veto the bill. Speculation is rife as to whether enough votes can be mustered to pass the bill over the President's veto, with the chances slightly against the bill's success.

The Engineer in Public Life

HERBERT A. WILSON

The Governor of Massachusetts has recently appointed an engineer, Herbert A. Wilson, as police commissioner of the City of Boston, adding to the ranks of engineers in public life. After graduation from the Brighton (Mass.) High School, in 1889, he spent seven months in the Boston City Surveyor's Office, on lines and grades for street construction. He was later promoted to the position of assistant in the central office of the Engineering Department of the City of Boston, principally upon the construction of bridges, wharves, and municipal engineering work of a miscellaneous character.

Mr. Wilson's engineering training did not get him into a rut nor dampen his political ambitions. He was elected to the House of Representatives of Massachusetts for the years of 1913-14-15-16, and to the State Senate in 1917 and 1918. In July 1918, Mayor Peters of Boston appointed him building commissioner, from which office he resigned in April of this year upon his appointment as police commissioner.

Mr. Wilson is a member of the Boston Society of Civil Engineers and the American Society of Civil Engineers.

To Consider Reciprocal Licensing

Reciprocal licensing of engineers will be considered by the Council of State Boards of Engineering Examiners which meets in Chicago on Oct. 2, 1922. This board consists of representatives from ten state boards, but it is expected that in some cases the entire state board will attend this meeting. An outline of the plan to be considered was published in *Engineering News-Record*, July 27, 1922, p. 156.

Indianapolis Seeks New Basis for Financing Resurfacing Costs

Methods of financing the cost of resurfacing improved city streets in Indianapolis, Ind., are being investigated by the Chamber of Commerce of that city, with the co-operation of the local chapter of the American Association of Engineers. The existing law, which it is desired to amend, places the entire cost of resurfacing upon abutting property owners. Information received as to the policies followed in 160 different cities shows that 70 cities do not assess the abutting property owner for resurfacing and that 93 assess some portion of the cost of resurfacing on the property benefitted. Of the 93 cities 60 assess more than two-thirds of the cost, while in the remainder of cases the assessment ranges from 25 to 50 per cent. Cities to the number of 39 follow the example of Indianapolis and assess the entire cost against the property owner.

For a number of years, according to a recent statement by the Chamber of Commerce, the problem of resurfacing improved streets had practically no significance because traffic was light and improved streets seemed destined to be long-lived. The theory behind the law which requires the abutting property owners to stand the entire cost of original improvement is that the property will be benefitted by the improvement to an extent commensurate with the cost of the improvement itself. However, such a theory, it is held, has no application to the law which now requiries the abutting property owners to pay for resurfacing costs, since the property receives no increased value as a result of the resurfacing. Because of the failure of the law now governing the assessment of resurfacing charges to stand on any sound economic theory, it is contended that the community, which wears out the pavement, and not the owners of abutting property, should bear all, or at least a part of the cost.

Adjustment of Land and Water Traffic Rights

Washington Correspondence

Questions were recently raised as to the practice of the War Department in adjusting the relative claims of land and water traffic at intersections between roads or railways and waterways. The following statement of the department attitude can be made: The corps of engineers has no hard and fast rule pertaining to superior right of way as between land and water traffic at bridges. The general policy is to prescribe regulations that will produce minimum inconvenience. Many draw bridges are not permitted to open during certain hours of the day, despite what is sometimes considered to be the paramount right of navigation. The highway bridge over the Potomac at Washington is not opened during the hours of peak movement of governmen employees to and from their work. The Harlem River Bridge in New York is opened only at certain hours, since it was raised to give a 24-ft. clearance height at high tide. Many boats can lower their smoke stacks and so arrange their upper gear as to make the frequent opening of draw bridges unnecessary.

Little Unemployment Among Professional Engineers

In a broad survey made by the employment department of the American Association of Engineers covering reports from more than 200 localities, little unemployment of professional engineers is found. Most sections are reporting a scarcity of men for engineering work that is in progress or positions that are available, particularly in the building field. Structural draftsmen, designers and architectural engineers have no difficulty in locating lucrative employment. The reported increases and adjustments to be made by the steel industry will in all probability affect engineering services. Such unemployment as exists is in certain manufacturing industries, and in the coal and railroad fields where labor trouble prevails. Apprehension is expressed from certain quarters of lessening construction activities and manufacturing due to car shortage, transportation difficulties and coal scarcity.

Considerable foreign work has been started or is anticipated by American firms who are and will be sending American engineers out of the country. Reports have been received from a number of members who have made connections to go to foreign countries. Practically all of the firms doing such work are in the East. Personal contact with these companies is the easiest means of effecting such a connection.

The following table shows the trend of employment covering all sections of the country and all work done by the association during June and July, 1922, as compared with July, 1921.

	July 1922	June 1922	July 1921
Applicants for employment	1484	1456	2215
Positions received	413	433	321
Men referred	1433	1462	2567
Men placed	206	225	212

In general the employment situation has taken a very decided turn for the better. This condition can be expected to continue for several months, or at least until the cold weather sets in, when construction activities slow down.

Oil Discharge Regulation Bill Passes Senate

A simplified bill to control the pollution of navigable waters, replacing a number of pending bills, was introduced in the U. S. Senate on Aug. 30 by Senator Frelinghuysen (New Jersey) and passed on the following day without debate and with no substantial change. The bill, which was endorsed as to general plan by Secretary of War Weeks and Maj.-Gen. Lansing H. Beach, Chief of Engineers, U. S. A., makes it unlawful to discharge oil—including fuel oil, sludge or refuse—upon, into or under navigable waters of the United States from any vessel, excepting for the purpose of smoothing the sea in case of emergency or under such regulations as may be prescribed by the Secretary of War in such quantities as shall not be deleterious to health or fish or dangerous to property. A fine of $2,500 for violation is provided and clearance papers may be denied until the fine is paid. The act does not become fully effective until three months after its passage and may be suspended in time of war.

U. S. Court Curbs Striking Shopmen by Drastic Injunction

On application of Attorney General Daugherty, Federal Judge Wilkerson of the U. S. District Court in Chicago has issued a temporary injunction against the striking shopmen, the officers and members of their unions and the affiliated unions of the American Federation of Labor, restraining them from interfering in any way with railroad operation. The writ is returnable on Sept. 11, when argument will be heard as to making the injunction permanent.

The restraint imposed on the strikers and their sympathizers is drastic and far-reaching. They are not to use the union funds in furtherance of any of the acts forbidden by the injunction. They are not to engage in picketing or in any way even by mail, telephone or through newspaper interviews, to persuade or encourage railroad workers to leave their positions. They are not to loiter about railroad property or to interfere with employees even to the extent of displaying force or numbers, jeering or taunting them. These restrictions are in addition to the usual restraint imposed upon actual interference with rail property and operation.

When the injunction was first announced organized labor through many spokesmen, including Samuel Gompers, displayed bitter resentment at its scope, and during the week-end there has developed a sentiment on all sides that the action is not calculated to achieve peace most speedily or on a basis of the greatest permanence. The railroad executives contend that conditions are not so desperate as to justify so drastic a step and fear that their efforts to resume normal operation may be set back rather than forwarded by the move.

Six Government Engineers Sail for Rio Engineering Congress

Washington Correspondence

When six of the Government's engineers were confronted with missing the opening of the International Congress of Engineers to be held at Rio in connection with the Brazilian International Exposition, the Federated American Engineering Societies intervened and was able to induce the State Department to allow these men to sail in time to be present at the opening session on Sept. 17. Among the number was Dr. T. T. Read of the U. S. Bureau of Mines, who was one of the delegates designated by the Federation.

The State Department had postponed from Aug. 24 to Sept. 2 the date of sailing of the government engineers and scientists being sent to the exposition. Several efforts were made without success to secure the revocation of this order. The State Department's position was that the government would have to pay the subsistence expenses of these men for a longer period. The Federation, in a letter to Secretary Hughes, proposed to meet this expense insofar as Dr. Read was concerned so that their delegate could be present at the opening session. The offer was not accepted but Secretary Hughes asked that the order be rescinded and that all the members of the government party be allowed to sail as originally planned.

Site is Chosen for Bridge Across San Francisco Bay

Ravenswood Point, 33 Miles South of City, Recommended as Location for Proposed Highway Structure

Active interest in schemes for bridging San Francisco Bay, so far as immediate construction is concerned, has for some time centered on the selection of one of the proposed locations for a highway bridge across the lower end of the bay, with approaches suited particularly to automobile traffic. The two most promising locations have their western ends, respectively, at Ravenswood Point, 33 miles south of San Francisco by highway, or about 1½ miles above the present Southern Pacific R.R. bridge at Dumbarton, and at Little Coyote Point, which is 24 miles by highway south of San Francisco. In order to provide for traffic at either location, a new highway south from San Francisco is needed as present routes are already greatly overcrowded. The proposed new highway is to cost about $5,000,000 and is to be built 100 ft. wide in a 125-ft. right-of-way, the first construction being of a 40-ft. pavement with provision for future widening.

The California State Highway Commission considered both bridge sites and recommended the selection of the Ravenswood Point location as the "most direct, practical and economical." The Little Coyote Point location was rejected on account of the high cost of construction. The bridge from Ravenswood Point is estimated to cost $2,691,475 and would consist of eight 200-ft. fixed spans and one 310-ft. draw span; both approaches would be supported on concrete piles, the western approach being 1,768 ft. and the eastern approach, 1,734 ft. in length.

Joint committees are at work apportioning the cost of the new highway from San Francisco, the approaches, and the bridge itself among the state and the several counties and communities interested. With the highway commission definitely on record recommending location and type of bridge, it is not anticipated there will be delay due to any further discussion on these points. At a meeting of the joint bridge committee in San Francisco on Aug. 28 M. M. O'Shaughnessy, city engineer of San Francisco, stated that it would cost $50,000 to make the necessary surveys for the new highway from San Francisco to the bridge. Representatives of San Francisco and San Mateo counties, through which this road would run, assured the meeting that funds for this survey would be made available.

Contractor Sues Bridgeport

The Holbrook, Cabot & Rollins Corp., of Boston and New York, general contractors, last week instituted a suit against the City of Bridgeport, Conn., to recover $400,000 damages, alleging the city delayed them in performance of their contract in connection with the construction of the Stratford Avenue bridge in Bridgeport. The contract was entered into Oct. 5, 1915, and completed in 1920, at a cost of nearly $500,000. The contractors undertook the contract before prices of labor and materials had begun their big ascent due to war conditions, and at various times the increased costs made the contract a losing one for the builders.

Hearings on Hydraulic Laboratory Bill to Begin Soon

Washington Correspondence

Hearings on the bill proposing that the federal government establish a national hydraulic laboratory, will begin Sept. 8 before a sub-committee of the Senate Committee on Commerce of which Senator Ransdell is chairman. John R. Freeman, president of the American Society of Civil Engineers, will appear before the Committee at that time. The hearings will be reconvened each day until he has completed his presentation of the need for such a laboratory. It then is the intention to allow an interim of several weeks before the next hearing is had so as to give an opportunity to circulate the printed copies of Mr. Freeman's testimony. Witnesses who are properly qualified to criticise or make suggestions in connection with Mr. Freeman's plan then will be called.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, San Francisco, Oct. 4-9.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York, Annual Convention, Cleveland, Oct. 16-19.

The Indianapolis Chapter of the American Association of Engineers at its meeting Aug. 24 took up the question of salaries for public service engineers. The A. A. E. chairman of the national committee on salaries of engineers in public service started the discussion which had in mind the securing of sufficient data upon which the national committee might base some action.

Personal Notes

HENRY E. ELROD, consulting engineer, Dallas, Texas, has returned to his home in Santa Monica, Cal., where he is located for the present regaining his health. He expects to return to Texas soon to resume his practice.

B. H. DUDLEY, former office manager of the P. J. Leevelling Construction Co., has become associated with M. Hayes & Sons, general contracting firm of Dongola, Ill. Mr. Dudley's new position is also office manager.

THOMAS R. CAMP, at one time a resident engineer and later city engineer of Breckenridge, Texas, has joined the consulting engineering firm of Hawley & Sands, of Ft. Worth and Houston.

D. L. COSTELLO, formerly an inspector of construction in the U. S. Navy construction department, has been made a resident engineer in the Massachusetts Bureau of Highways, Department of Public Works. He is stationed at South Egremont, Mass.

MCCLENDON & PURNELL, Mineral Wells, Texas, have been appointed engineers for Bosier Parish, La., where $1,000,000 will be spent on flood control.

CLIFFORD R. ALLEE, former construction foreman for the Indiana Oil Refining Co., has become associated with the Port Jervis (N. J.) Waterworks Co. as superintendent in municipal water supply construction.

IVAN M. DANSARD, former assistant in civil engineering at Purdue University, has joined the staff of the Fargo Engineering Co., Jackson, Mich.

R. E. KILLMER, recent assistant county engineer of Bexas County, Texas, has been appointed county engineer, vice C. E. HOFF who has resigned to engage in road contracting work.

T. H. WEBB testing engineer, has been appointed assistant state highway engineer of Texas to succeed CHARLES H. KENDALL who has resigned. R. J. HANKS will succeed Mr. Webb as testing engineer.

ARTHUR P. PATTERSON has been appointed county engineer of Coffey County, Kansas, to fill the vacancy caused by the resignation of B. S. COHN. Mr. Patterson was formerly employed by the Portland Cement Association at Milwaukee, Wis.

E. H. COTTRELL, consulting engineer of Dallas, Texas, was recently appointed city engineer of McKinney to succeed CHARLES SCHULTZ who has resigned to become city engineer of Tulsa, Okla.

CAPT. HENRY C. PORTER has been appointed a Texas state highway division engineer to succeed JAMES PERIE who resigned to become city engineer of Ballinger, Texas. Capt. Porter was until recently county engineer of Kleberg County.

EDWARD SVANOE, a widely-known Norwegian hydro-electric engineer, will arrive in the United States Sept. 16 to attend the San Francisco meeting of the American Society of Civil Engineers. O. C. Merrill, the executive secretary of the Federal Power Commission, is arranging an itinerary for Mr. Svanoe, which will allow him to visit some of the larger hydro-electric developments in this country prior to the opening of the meeting on Oct. 4.

JOHN E. BLAIR until recently a resident engineer, Texas State Highway Department, is now city engineer of Mineola, Texas.

CALVIN E. COCK, of Temple, Texas, has been appointed county engineer of Neches County, Texas, with headquarters at Corpus Christi.

R. D. MORGAN, who has been city engineer of Temple, Texas, fo a number of years has resigned to become superintendent of water and sewers at Mexia, Texas.

BLAINE POTTER, Superintendent of Public Works for Jamestown, N. Y., has resigned. The office which he has occupied will be consolidated with that of the city engineer.

FAY, SPOFFORD & THORNDIKE, consulting engineers of Boston, have announced that they have admitted to partnership the following men: JOHN AYER, BION A. BOWMAN, CARROLL A. FARWELL, RALPH W. HORNE, RALPH T. JACKSON, GEORGE L. MIRICK, BARZILLAI A. RICH, and WARREN D. TRASK. Most of these men have been long associated with the firm. The business is to be continued as heretofore under the existing firm name.

WILLIAM A. DOERRIES, at one time assistant engineer of Elizabeth, N. J., and previous to that time assistant chief engineer on the construction of the Bayway refinery of the Standard Oil Co. of N. J., is now associated with the Ozark Engineering Co., Springdale, Ark., engineers, as chief engineer. The organization with which Mr. Doerries is associated is engaged in considerable road construction work in the Ozark Mountains.

BOYD A. BENNETT, recently elected city manager of Charlottesville, N. C., after having been director of public works for Lynchburg, Va., assumed his new duties Sept. 1. Mr. Bennett has been acting city manager of Lynchburg during the absence of E. A. BECK, city manager, on vacation.

COL. C. H. CRAWFORD, the South American manager of the Baldwin Locomotive Co., and CLIFFORD SHOEMAKER, of Washington, D. C., have been appointed official representatives of the American Association of Engineers to attend and report upon the International Engineering Congress being held at Rio de Janeiro in connection with the Brazilian Centennial Exposition. The congress opens Sept. 17.

Business Notes

R. E. BROOKS CO., New York City, has taken over the sale of industrial barrows manufactured by the Akron Barrow Co. The company will act as exclusive selling agents in greater New York.

THE AUTOMATIC FLUSH TANK CO., Cedar Rapids, Iowa, has taken over the business of the DE LA HUNT FLUSH TANK CO., including late improvements in siphonic and air-locking devices for intermittent flooding of sand filters, and announces that the organization and plant facilities have been enlarged and improved considerably.

THOMPSON & MATTHEWS CO. INC., general contractors, of Red Bank, N. J., wish to announce that the firm name has been changed to S. S. THOMPSON & CO. INC.

L. R. TILLOTSON has been appointed sales representative for the Barrett Co., New York, in Kansas. He

will be connected with the Kansas City, Mo., office with headquarters in Topeka, and his attention will be directed towards rural highway work.

THE UNITED PAVING & CONSTRUCTION CO., LTD., Victoria, B. C., has been organized recently and has undertaken a street-paving project for the city of Victoria to cost approximately $200,000 and consist of about ten miles of asphalt penetration road. D. W. Johnston of Vancouver, who has been identified with a number of western municipalities in engineering work during the last fifteen years, is the chief engineer of the newly-organized company.

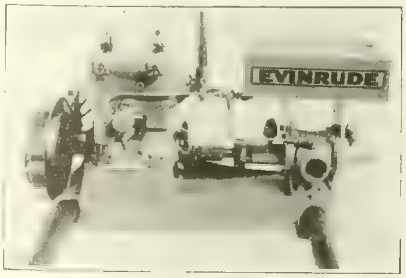
FRANK E. RANSOME, until recently with the Fegles Construction Co., Ltd., Minneapolis, as construction superintendent on the recently completed Barge Canal grain elevator at the Erie Basin, Brooklyn, N. Y., has purchased an interest in the Lynch Construction Co., New York City, and will serve as construction superintendent for that organization on a $2,000,000 warehouse for the Standard Milling Co., Jersey City, N. J. Mr. Ransome's past experience includes connections with Twohy Bros., contractors, Portland, Ore., the Security Bridge Co., Minneapolis, and the Turner Construction Co., New York City.

THE MCWANE CAST IRON PIPE CO., through its president, J. R. McWane, has announced that a new plant will be built on a 30-acre tract in Birmingham, Ala., to take care of future expansion. The first unit will be started at once and is expected to be in operation by March 1, 1923. The new plant will specialize for the present on the smaller sizes of cast-iron pipe, particularly the newly-developed 2-in. and 1¼-in. sizes, claimed to be the smallest cast-iron pipe now made. It will turn out approximately 8,000 ft. of pipe per day and will start with a force of 150 men. The company is comparatively new, having been organized early this year, but Mr. McWane has been in the cast-iron pipe business for years and was one of the organizers and, later, president of the American Cast Iron Pipe Co., also of Birmingham. From this same company James D. Sample, assistant to the president, resigned to become vice-president of the McWane company. One of the chief products of the new company will be the McWane precalked-joint, cast-iron pipe, described in another column of this issue.

Equipment and Materials

Portable High-Pressure Pump

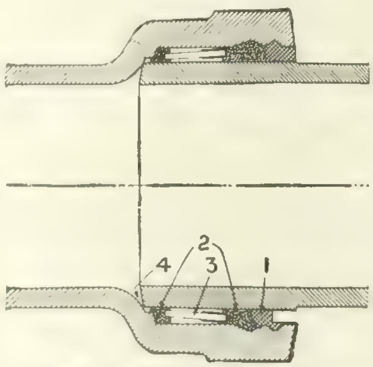
A light portable, high-pressure pump designed primarily for use in putting out forest fires, but adapted, also, according to its manufacturer, the Evinrude Motor Co., of Milwaukee, to a variety of construction uses, has been placed upon the market. The equipment, illustrated herewith, weighs less than 100 lb. complete and has a capacity of 2,400 gal. an hour under 70-lb. pressure, and 900 gal. an hour at 155-lb. pressure. The pump is a small Viking special internal gear pump, direct-connected to an Evinrude 4-5 hp. two-cylinder, two-cycle motor, with magneto built into



the flywheel. The overall length is 31 in., the width 11½ in., and the height 17 in.

Precalked Joint for Cast-Iron Pipe

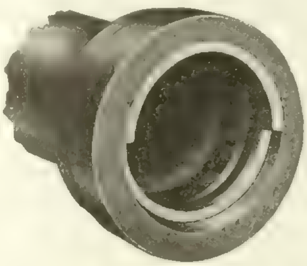
A precalked joint for cast-iron pipe, the result of 8 years of research, has been developed by the McWane Cast Iron Pipe Co., of Birmingham, Ala. The joint is practically factory-made and eliminates the need for the bell hole in laying. In manufacturing it the pipe is stood vertically in racks, bell end upward. A mandrel imperceptibly larger than the spigot end of the pipe it represents is inserted in the joint. Then braided hemp packing, a specially-prepared ring of closeset iron wedges, two more braids of hemp and a final filling



1, Lead; 2, Hemp; 3, Iron Wedge; 4, Shoulder of Pipe.

of lead are placed in the joint. Pneumatic calking tools calk the joint thoroughly for one-half its circumference.

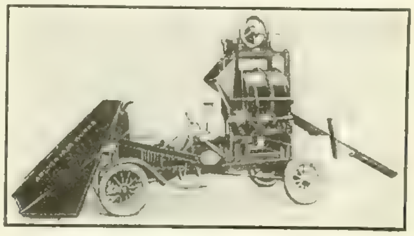
In laying this pipe it is only neces-



sary to knock out the protecting wooden blocks, place the pipe with the precalked side downward in the trench, and calk on top. Driving the lead in thus at the top forces the pipe down firmly to a seat at the bottom. A little touching up of the bottom side of the joint with double offset tools completes it.

Small Mixer Mounted on Ford Truck

A 7-cu.ft. paving and building mixer, mounted on a Ford truck chassis, has been placed on the market by the Archer Iron Works, Chicago. The full power of the Ford engine is available for the operation of the mixer, which can be controlled by one man either from the driver's seat or from the ground. The short wheelbase is pointed out as an advantage for the road contractor's use. The machine is equipped with a loader, automatic water tank and a 9-ft. distribution chute with gate openings. The mixer frame is clamped to the chassis with U-bolts allowing



contractors to adopt it to their own Ford trucks if desired. The weight of the outfit, complete with loader, is 2,500 lb.

Advantages are claimed for this equipment as a building mixer, especially where work is spread over a large area, requiring frequent movement from one location to another.

The Archer-Ford mixer is also furnished as a low-charging mixer with drum set directly on the truck chassis and equipped with loading platform for charging materials into the drum direct from wheel barrows. In this type the loader, water tank and paving chute are not provided.

Out-of-the-Ordinary Trade Publications

Synchronous Motors—THE ALLIS-CHALMERS MFG. CO. has issued a new bulletin 20 pp., illustrated, dealing largely with industrial uses of synchronous motors for belted, coupled or direct-connected service.

Wave Transmission of Power—Walter Haddon, 132 Salisbury Square, Fleet St., London, E. C. 4, England, has issued a 56-p. illustrated booklet describing his patented method of power transmission by wave vibrations and the storage of energy in liquids. Applications of the system to rock drilling and other industrial uses, such as riveting and calking, are illustrated. In the wave-transmission method, the discovery of Gogu Constantinesco, water is contained in a system of flexible-jointed piping connecting apparatus which generates wave motions with the drill or other machine which applies the power created. Power is derived not from a direct flow of water, but rather by a series of pulsations backward and forward. The wave generator consists of one or more cylinders with pistons driven by steam or gasoline engine or electric motor. Drilling equipment utilizing the wave transmission principle is manufactured by W. H. Dorman & Co., Ltd., Stafford, England.

Business Side of Construction

Facts and Events that Affect Cost and Volume

August Contracts Show Gain Over Preceding Month

Average Weekly Rate of $32,026,000, Against $29,793,476 During July Heavier Than August, 1921.

August contracts, as announced in the five August issues of *Engineering News-Record*, aggregated $160,130 000, compared with $119,173,906 reported in the four July issues. This is an average weekly rate of $32,026,000, against $29,793,476 for July. This total includes $12,542,000 for Canada, leaving $147,588,000 as representing important engineering-construction contracts awarded in the United States during the five weeks. The rate for August, 1921, was $26,161,000 per week, which is about 20 per cent lower than this year.

These figures are compiled from Construction News and involve large engineering projects only, with a minimum of $25,000 on public works, except water-works, ($15,000), $40,000 for industrial construction and $150,000 for commercial buildings.

The most notable gains were in industrial lettings and building awards. Industrials reached a total of $21,660,000 during the five weeks of August as against $11,616,000 during the four weeks of July. Buildings totaled $73,512,000 as compared with $50,834,000 for July. Streets and roads contracts aggregated $37,035,000 as against $33,536,000 for July. Federal Government contracts totaled $1,547,000 for August as compared with $7,099,906 in July.

Lettings in the Middle West reached $46,004,000 as against $44,756,000 in the Middle Atlantic states. This makes the third instance since the first of the year in which the Middle West has surpassed the Middle Atlantic states in the total values of contracts awarded.

Finance Briefs

Stock market strong.

Bond market irregular, with few new issues. Appointment of a receiver for the Chicago & Alton weakened the more speculative railway bonds. Industrials dull. Discussing foreign government obligations the Annalist says: "Evidently the decision to allow a six months' moratorium, with present payments made in short-term German Government Treasury Notes, was regarded as constructive, for prices for securities of the Governments most interested were strong at the close."

Money—Resources of the national banks of the United States amount to $20,706,000,000 on June 30, which was $529,000,000 more than on May 5 and $188,000,000 over June 30, 1921.

Higher Fuel, Labor and Sacks Advance Cement Prices

In a letter from Mr. C. B. Rogers, sales manager of the Sandusky Cement Co., Cleveland. Ohio, recently sent to retail dealers in the distributing territory of Indiana, Illinois, Iowa, Michigan, Ohio and Wisconsin, the cost of coal and its effect upon cement prices are very forcibly illustrated.

The price of coal per ton, f.o.b. the Bay Ridge, Ohio and Dixon, Ill. mills, during the first four months of 1922, was $4.02. During the months of May and June the price rose to $4.85 and between July 1 and 15, another advance brought the figure to $9.64. The cost of fuel reached $10.64 per ton between July 16 and 31.

Commenting upon the situation, Mr. Roger's letter is quoted in part:

"It takes 200 lb. of coal to burn one barrel of cement. Therefore, every $1.00 per ton on cost of coal equals 10c. per barrel on cost of finished cement.

"It is readily seen that the one item of coal entering into the cost of manufacturing a barrel of cement shows an increase of 66c. per barrel during the last fifteen days of July over the first four months of the current year, and no immediate prospects of relief.

"The first four months of this year

Engineering News-Record Construction Cost Index Number

September, 1922	185.00
August, 1922	173.40
September, 1921	188.27
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is 12 points higher than last month, due to continued stiffening in prices of steel and lumber, and advance in cement and labor. Steel is now $1.90@$2.25, Pittsburgh mill. Lumber and cement advanced generally. Common labor stiffened in three important centers, resulting in an average rate for the entire country of 45c. Thus, general construction cost is only 2 per cent cheaper than one year ago and 32 per cent under the peak; it is 85 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
August, 1922	**154**
July, 1922	**118**
August, 1921	**94**
1913	**100**
Yearly	
1921 (entire year)	**88**
1920 (entire year)	**91**
1913	**100**

Engineering News-Record's Construction Volume Index Number is 154 for the month of August, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 154 for August, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA IN AUGUST, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Waterworks		$2,193,000	$312,000	$873,000	$677,000	$232,000	$207,000	$4,494,000
Sewers	$104,000	408,000	568,000	1,577,000	463,000	76,000	254,000	3,450,000
Bridges	151,000	516,000	997,000	810,000	485,000	731,000	1,481,000	5,171,000
Excav. and dredging	.....	19,000	6,600,000	123,000	128,000	50,000		6,920,000
Streets and roads	1,041,000	6,343,000	6,568,000	12,157,000	6,044,000	2,542,000	2,340,000	37,035,000
Industrial works	2,040,000	7,155,000	519,000	6,408,000	2,050,000	576,000	2,912,000	21,660,000
Buildings	3,197,000	26,488,000	1,098,000	23,729,000	8,622,000	7,153,000	3,225,000	73,512,000
Fed. Gov't work	166,000	269,000	887,000	17,000	11,000	197,000	......	1,547,000
Miscellaneous	180,000	1,365,000	883,000	310,000	189,000	1,291,000	2,123,000	6,341,000
Total	$6,879,000	$44,7[illegible]	$18,432,000	$46,004,000	$18,669,000	$12,848,000	$12,542,000	$160,130,000

we secured all needed common labor at 25c. to 28c. per hour. Today we are paying for same class of labor 35c. per hour or an increase of 25%. All semi-skilled and skilled labor in like proportion.

"During the winter of 1921-22 cement sacks could be purchased at 9½ and 10c. each; today the cost is 16c., an increase of 6c per sack or $6,000 per car. We still charge you but 10c. for each sack. We purchased our last car of 100,000 sacks on June 28, 1922. We have purchased 500,000 sacks since January 1st. This last purchase was made due to Medusa Sacks not being returned as promptly as might be, nor in proportion to increased shipments due to heavy storage on part of contractors.

"These are but three items that enter into the cost of producing a barrel of finished cement. The above figures are accurate as applying to Medusa Cement.

"Permit us to ask: would you raise your price if you were in our position?

"In addition to above, our 'Annual Jinx' is now on our heels—'Car Shortage.' For two successive days, we have received no cars in which to ship orders."

Bad Order Cars Decrease 9,438 In Twenty-four Days

Reports received from the railroads of the United States by the American Railway Association, show that out of the 2,267,399 freight cars on all lines, 335,575 or 14.8 per cent, were in need

Labor Rates and Conditions Throughout the Country

With the strike in the bituminous mines nearly over, save for a few thousand men still out in the non-union fields of Pennsylvania and the union districts of West Virginia, and settlement with the anthracite miners practically effected, soft coal production reached a total of nearly 9,700,000 tons for the week ending Sept. 2, according to the Geological Survey.

Now comes the complaint of a car shortage, the limiting factor in the production of bituminous coal, from the union districts of Eastern Ohio and Northern West Virginia. With the soft coal output, for the week in question, over 25 per cent above the country's normal weekly consumption for that period, a car shortage rather than an insufficient fuel supply becomes the principal check to normal industrial progress. With the supply of fuel increased, greater activity is also noted in steel operations. Miners temporarily employed in the steel works, will presumably return to the coal fields, now that the old wage rate has been definitely maintained. That, together with restricted immigration and several other factors tending toward a scarcity of labor in the steel mills, is responsible for the notable advance of 20 per cent in the wages of common labor in the steel industry, effective Sept. 1.

Following the wage gains realized by coal miners and steel workers come announcements of advances in common labor rates, in the construction industry, from three cities reporting to *Engineering News-Record*. All three quote a minimum of 30c.@35c. per hr. as against a rate of 30c. in Atlanta, 25c.@30c. in Montreal and 25c.@35c. per hr. in Philadelphia, previously. Bricklayers in Philadelphia have been granted $1.20 as against $1 per hr. and hoisting engineers in Kansas City, $1@$1.25 as compared with $1 per hr., last month. No reductions have occured in the building trades' wage schedule, throughout the country, during the month.

Local labor conditions as reported by *News-Record* correspondents are given as follows:

Seattle — Lumber mills operating within 2 per cent of normal and logging camps running full blast. Volume of new construction holding up and expected to continue into the early winter. Demand for harvest hands absorbing all unemployed.

Detroit—All classes of labor a little more plentiful than a month ago, due to slackening of construction. Men on city work threatened with lay-off because of lack of cement. Bonuses being paid to bricklayers.

Birmingham — Construction less active. Wage increase of 20 per cent granted steel workers and coal miners.

Philadelphia—Scarcity of bricklayers, hodcarriers, carpenters and hoisting engineers. Fair supply of piledrivers and structural ironworkers. Plenty of common laborers, but men are paid off each night and new ones hired next day.

Kansas City—Scarcity of bricklayers and carpenters. Plenty of all other crafts. Union common laborers receive 60c. per hr.

Pittsburgh — Carpenters and bricklayers scarce; plenty of hodcarriers and common laborers and a sufficient number of hoisting engineers and structural iron workers. Wage advance of 20 per cent in steel mills, effective Sept. 1.

Montreal — Scarcity of bricklayers; ample supply of other trades.

San Francisco—Still plenty of work for all classes of construction labor.

New Orleans—No complaint on the part of contractors of a shortage of skilled or unskilled labor.

Denver—Building trades mechanics, 100 per cent employed.

New York—No change in skilled building trades' wage rates since 1921. Common labor average still between 44c. and 60c. per hr. Pick and shovel men in excavation work, however, receive as low as 40c. per hr., non-union. In building construction common laborers receive not less than 50c. with the union minimum rate at 60c. per hr.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$0.70	$0.30	.....	$0.65	+$0.30@.35
Baltimore	1.25	.80	.87	.54	$0.74	1.00	.30
Birmingham	1.00	75	.50@1.00	.15@.25	......	1.00	.15@.20
Boston	.90	.90	.90	.60	.90	.90	55
Cincinnati	1.25	.95	.95	.72½	.77¼	.95	.40
Chicago	1.10	1.00	1.10	......	1.10	1.05	.72½
Cleveland	1.25	1.04@1.10	1.04	.60	.91	1.10	.57½
Dallas	1.00	1.00	1.00	.60	1.00	1.00	.25
Denver	1.25	1.00	1.00	.75@.81¼	1.00	1.03¼	.35@.50
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.07½	1.00	+1.00@1.25	.80	.85@1.00	1.07½	.60
Los Angeles	1.25	1.00	1.00	1.12½	87½	1.00	.56¼@.62½
Minneapolis	1.00	.80	.80	.65	...	.80	.35@.50
Montreal	.90	.65	.50	35	.50	.55	+.30@.35
New Orleans	1.00	.85	.90	.50	.80	1.00	.35@.40
New York	1.25	1.12½	1.25	87½	1.00	1.12½	.44@.60
Pittsburgh	1.30	1.12½	1.00	.80	1.00	1.00	.50@.60
St. Louis	1.25	1.12½	1.12½	.85	1.00	1.05	.35@.40
San Francisco	1.12½	1.00	1.00	.75	1.00	1.12½	47½@.50
Seattle	1.00	80	.90	.70	1.00	80@.90	.50@.60
Philadelphia	+1.20	.90	.90	.75@90	1.00	.90	+.30@.35

of repairs on Aug. 15. This was an increase of 10,992 cars over the total number in bad order on July 1, when the shopmen's strike began, at which time there were 324,583 cars or 14.3 per cent.

Between Aug. 1 and Aug. 25, however, freight cars in need of repairs decreased 9,438, according to reports of the Association of Railway Executives, issued Sept. 2.

Surplus cars, in good repair and ready for immediate use if necessary, totaled 140,253 on Aug. 15. This represents a decrease of 13,627 cars since Aug. 8. Of the total, 10,453 were surplus box-cars, a reduction of 5,420 within a week; while 111,521 were surplus coal cars which was a decrease of 6,523 within the same period. Surplus coke cars totaled 3,620, a decrease of 262 since Aug. 8.

Coal loadings on Thursday, Aug. 31. totaled 29,027 cars. Although this was an increase of 816 cars over the preceding day, it was also 1,027 cars fewer than were loaded on Monday, Aug 28, when the total was 30,054 cars, the largest number loaded on any single day since April 1, when the miners' strike began.

Increases in coal loadings were reported in the Allegheny, Northwestern, Centralwestern, and Southwestern districts, with small decreases in the others.

Lumber Industry Looking for Cars

The lumber industry throughout the country is looking for cars to make shipments and hoping that embargoes may soon be lifted. For the week ending Aug. 19 reports of the various associations to the National Lumber Manufacturers Association indicated a slight drop in production, shipments of only 88 per cent of the cut, but orders were 95 per cent of the cut. It is evident that many mills are turning down orders and thus restricting new business on account of their inability to ship much stock already cut and dry, according to A. Fletcher Marsh, statistician of the association.

Among the individual associations the volume of southern pine new bookings continue high although shipments are 20 per cent less than new business and some of the mills east of the Mississippi are still shipping nothing. On the Pacific Coast, the West Coast Lumbermen's Association shows a production at the same level as for the previous week, with shipments picking up somewhat, but orders are being refused by the mills.

Reports received, Aug. 31, by telegraph from all the regional softwood lumber manufacturing associations of the country, reflect the cumulative effects of the coal and railway strikes, which are expected to continue to influence the lumber movement for some time after their settlement. Orders for lumber show a noticeable decrease from those of the previous week, production also fell off and shipments barely held their own. Neverthelesss the lumber industry continues to hold a decided margin of increased activity over this time last year.

With respect to the normal production for the week ending August 26 of the five larger associations, that being 214,594,097 feet, the actual cut was 100 per cent, shipments 88 per cent and orders 92 per cent. For all the eight regional associations reporting weekly, shipments were 89 and orders 91 per cent of production.

Total production for the week by 375 mills was 236,485,952 feet; shipments, 210,551,595; orders, 214,778,959; the respective decreases being, 4,722,445 feet, 369,423 and 13,204,602, from the figures of the 388 mills reporting the preceding week. As compared with the corresponding week of 1921 production advanced by 61,294,848 feet, shipments by 37,539,042 and orders by 27,817,992. These advances do not maintain the margin of increase for the year as a whole, or come up to expectations for August as based on the usual ratio of that to other months.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron — Continued scarcity has advanced price of No. 2 foundry, $6 in Cincinnati and Chicago, $7 in Birmingham, and $8 in Pittsburgh, during the last month. Basic iron up $1 in Pittsburgh, $2 in Cincinnati and $5 in Philadelphia; bessemer, $5 per gross ton higher, in Pittsburgh.

Railway Supplies—Light rails up $3 per ton in Pittsburgh. Standard spikes advanced 10c.@15c. and track bolts 25c. per 100 lb., at mill.

Pipe—Discounts reduced three points on black steel, two on galvanized, and five on both black and galvanized iron pipe, on new Pittsburgh basing card of Aug. 23. Similar reductions in warehouses throughout the country. Pig-iron scarcity, consequent to recent fuel shortage, reflected in higher cast-iron pipe quotations. Rise of 50c. in Birmingham, $1.46 in Chicago and $2 per ton, on 6-in. pipe, in New York. Clay drain tile, 4-in., up $3 and 8-in., $10 per 1,000 lin-ft., in New York. Sewer pipe, together with most other clay products affected by fuel situation; rise of 1c.@4c. per ft. on smaller sizes at Pittsburgh, followed by similar advances in Detroit, Philadelphia and New Orleans.

Road and Paving Materials—Road oils up ½c. per gal. in New York. Bulk asphalt advanced $1 in New York, Baltimore and Atlanta; $2 in Boston and Philadelphia and $4.50 per ton in Detroit. Asphalt in packages up $1 in Boston and $3.50 per ton in Detroit. Rise in road oils and asphalt due to abrupt falling off in Mexico petroleum output since striking salt water at principal production centers. Granite paving blocks, 5-in., up $3 in Philadelphia and $3.25 per M in New York. Wood paving blocks, 3½-in., advanced 12c. in New York, 12½c. in New Orleans and 15c. per sq.yd. in Boston; due to higher lumber and labor costs. Philadelphia, however, quotes reduction of 24c. per sq.yd.

Sand Gravel and Crushed Stone—Sand and gravel quoted at $2 as against $1.80 per cu.yd. in Chicago, and at $1 as compared with $1.25, one month ago, in Seattle. Minneapolis quotes advance of 25c. and Philadelphia, 5c. per cu.yd. on both ¾-in. and 1½-in. gravel. Price fluctuations due to purely local conditions.

Lime—Advance of $2 per ton on both lump and hydrated in Philadelphia. Lump finishing quoted at $2.40 as against $1.75 per bbl. (180 lb. net) in New Orleans. Hydrated finishing down 50c. per ton and common lump 5c. per bbl. in Atlanta. Reductions due to falling off in demand.

Cement—Mill advances, due to fuel situation, of 10c. at Hudson, N. Y., Mason City, Ia., and Northampton, Pa.; 15c. at Buffington, Ind., Universal, Pa., Fordwick, Va., and Leeds, Ala., and 5c. per bbl. at Hannibal, Mo., effective during the last month. Mill rise reflected in following advances: f.o.b. Philadelphia, 10c.; Chicago, Pittsburgh, Cleveland, Detroit, Indianapolis, Milwaukee, Peoria, Cedar Rapids and Davenport, 15c.; New York, Cincinnati and Toledo, 20c. per bbl.

Structural Steel—Wage advance of 20 per cent plus increased fuel costs, reflected in higher steel quotations both at mills and warehouses. Minimum of $1.90 on steel shapes established by leading interest; independents, generally, quoting $4@$5 per ton, higher. Maximum of $2@$2.25 per 100 lb., f.o.b. Pittsburgh, on shapes and bars, has applied on actual sales during week.

Shapes and plates up 15c. in San Francisco, 20c. in Dallas, 21c. in New York and 24½c. per 100 lb. in Chicago warehouses, during month. Reinforcing bars advanced 21c. in New York, 22½c. in Chicago and 45c. in San Francisco. Rivets, ¾-in., up 25c. at mill; 15c. in New York, 25c. in Chicago and 50c. per 100 lb. in Dallas warehouses.

Steel Sheet—Rise of 10c.@20c. per 100 lb., f.o.b. Pittsburgh. Blue annealed up 25c.; black, 40c. and galvanized 50c. in Chicago warehouses, during month. Advance of 25c. per 100 lb. in New York.

Brick and Hollow Tile—Common brick quoted at $18@$20 as against $20 per M, alongside dock, New York. Slight falling off in demand. Dallas reports reduction of 25c. per M., in month. New Orleans, however, quotes advance of 50c., Mineapolis, $1 and Cleveland, $2 per M. Hollow tile continues to rise. Slight advance in Denver, Cleveland, Mineapolis and Philadelphia.

Lumber — Despite prevailing transportation difficulties, lumber demand is very strong. Sharp advances reported in New York, Chicago, Mnneapolis, Birmingham, Philadelphia, Detroit and Montreal.

Scrap—Pig-iron shortage causing increased demand for iron and steel scrap. Average advance of $1 per gross ton on all grades, in New York.

Explosives — Market stable; slight advance in Birmingham on 40@60 per cent gelatin dynamite.

Linseed Oil—Prices firm throughout country. Chicago, however, reports drop of 2c. per gal. during month; slight reduction in Minneapolis.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$[illegible].05†	$24.50
Northern Basic	28 27†	21.52
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	32.27†	22.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	32 44†	30.26
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	27.00†	20.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25 @ 2.75 sil.)	33 64†	21 76
Virginia No. 2 (silicon 2.25 @ 2.75)	31 17†	28.74*
Basic	31 14†	20.26†
Grey Forge	31 50†	22.26
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	30 00†	20.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	28.00†	26.66
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	33 00†	21.96
Basic	26 00†	19.96
Bessemer	30.00†	21.96

*F.o.b. furnace. † Delivered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	$40.00	$45 00	. . . .	$40.00
Standard openhearth rails	40.00	47 00	$40 00	40 00
Light rails, 8 to 10 lb.	**38 00**	45 00	1 70*	1 60@1.70*
Light rails, 12 to 14 lb.	**38 00**	45.00	1.70*	1.60@1.70*
Light rails, 25 to 45 lb.	**38@40**	40.00	1.70*	1.60@1.70*
Rerolled Rails	2[illegible]@**29.50**	....	......	....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.35	$1.50
Chicago, Hardwood and Red Oak	1.20	1.30
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco. Green Douglas Fir	.85	1 10
San Francisco, Empty Cell Creosoted, Douglas Fir	1.86	2.30
St. Louis, White Oak*	1 10	1 44
St. Louis, Red Oak*	.97	1.17

St. Louis (creosoted).............No. 1, $0.86; No. 2, $0.96; No. 4, $1.28

*Standard specifications 38c. per tie additional. Zinc chloride process 27c. per tie additional.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, $\frac{9}{16}$-in. and larger	$2 35@**2 50**	$3.00	$2 55	$3 00	$4.10	$2 80
Track bolts	**3 25@3 50**	4.00	3 65	4 25	5.10	3.80
Standard section angle bars	2.40	2.75	2.40	3.00	4.00	3.00

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	68	56½	¾ to 1½	39½	24½

LAP WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	61	49½	2	34½	20½
2½ to 6	65	33½	2½ to 4	37½	24½
2 to 8	62	49½	4½ to 6	37½	24½
9 to 12	61	48½	7 to 12	35½	22½

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	66	55½	¾ to 1½	39½	25½
2 to 3	67	56½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	59	48½	2	35½	22½
2½ to 4	63	52½	2½ to 4	38½	26½
4½ to 6	62	51½	4½ to 6	37½	25½
7 to 8	58	45½	7 to 8	30½	18½
9 to 12	52	39½	9 to 12	25½	13½

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	**60%**	62½%	59%
2½ to 6 in. lap welded	**57%**	59½%	56%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	**47%**	48½%	45%
2½ to 6 in. lap welded	**44%**	45½%	42%

Malleable fittings, Class B and C, from New York stock sell at list less 10% Cast iron, standard sizes, *32-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Current	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	**$42 00**	**$60.30**	$48 30	**$50 70**	......	$55.00
6 in. and over	**37 50**	**55 30**	43.30	**46.86**	......	51.00

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$40 00	$50 00	. . .	$50 00	. . .	$55 [illegible]
4	**53.00**	60.00	$80.00	60.00	$76.50	65 [illegible]
5	80.00	90.00	. . .	80.00	97 75	84 [illegible]
6	100 00	115.00	140 00	100.00	127 50	110 [illegible]
8	**160.00**	185.00	200.00	150.00	212.50	181 [illegible]

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	*$0.14*	**$0 096**	.....	..	$0.12	$0 12	......
4	*.14*	**.096**	$0 09	$0.0875	.12	.15	$0.18
5	*.20*	**.144**	.1125	.	.18	.18	.165
6	*.20*	**.144**	.135	.1225	.18	.21	.26
8	*.34*	**224**	.225	.20	.28	.30	.35
10	*.51*	**336**	.2925	.28	.42	.42	.....
12	*.6[illegible]*	**.432**	.3825	.36	.54	.54	.80
15	*1.08*†	**.576**	.5625	.52	.72	.90	.....
18	*1.50*†	**80**	.765	.68	1.00	1.32	.....
20	*1 80*†	**96**	. .	.92	1 20	......	.....
22	*2 40*†	**1 28**		....	1.60	......	.....
24	*2.70*†	**1 44**	1.50	1.20	1.80	2 16	2.40
27	*4.50*†	**2.60**	....	2 00	3.75†	3 00	.....
30	*5.00*†	**2.88**	...	2.45	4.75†	3 60	.....
33	*6.50*†	**3.87**	...	3.00	5.50†	......	.....
36	*7.50*†	**4.4075**	...	3.25	6 00†	......	.....

	3	5	8	12	24	36
Boston	$0.105	$0.1575	$0.245	$0.4725	$1.575	$4.408
Minneapolis	......	......	.40	.72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	....	.32½	.65†	2 34	.....
Los Angeles	.11*	.165*	.275	.495	1 65	.....
New Orleans	1.06*	**.159***	.27	.459	1.755†	.....
Cincinnati	.096	144	.224	.43	1.44	4.382†
Atlanta	.09*	135	.22	.375	1.45	.....
Montreal, *delivered*	68‡	.45*†	70	1.35	4.50†	.
Detroit	**102**	**.153**	**[illegible]**	**.459**	**1 98†**	**6.15†**
Baltimore	.1225	.2275	35	.6870	2.29	5.23
Kansas City, Mo.	.13½	*.19*	[illegible]	.		
Philadelphia	**.114**	**.171**	**.266**	**513**	**1 71†**	**3.895†**

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. [illegible]

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. [illegible] f.o.b. place named:

	Current	One Year Ago
New York, 45% asphalt......(at terminal)	**$0.05½**	$0.05
New York, 65% asphalt......(at terminal)	**.05½**	.05
New York, binder..........(at terminal)	**.0625**	.06
New York, flux............(at terminal)	**.06**	.05½
New York, liquid asphalt....(at terminal)	**.065**	.06½
St. Louis, 30-50% asphalt (*f.o.b.*) *Wood River, Ill.*	.05	.02¾*
Chicago, 40-50% asphalt	.05¼	.05
Chicago, 60-70% asphalt	.05½	.05¼
Dallas, 40-50% asphalt	.10	.10
Dallas, 60-70% asphalt	.13	.13
Dallas, 75-90% asphalt	.15	.15
San Francisco, binder, per ton	13.00†	15.00

* Freight $21 75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb bbl or 425 lb drums) and in bulk in carload lots, f.o.b points listed

	Package	Bulk
New York (*Mexican*)	**$20 00**	**$14 00**
Boston (*Mexican*)	**19 50**	**16 00**
Chicago (*Standard*)	20 35	14 00
San Francisco, (*bulk delivered*), Oleum, Cal	19 50*	13 00*
Dallas, (*Texas*)	35 00	27 00
Seattle [illegible] (*California*)	23.75	13.00†
Denver [illegible]	40 00	..
Minneapolis (*cb. Twin Cities* (*Mexican*)	33 50	28.00
St. Louis (*Mexican*		
Baltimore (*Mexican*)	18 00	**14 00**
Los Angeles, *at factory, Bakersfield* (*California*)	22 50	15 00
Montreal (*Mexican*)	28 00	21.00
Atlanta (*Mexican*)	22.00	**17 50**
Detroit (*Mexican*)	**22 50**	**19 50**
Cincinnati (*Mexican*)	22.50	19.50
Maurer, N J (*Trinidad and Bermudez*)	28.50	26 50
Maurer, N J (*Mexican*)	18.50	16.50
Philadelphia (*Mexican*	18@20	**15 00**
Kansas City, *petroleum*	28.83	22 83

***Freight to San Francisco, 80c. per ton.**

†F.o b. Richmond, Cal

NOTE —Barrels or drums are optional in most cities. About 6 bbls to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl , no rebate for drums.

PAVING STONE—

New York *delivered*	5-in. granite, 28@29 blocks per sq.yd.	**$135.00** per M
Chicago	About 4x8x4 dressed	3 20 sq yd
	About 4x8x4 common	3 00 sq.yd.
San Francisco	Basalt block 4x7x8	70 00 per M
Boston	5-in granite	no report
Atlanta	Granite	2.00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	100 00 per M
Baltimore	Granite	2.00 sq.yd.
Montreal *delivered*	Granite	100 00 per M
New Orleans	Granite. 4 x 8 x 4	3 25 sq yd.
Cincinnati	Granite	3 84@4 sq.yd.
St Louis	4x8x4 dressed	3 35 sq yd
	4x8x4 common	3 00 sq yd.
Kansas City	No. Granite	**3.95** sq.yd.
Philadelphia	Granite	**128.00** per M.

FLAGGING—

New York	Bronx	$0.25	sq.ft
	Manhattan, 4 ft	.26	sq ft.
	Queens, 5 ft	.26	sq.ft.
	6x20-in. cross-walk.	1.00	lin ft.
Chicago	18 in. wide	99	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c for 5x16 in , 88c. for 5x18 in., in cargo lots.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	**$2 09**
New York (*delivered*)	3½	16	**2 29**
New York (*delivered*)	4	16	**2 57**
Boston	3½	16	**2 32**
Chicago	4	16	3.00@3 25
Chicago	3½	16	2 50
St. Louis	3½	16	2 50
St. Louis	4	16	3 00
Seattle	4	16	Off market
Minneapolis	3½	16	2 09
Atlanta	3½	16	2 30
New Orleans	3	16	**1 80**
New Orleans	3½	16	**2 02½**
New Orleans	4	16	**2 25**
Dallas	4	18	3 90
Baltimore	3½	16	3 44
Montreal	4	16	4 50
Detroit	3	16	2 84
Detroit	4	16	3.00
Cincinnati	4	16	2.10
Kansas City	4	16	2 15
Philadelphia	3½	16	[illegible]

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractors is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$1 75	$2 25	$1 75	$2 25	$1 00	$1 25
Denver	1 75	2 00	1 75	1 80	1 75	1 60
Chicago	**2 00**	1 80	**2 00**	1 80	**2 00**	1 80
St. Louis, per ton	1 25		1 30		1 10	
Seattle	1 00	1 50	[illegible]	1 50		1 50
Dallas	2 25	3 09	2 25	[illegible]	2 25	2 50
Minneapolis	**1 75**	2 00	**1 75**		1 00	1 00
Cincinnati	1 87½	2 25	1 87	2 25	1 43	1 69
San Francisco	2.25	2.25	2.25	2.50	1.50	1.50
Boston		2 65		2 65		2 10
New Orleans	**2 85**	2 85	**2 85**		1 35	1 55
Los Angeles per ton	1 50†	1 35	1 50†	1 45	1 35†	1 20
Atlanta, per ton	1 85	2 25	1 85	2 25	1 15	1 35
Detroit	2.00	2.00	2 00	2 00	2 00	2 00
Baltimore, per ton	1 40	1 40	1 60	1 60	2 00	2 40
Montreal, per ton	1.25	1.50	1 50	1.50	1.25	1 25
Birmingham, per ton (Crushed slag used instead of gravel)					1 28	1 75
Philadelphia	**1.60**	....	**1.65**	....	1.60	
Kansas City, per ton	2 00‡		2 00‡		[illegible]	

* Fine white sand: Pacific, $5 per ton; Ottawa. $6.

† Freight from quarry to Los Angeles is 85c. per ton, and is included in above price.

‡ Per cu. yd

CRUSHED STONE—Price for cargo or carload lots f.o b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1 65	$1 90@2.00	$1 75	$1.90@2 00
Chicago	1 60	2 00	1 60	2.50
St. Louis *delivered*	1.65	1.60*	1 65	1.60*
Dallas	1 65	2 80	1 65	2.80
San Francisco	2.25	2.25	2.25	2.50
Boston, [illegible]		3 00		3 00*
Minneapolis, *at plant*	2 00	2 00	2 25	2 25
Kansas City [illegible]	2 10	1.50	2.10	1.50
Denver	3.50		3.50	
Seattle *delivered*	3 00	3 00	3.00	3.50
Atlanta	1.90*	2 25*	1 90*	
Cincinnati *delivered*	1.75	2 06	1.75	2.06
Los Angeles	1.75*	1.60*	1.85*	1 70*
Detroit	1.90*	1.90*	1.90*	1 90*
Baltimore	1.75*	1.75*	1.65*	1.65*
Montreal	1 50*	2.00*	2 00*	2.10*
Birmingham *delivered*	3.20	3 20	3 10	3 10
Phildelphia	1.70*		1.55*	...
Pittsburgh	2 85		2.85	....
Cleveland	3.00*		3.00*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots per net ton, at plants

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1 30	$2.00	$1.30
Steubenville District	1.40	1 40	2.00	1.40
Ironton District	1 40	1 40	2.00	1.40
East Canaan, Conn	1.25	1.35	4 00	1.00
Easton, Catasaqua, Pa	1 00	1 00	2.00	0.90
Birmingham, Ala	0.75	0.75		0.25
Buffalo, N. Y., and Erie, Pa	1.25	1 25	2 25	1 25
Cleveland, Ohio	1.20	1 20		1 00
Eastern Pennsylvania and Northern New Jersey	1 20	1 20	2.00	1.20
Western Pennsylvania	1.25	1 25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$15.80@$16.17	$13.10	$3.63½*	$2.75@$3.14½*
Chicago	18 00		...	1.40†
St. Louis	23.20	20.00	2.35†	....
Boston	....	.....		
Dallas	25 00		...	2.50†
Cincinnati	15.10	12.50	10.75‡	12.50‡
San Francisco	22.00	*16.00*	....	1.75†
Minneapolis	29.00	22.00 (white)	1.70†	1.40†
Denver	24 00		...	2.70†
Detroit	18.00	16.00		17.00‡
Seattle *paper sacks*	24 00		2 80†	
Los Angeles	30 00	30 00	3.00*	3 00*
Baltimore	15 00	13 00		12.00‡
Montreal	21.00	21 00	15 00‡	11.00‡
Atlanta	*22.50*	13.00	2.00†	[illegible]†
New Orleans	.....	17.25	**2 40†**	
Philadelphia	**15.00**	**14 00**	**12 50‡**	**11 50‡**
Kansas City	25 60	....		12 40†

*Per 280-lb. bbl. (net). †Per 180-lb bbl (net). ‡Per ton—Refund of 10c per bbl. Minneapolis quotes brown common lump lime Kelly Is white is $1 70 Sheboygan $1.55. New York quotes hydrated lime "on cars" in paper sacks, lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags

	Current	One Year Ago
Minneapolis (Rosendale)	$2 80	$2.80
Kansas City (Ft Scott)	1 60	1.60
Atlanta (Magnolia)	11 00 ton	11 00
Cincinnati (Utica)	1.77	1 87
Boston (Rosendale) per bag		0 95@1.05
St. Louis (Carney)	1 87	

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b points listed, without bags. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York, del by truck	**$2 60**	$2.40@2.50	$2 60@2 70
New York, alongside dock to dealers	**2 30**	2.10	2 40
Jersey City	**2 73**	2.28	2.89
Boston			2.86
Chicago	**2 20**	2.05	2.17
Pittsburgh	**2 24**	2.09	2.17
Cleveland	**2 46**	2.31	2.43
Detroit	**2 48**	2.33	2.43
Indianapolis	**2 41**	2.26	2.43
Toledo	**2 53**	2.33	2.49
Milwaukee	**2 37**	2.22	2 39
Duluth	2 14	2.14	2.10
Peoria	**2 41**	2.26	2 45
Cedar Rapids	**2 48**	2.33	2.51
Davenport	**2 43**	2.28	2.47
St. Louis	2 20	2 20	2 90
San Francisco	2.71	2.71	3 09
New Orleans	3.20	3.20	3 20
Minneapolis	2.39	2 39	2 41
Denver	2.85	2 85	3.10
Seattle	2.90	2 90	3 10
Dallas	2.25	2 25	2.80
Atlanta	2.50	2.50	2.75
Cincinnati	**2 59**	2.39	2 57
Los Angeles	3 30	3.30	3.31
Baltimore, del by truck	2 50	2.50	2 98
Birmingham	2 10	2.10	2 85
Kansas City	**2 85**	2 40	3.05
Montreal	2 78	2.78	2.75
Philadelphia	**2 41**	2.31	
St Paul	2.39	2.39	2.41

NOTE—Bags 10c. each. 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind	**$1 95**	Mason City, Ia.	**$2 35**
Universal, Pa	**2 00**	Hudson, N. Y.	**2 10**
Steelton, Minn	1 95	Leeds Ala	**2 10**
Fordwick, Va	**2 35**	Hannibal, Mo	**2 00**
Mitchell, Ind	**2 35**	Lehigh Valley District	**2 00**
Iola, Kan	**2 10**	La Salle, Ind	**2 35**

TRIANGLE MESH—Price per 100 sq.ft. in carload lots

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	Dallas	San Francisco
032	22	$0 74	$0.95	$0 86	$1 15	$1 20
049	28	9	1.23	1 11	1 46	1 55
068	35	1 14	1 48	1 35	1 80	1 89
093	45	[illegible]	1 91	1 73	2 30	2 43
126	57	[illegible]	2.35	2 13	2 86	3 01
153	68	2	2 81	2 54	3.40	.
180	78	2 46	3 22	2 92	3 93	. . .
245	103	3 24	4.25	3 85	5 15	. . . .
287	119	3 75	4 90	4 45	5 96	6 31
336	138	4 35	5.69	5 16	7 32	. . . .
395	160	5 04	6.60	5 98	8 00	. . . . .
			PAVING			
036P	17	$0.56	$0 72	$0 66	$0.88	. . . .
053P	24	79	1 02	93	1 24	. . . .
072P	31	99	1 29	1 18	1 57	. . . .
097P	40	1 28	1.67	1 52	2 02	. .
049R	24	79	1 02	93	1 24	.
067R	31	99	1 29	1 18	1 57	
089R	40	1 28	1 67	1 52	2 02	

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft lengths Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft long, or 600 sq ft

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27BB	2.3	$22 00	$20 39	$21 25	$20 78	$25 50
26BB	2.5	22 00	22 00	22 75	21 43	27 56
25BB	3.0	22 00		27 10		30 71
24BB	3.4	24 00	26 33	29 25	24 28	33 16
22PO	4.33	27 00	31 00	31 75		35.10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
¾ and larger	$1 90@2 25	$1 85	$2 94	$2 82½		$3 50	$3 00
⅝ . .	1 95@2 30	1 90	2 99	2 87½		3 55	3 05
½ . .	2 00@2 35	1 90	3 04	2 92½		3 60	3 10
⅜ . .	2 15@2 50	1 95	3 09	3 07½		3 75	3 25
¼ . . .	2 40@2 75	1 95	3 44	3 32½		4 00	3.50

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	$1 70	.	$3 25	⅜	$1 95		$3 50
⅝ in.	1.75	. . . . .	3.30	¼	2.20		3 75
½	1 80		3 35	. . . . .	. . .	. . .	. .

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	$21.30@23.50	$23.50	$18 40	$42 00†	$50 00†
New York (at dock) . . .	18@20	20.00	15@15 50		. . .
Chicago	11 00	11 00	11 00	34 00	42 00
St. Louis, salmon . . .	14 00	14 00	17 00		28.00
Denver, salmon	12 00	12 00	14 00	.	. .
Dallas	10 90	11 15	12 72	no market	
San Francisco	15 00	15 00	18 00	. .	.
Los Angeles (del.)	15 00	15 00	15 50	(not used)	
Boston (del.)	.	16 00	17 00	44 00†	53 00†
Minneapolis (del.)	18@19	17@18	17 00	. . . . .	43 00
Kansas City	16 50	14 50	15 50		. . . . . .
Seattle	14 00	14 00	14 00	44 00	.
Cincinnati	15 00	15 00	19 00	41 00	36.50
Montreal	16 00	16 00	18 00	.	68 00
Detroit (del.)	16.50	16 50	17 00	36 50	39 50@41
Baltimore (del.)	20 00	20 00	20 00	36 00‡	. .
Atlanta	11 00	11 00	10 00	38 00	.
New Orleans	13 00	12 50	14 00	.	.
Birmingham	12 00	12 00	11 50		.
Philadelphia	17.50@18.50	17.50@18.50	16.50@17.50	38.00	46 00
Pittsburgh (del.) . .	16 00	16 00			
Cleveland	16 00	14.00		. . .	. .

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current on Trucks*	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12 . . .	$0.11120	$0.11370	$0 0808	$0 115	$0 0635	$0 108	.
6x12x12 . . .	.16670	.15160	1112		08	156	. .
8x12x12 . . .	.20840	.20210	1516	18	.12	244	$0.17890
10x12x12 . . .	. . . .	. . . . .	1879	.	.16	. . . . . .	.21050
12x12x12 . . .	. . . .	. . . . .	2147		.185	. . . . . .	.27370

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	.		
Minneapolis (f.o.b. cars)	$0 08	$0 13125	$0 23
Minneapolis (delivered)	.09	14675	.255
Cincinnati	.0670	1263	.175
Kansas City	.085	.167	.270
Denver	.087	145	.21
Seattle (delivered)	.11	.25	.36
Los Angeles factory	.095	.176	.22
New Orleans	.12	23	.36
Detroit (delivered)	.070	135	.225
Montreal	.09	16	.30
Baltimore	.14	.25	39
Atlanta	.0776	.1453	. . . . . .
Dallas	115	. . . .	. . . . .
Birmingham	.10	.17	. . . .
Pittsburgh (del.)	.068	.128	179
Cleveland	.08	164	

San Francisco, Philadelphia, Atlanta, New York, quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, *Mill*	Birmingham *Mill*	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	1.90@2 25	$1.95	$3.04	$4.20	. . . .	$2 92½	$3.25
Channel, 3 to 15 in. . . .	1 90@2 25	1.95	3 04	4 20	. . . .	2.92½	3 25
Angles, 3 to 6 in., ¼ in. thick	1 90@2 25	1.95	3.04	4 20	. . . . .	2 92½	3 25
Tees, 3 in. and larger . .	1 90@2 25	1 95	3 04	4 20		2 92½	3 25
Plates	1 90@2 25	1 95	3 04	4 20		2 92½	3 25

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse: New York Current	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$2 65	$3 85	$4 40	$3 35	$3 09½	$4 25	$6 00
		CONE HEAD BOILER					
¾ in. and larger	2 75	3.95	4 50	3 45	3.19½	4 35	6 15
⅝ and 11/16 .	2 90	4.11	4 65	3 60	3 35½	4 50	6 30
½ and 9/16 . . .	3.15	4 35	4 90	3 85	3 59½	4 75	6.55

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2 40@2.60	$3 10	$3 90	$5 00	$3.25	$4 95
Cut	2 25	5 50	5 65	7 75	. .	5 00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square, f.o.b., as follows:

	New York: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.
No. 1 grade . . .	$2 10	$2.55	$3.00	$1 90	$2 35	$2 80
No. 2 grade	1.85	2.15	2 55	1 70	2.00	2.40

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.50 per package (sufficient to cover 50 sq.ft.) in carloads; $5.75 in smaller quantities, in Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia. l.c.l., $5 90

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft.	$2 00
Tar pitch (in 400-lb. bbl.), per 100 lb.	1 65
Asphalt roofing (in barrels), per ton, f.o.b. plant*	40.50
Asphalt felt (light), per ton, f.o.b. plant*	64.50
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3,00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2 50@$2 60	.	$4 00	$4 35	$4 03
No. 12	2.55@ 2 65	. . . .	4 05	4 40	4 08
No. 14	2 60@ 2 70		4 10	4 45	4 13
No. 16	2 80@ 2.90		4 20	4 55	4.23
Black					
*Nos. 18 and 20	3 20@ 3 35	. . .		5 45	4 40
*Nos. 22 and 24 . . .	3 25@ 3 40		4 70	5 50	4 45
*No. 26	3 30@ 3 45		4 75	5 55	4 50
*No. 28. .	3 35@ 3 50		4 85	5.65	4 60
Galvanized					
No. 10	3 35@ 3 45		4 85	. .	4 60
No. 12	3 45@ 3.60		4 95	5 60	4 70
No. 14	3 45@ 3 60		4 95	5 60	4.70
Nos. 17 to 21	3 75@ 3 90			5 90	5 00
Nos. 22 and 24	3 90@ 4.05		5 40	6.05	5 15
*Nos. 25 and 26 . . .	4 05@ 4 20		5 55	6 20	5 30
*No. 28	4 35@ 4.50		5 95	6 50	5 60

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Current	One Year Ago	Chicago: Current	One Year Ago
Raw in barrel (5 bbl. lots)	$0.91	$0 78	$0 99	$0.75

WHITE AND RED LEAD—Base price in cents per pound [illegible]

	Red Current Dry	Red Current In Oil	Red 1 Year Ago Dry	Red 1 Year Ago In Oil	White Current Dry or In Oil	White Yr. Ago Dry or In Oil
100-lb. keg	12 50	14 00	12 25	13 75	12 50	12 25
25 and 50-lb. kegs..	12 75	14.25	12 50	14 00	12 75	12 50
12½-lb. keg	13 00	14 50	12 75	14 25	13 00	12 75
5-lb. cans..........	15 50	17.00	15 25	16 75	15 50	15 25
1-lb. cans..........	17 50	19.00	17 25	18 75	17 50	17 25

LUMBER

Price wholesale to dealers in carload lots f.o.b. [illegible]

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6, 8 and 12 Ft.	10, 16, 18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$28 00	$31 00	$31 00	$33 00
3x6 and 8............	28 00	31 00	31 00	34 00
4x4-6 and 8............	28 00	31 00	32 00	35 00
3x10 and 12..........	28 00	33 00	32 00	36 00
3x14..................	32 00	33 00	34 00	36 00
4x10 and 12..........	28 00	31 00	32 00	35 00
4x14..................	32.00	33.00	34 00	36 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$30 00	$33.00	$35 00
6x14	32 00	35 00	37 00
8x10.	30 00	33 00	35 00
8x14......	32 00	35 00	37.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine

	New York 20 Ft. and Under	New York 22-24 Ft.	Chicago 20 Ft. and Under	Chicago 22-24 Ft.
3x 4 to 8x8	$44 00	$45 00	$43 00	$45 00
3x10 to 10x10	46 00	47 00	46 00	48 00
3x12 to 12x12	48 00	45 00	49 00	51 00
3x14 to 14x14	54 00	55 00	54 00	56 00
3x16 to 16x16	60 00	61 00	58 00	60 00
3x18 to 18x18	68 00	69 00	65 00	67 00
4x20 to 20x20	78 00	79 00	75 00	77 00

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under P.	Fir	Hemlock	Spruce	12 x 12-In. 20 Ft. and Under P.	Fir
Boston						
Seattle..............	....	$23.00			......	$23 00
New Orleans.....	$30 00				$35 00	
Baltimore..........	36.45	..			38 50	....
Cincinnati.....	39 00	50 00			40 00	64 00
Montreal....	50.00	50 00	$35 00	$38 00	78 00	50 00
Los Angeles....		44 00	43 00			44 00
Denver............	.....	36 25	36 25	36 25		50 00
Minneapolis........	47 00	41 00	42 00		49 00	41 00
Atlanta............	35 00				40 00	
Dallas............	37.50	...			40 00	
Kansas City..	39 25				48 25	
Birmingham........	32 00				36 00	
Philadelphia........	39 00	39 00	44 00	50 00	48 00	39 00
Detroit............	43 75	47 75			51 75	46 75
St. Louis	35 00				38 00	

	1-In. Rough, 10 In. x 16 Ft. and Under P.	Fir	Hemlock	2-In. T. and Gr. 10 In. x 16 Ft. P.	Fir
Boston.....					..
Seattle..................	......	$15 50			$16 50
New Orleans, at mill..........	$70 00			$37 00	
Baltimore....................	35 00			36 45	
Cincinnati..................	62 50	80 00		33 50	
Montreal	66 00	45 00	$27 00	45 00	45 00
Los Angeles....	..	37 00	36 00		43 00
Denver....................	....	34 25	34 25		
Minneapolis................	46 50	40 25	38 25	43 75	40 25
Atlanta	22 00			26 00	
Dallas	37 50	30 00		40 50	
Kansas City	71 50			39 50	
Birmingham................	28 00			30 00	
Philadelphia	32 00	37 50	45 00	34 00	37 50
Detroit....................	44 25	36 50		41 00	39 00
St. Louis..................	36 00			35 00	

Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $2 00 additional per M. ft to contractor.

Boston and Cincinnati—Prices to contractors [illegible]

Denver—Quotes dealers prices to contractor on large projects.

St. Louis—Wholesale price to contractors, $4 50@ $6 per M ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district [illegible] tural shapes, merchant steel, bars, pipe fittings [illegible] rivets, spikes, bolts, flat sheets (except plates [illegible]) the following freight rates are effective in cents per 100 lb. [illegible]

Baltimore	$0 315	Detroit	$0 295
Birmingham	69	Kansas City	735
Boston....	.365	New Orleans	515
Buffalo....................	.265	New York	34
Chicago...	34	Pacific Coast (all rail)	1 50†
Cincinnati..............	295	Philadelphia	325
Cleveland...	215	St. Louis..................	.43
Denver......	1 275*	St. Paul..................	.595

*Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only, 80,000 lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2 35	$1 65@1 85	$2 00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	30%
Patent flattened strand, special and cast steel....................	30%
Patent flattened strand, iron rope..............................	15%
Plow steel round strand rope	45%
Special steel round strand rope	40%
Cast steel round strand rope	32½%
Round strand iron and iron tiller..............................	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	[illegible]

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra, while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft., ⅝-in., 6; ¾-in., 4½; 1-in., 3⅓; 1⅛-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston		New Orleans	$0 17½
New York	$0 17	Los Angeles	.16½
Chicago	19	Seattle	18
Minneapolis..	19½	St. Louis	.21
San Francisco	17	Montreal........	.30
Atlanta.......	21	Detroit.....	.19
Denver.......	20	Baltimore...............	.20
Cincinnati.....	20	Kansas City	18½
Dallas........	.29	Birmingham	20½
Philadelphia.	18¼		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0 29	$0 32
Boston................................	......	
Kansas City..........................	2425	.2725
Seattle..............................	.175	.195
Chicago	2450	.2750
Minneapolis	2092	.2295
St. Louis	2475	.2775
Denver	1775	2075
Dallas................................	.29	375
Los Angeles	23	.26
Atlanta..............................	.2525	.2825
Baltimore	2550	27
Cincinnati..........................	.2350	255
Montreal	195	.235
Birmingham, *delivered*.	195	.235
New Orleans..........................	.2675	.3025
San Francisco	195	.235
Philadelphia	24	.27

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt..................	6 in.	30 to 50 ft.	$0.13	$0 17½
12 in.—2 ft. from butt.........	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt.........	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt.........	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt.........	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt.........	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought..........	$12 50	$11 50	$12 00
Stove plate	13 50	12 00	13 50
No. 1 machinery cast............	17 00	16 50	14 50
Machine shop turnings..........	7 00@7 50	4 00	5 00
Cast borings....................	11 00	5.50	6 75
Railroad malleable cast..........	14 00	12 50	10 25
Re-rolling rails..................	13 00	13 00	15 00
Relaying rails....................	28.50	30.00	15.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
½......................................	$6 75	$5 50	$8 55
⅝......................................	6.30	5.05	8 25
¾	6 15	4 90	8.30

Pittsburgh base in lots of 200 kegs or more $3 25

A Consolidation of Engineering News ... Record   McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN
Editor

Volume 89   NEW YORK, SEPTEMBER 14, 1922   Number 11

Saner Second Thought

AFTER all, we are not to have a general strike. The Gompers' vaporings have not found favor with other labor leaders. And so the country is assured that there will be no general stoppage of enterprise, that it is not to be punished merely because Mr. Gompers felt that the government was not justified in seeking an injunction against the rail strikers. It was our feeling that there would be enough sober thought to counteract the heat of the leader of the American Federation of Labor. The event has proved that such was the case.

The Business Outlook

TESTIMONY comes from many lines of business and industry that if the coal and railway disturbances were out of the way business would go ahead in very active fashion. Past experience in business indicates that their optimism is justified. We have learned that once fundamental conditions are sound, which means that credit is easy and the purchasing power of the country large, even serious industrial disorders have not deflected downward an upward trend in the business curve. How long the present upward progress will continue cannot be, with certainty, foretold. But for the immediate future, six to nine months to be conservative, business prospects promise well. With the coal strikes settled, even though on an economically unsound basis, and the rail strike dwindling away, the outlook is encouraging.

Sewage Relief for Los Angeles

LOS ANGELES is to be congratulated on its large majority vote for a bond issue to build a new outlet sewer to the Pacific and provide treatment works. During the rainy season the new outlet will prevent the flooding that occurs at some points because of the present overcharged outlet. The treatment works are a response to the complaints of the beach cities and their patrons against the fouling of the beaches and adjacent waters. The bond issue was defeated three or four times, but at last it went through with a large majority. Aside from the importance of the favorable vote to Los Angeles and its neighbors it is of interest as preparing the way for the first large sewage-works on the Pacific Coast.

Responsibility for Safe Housing

THERE is a law in Boston which requires the most crowded and most dangerously built types of tenement to be equipped with automatic sprinklers in basement and hallways. A very bad tenement fire some years ago demonstrated the need for at least this minimum of protection to the inhabitants of such tenements—buildings of combustible construction lacking even corridor and stairway protection, and housing ten families or more. Primarily the law seeks to safeguard life, but of course in its ultimate effect it is as much in the interests of the landlord as of the tenant. One might therefore expect to find that it was promptly and cheerfully complied with by the owners. Not so. The owners ignored the law and did nothing about sprinklers. The authorities, with equal inertia, suffered the matter to rest for several years, in fact until last week; now they have instituted court proceedings to compel action. Thus, before a necessary bit of progress toward safety is achieved there is long delay and a struggle—the same unfortunate experience that has attended most other steps in social progress. The trouble arises in part, we think, from the fact that the burden of bringing about an advance is thrown on the government instead of being assumed by the group directly in interest. Safe housing—safe building construction and administration generally—is in every way the concern of the real-estate section of the community in the first instance, and, correspondingly, the promotion and enforcement of progressive regulations should have its source there. Results would be quicker and more effective, at all events, than when the awkward machinery of governmental legislation and enforcement is depended upon. But the real-estate community does not appear to have recognized this obligation and opportunity very fully; certainly not in Boston.

Bridge Loading

AMONG the technical developments of the past week one of the most noteworthy was the discussion of railway bridge loadings which developed at the opening meeting of the American Society of Civil Engineers. It indicated that progress has been made in the direction of clearing up this question, which involves not only bridge safety and economy but also sound engineering procedure. Some weeks ago (July 27, p. 131) we referred to the complex situation in bridge design growing out of the divergence between actual loads and design loads, and to the fact that the standard Cooper loading system is no longer safe to use without arbitrary adjustments for each individual case. Although previous conclusions, chiefly in the American Railway Engineering Association, had reaffirmed the value of the Cooper loadings, a surprising preponderance of opinion at last week's meeting condemned that system as long outgrown. With such views prevailing there is a chance to agree upon a new and better system. But before this problem is taken up it will be well if as much testimony as possible is accumulated on the deficiencies of the old system; a sufficiently broad collection of opinions and experience statements is almost sure to mark out the main lines that a new system should follow. The open forum of the society discussion offers ideal opportunity for the purpose. It will be desirable also to correlate the subject closely with actual stresses. So far as it has gone, the discussion has been based only on calculated results, instead of upon measurements of load effects on bridges. Not many such measurements have been made, unfortu-

nately. However, since strain-gage work by Charles Evan Fowler on the Niagara arch a few years ago showed little change in stress as the engine was moved along, there is a possibility, to say the least, that conclusions based on calculated results may not be of full value.

Aerator Nozzles

IF AERATION can be obtained by the expenditure of 5 ft. of head instead of the usual 10 to 15 ft. it will be far more likely to be considered in future water treatment plants, especially where the water is likely to be infested with odor-producing algae. The single-spray nozzle, the underlying principle of which was accidentally discovered by the engineers at Sacramento (as described in last week's issue of *Engineering News-Record*), answers the low-head requirements and apparently gives the other necessary efficiencies of liberating odors and taking on dissolved oxygen—or liberating the latter if a super-saturated condition exists. The spray produced fits in with the recent thinking of sanitary chemists on the question of getting oxygen into water or sewage in that at all heads it produces a thin gossamer-like sheet. It is this thin double surface sheet, the analysts find, that absorbs oxygen instantaneously. A double surface sheet presents a far more extended area of liquid than do the globular drops from the ordinary spray. The same thought underlies the substitution of mechanical stirring for agitation by compressed air at some activated-sludge plants in England. At those plants aerating paddles give a rotary forward movement to the sewage in long channels, thereby continually presenting new sewage surfaces to the air. Bubbling air through sewage presents globular surfaces of air to the sewage. Per unit the surfaces thus exposed are a minimum compared with the flat surface of spray sheets. While the experiments at Sacramento were mainly for hydraulic results, the chemical and physical changes need as careful study.

Corrosive Waters

THE BANE of many water-works engineers and superintendents is water that corrodes or incrusts metals. These metals form a large part of the investment which it is his duty to conserve and his greater duty to maintain in an efficient condition. In some sections of the country, corrosion is worst where the waters are naturally soft but high in color. Color removal increases the evil. At a few plants in New England mechanical filtration, with prechlorination—the chlorine and alum being introduced simultaneously—produces a non-corrosive low-colored water. To the extent which this combination is available, the engineer and superintendent may chose between water treatment to make the water non-corrosive, a coating to protect the metal and, in the case of pipes, cleaning to remove corrosion. In other words, he has a choice of eradication, protection and amelioration—for cleaning even if complete is only temporary. In practice, the choice may not be simple nor the chosen method so completely as the bald statement in the preceding sentence indicates. Relative costs and perhaps relative efficiencies must be weighed. In some cases, if not most, both eradication and protection may be required; in some, both correction and amelioration; in extreme cases, perhaps all three. A protective coating for all cast-iron and other metal water mains is now, and for all that can be seen will continue to be, in demand.

Designing to Fit the Case

POVERTY is often a spur to excellence in engineering. An illustration to the point is the road improvement described by G. F. Schlesinger in this issue. Here a standard procedure would have been followed without question had the pinch of poverty not diverted attention to other methods. Had there been ample funds and had the construction proceeded in the normal manner the community would probably have possessed as good a road but the engineering would not have been so good. It would not have been an instance of doing well with a dollar what could be done after a fashion by anyone with two dollars. The greater significance to road builders of this operation lies, however, in the emphasis which it lends to the too often neglected doctrine that in reconstructing a highway the original improvement should be capitalized to the greatest possible degree. Incidentally it demonstrates, as a conclusion from the previous statement, that the design of pavement should be made different according to the condition of the old pavement, with a view to obtaining a new pavement of equal strength at all points. This is sound engineering because it is economy as well as the accomplishment of structural unity. The procedure involves no more than a condition survey of the old surfacing and a classifying of the conditions formed into several groups for each of which a standard section of pavement is designed. The article in this issue is of practical value in setting forth a classification and a method of mapping the condition survey.

Closer Relations With Latin-America Through Engineering

IN RIO DE JANEIRO there meets this week an International Engineering Congress, simultaneously with the great exposition and celebration marking the completion of the first 100 years of independence of Brazil from European rule. The Congress, from the standpoint of engineers and manufacturers in the United States, comes at a most opportune time. Just when the engineers and constructors of Latin-America have begun to show a larger appreciation of the characteristics of the engineering and construction methods of the United States, the Congress gives us an opportunity to bring home to Latin Americans the adaptability of our engineering thought to their conditions.

It was quite natural in the past that the engineering thought of Latin America should show in a marked manner the influence of France. Every educated South American speaks French as well as he does his native language. He turns with ease, therefore, to the French technical literature for inspiration and guidance. Moreover, Paris is the Mecca of the Latin world. French engineering thought, as well as French thought in other lines, has naturally had a dominating influence. Of late years, however, while not under-valuating what they have learned from France, the engineers and constructors in our southern hemisphere have come to appreciate that in the development of our far-flung continental territory we have been through the experience with which they, in their equally broad expanses of territory, with sparse population, are now confronted. There has grown apace, therefore, an admiration for our engineering views and methods.

At the Congress now in session in Rio our representatives—and, besides unattached engineers, there will

be present official delegates from each of the four leading national engineering societies—will without a doubt make the best of their opportunity, to the benefit of ourselves, to be sure, but equally, we are confident, of the Latin-American republics.

Back of the engineering significance of the Congress, of course, lies the certainty that a fuller understanding between the engineers of North and South America will have an important influence upon trade development. The political unity of the Americas has long been recognized, to the extent, at least, that we were all of one mind that aggressions from the other side of the Atlantic were not to be tolerated. Commerce, however, knows no commercial bounds and the shrewd traders from overseas, the English and the Germans particularly, were most successful in commercial exploitation south of the Caribbean. We, at the time, were rightfully more concerned with the development of our tremendous domestic market, created by the expansion of our West. Now, however, that we are in a new era, when we have an exportable surplus of finished products, our turn has come to cultivate the buyers of other lands. In this process engineering is the handmaiden of commerce and, by their participation in the Rio discussions, our engineers and constructors must inevitably contribute, no matter how close their concentration upon technical topics, to the strengthening of our commercial relations with Latin-America. Such a strengthening, we need hardly add, is devoutly to be wished.

No Thoroughfare

A PIOUS wish expressed in *Engineering News-Record* recently (July 20, page 90) concerning the desirability of determining the relative importance of land and water traffic at interesting points has unfortunately suffered some misinterpretation, and as it has been circulated with that misinterpretation attached it may mislead some. Another word on the subject may therefore be in order.

Our wish was expressed in connection with two bridge cases where the superior claim of water traffic was in question. One of the cases was that of Newark Bay, where crossed by the main line of the Central Railroad of New Jersey; the city of Newark is opposing the rebuilding of the bridge. Interests supporting the city quoted our wish as being in support of their attitude, and particularly in support of their present endeavor to delay a decision by the War Department on the rebuilding project. Those of our readers who are outside of Newark Bay's five-mile sphere of influence—odoriferous and otherwise—did not, we hope, misunderstand our position so completely, but for the due information of others be it said that we referred in no way to the issues of the Newark case but quite generally to the situation that exists at innumerable points throughout the country as between land and water traffic.

Long-established principle, fixed by tradition rather than by legislation, is that water traffic has the right of way. How this principle works in practice—or rather how unworkable it is—can be appreciated very easily by anyone who will look at a map and note how the country is cut up into little localized strips of land by all sorts of waterways, most of them navigable or potentially navigable. If traffic on each of these little blue lines on the map were actually paramount, as compared with intersecting land traffic, the country could not do business. In view of this perfectly obvious fact it will not be surprising to the map reader that he sees the black lines of railroads cross the little blue lines frequently and in all directions. On the black lines, and on the little faint lines indicating roads (not shown on most maps), depends the whole intercourse between town and town, or state and state. It is they which tie the country together and enable business to go on. Therefore a sort of truce between rail and intersecting water traffic has come into being, administered by the War Department, under which bridge clearances and drawbridge requirements are adjusted.

Under this compromise arrangement, however, water traffic still continues to occupy the favored position, and decisions are made by the War Department which bear no recognizable relation to present or future traffic requirements. All these things mean public loss, or added burden on the community; and the community has burdens enough nowadays. For these reasons we suggested the propriety of a special study of the relative claims of water and land traffic, in order that a more fundamental doctrine as to their relative adjustment at intersecting points could be laid down and the matter thereby removed from its present arbitrary and unsatisfactory basis.

In such adjustment it is not at all impossible that it may be found necessary or desirable to outlaw some of the present "navigable" waters which amount to nothing more than "No Thoroughfare" notices planted across the face of the country. The view has been growing among army engineers themselves, we believe, that in many instances the traditional sanctity of waterways as navigation routes has become very threadbare indeed, because of the continued absence of navigation, and that the old doctrine is irksome even to them as its upholders. Present requirements as to bridge construction, for example, are vague and variable, and in the interest of water navigation development as well as of road and railroad improvement, it would be in the highest degree advantageous to have a specific formulation of the place to be accorded to water transportation and land transportation respectively, where they come into conflict. Fancies of political agitators might then bow to facts.

In expressing the wish that such a statement of principles might be developed, we were particularly careful not to have it relate directly to the Newark case because that city is in a most delicate position with respect to waterways, since it is entrenched behind two notorious "navigable" rivers, at the head of a bay, and itself lies like a barrier across all the lines of communication westward from New York City. However, even at the risk of offending local sensibilities it seems necessary to point out that the study of water and land traffic rights will of necessity, embrace not only rivers, but also coastal indentations, lagoons and bays, unless the efficiency of the entire coastal district is to be sacrificed. It is so obviously illogical to sacrifice the development of great areas of country to the commercial ambitions and speculations of land holders on lagoons and mud flats, or on bodies of water whose shipping possibilities are nothing more than dreams, that the investigation is bound to cover river and coastal indentations alike. Otherwise the No-Thoroughfare aspect of unused "waterways" will continue to give trouble.

Building the Rondout Creek Highway Suspension Bridge

Concrete-Floor Highway Bridge of 705-Ft. Span Constructed by State—Stiffening Trusses Continuous Over Three Spans—Method of Spinning the $9\frac{3}{4}$-In. Wire Cables—Floor Concreting

By W. E. Joyce and M. Bebarfald

R[illegible] of Rondout Creek Bridge for the New York Highway C[illegible] Ferris & Tench Co., contr[illegible] respectively; president and vice-president of the W. E. Joyce Co., Inc., engineers, Kingston, N. Y.

WITH the opening of the Rondout Creek bridge at Kingston, N. Y., this summer, an important link of the state highway along the west side of the Hudson River from New York to Albany was completed. The bridge, shown completed by the view Fig. 1, means a big traffic improvement, as it replaces an antiquated ferry which gave unsatisfactory service. It is a noteworthy innovation in the highway field because it is probably the first and much the most important suspension bridge for highway service built under the modern state highway construction system. Structurally it is important as a demonstration of the adaptability of the suspension principle to relatively short spans for highway traffic.

The Rondout Creek bridge is proportioned for the standard heavy highway loading (20-ton truck and 80 lb. per sq.ft.), and because of this and the heavy floor used (reinforced-concrete slab) it is unusually massive, having $9\frac{3}{4}$-in. and $10\frac{1}{4}$-in. cables. Its stiffening truss system is unusual as the truss is continuous over the three spans (main span 705 ft., side spans 176 ft. 3 in.). The panel length was kept constant, 17 ft. $7\frac{1}{2}$ in., but the depth of the truss was decreased from 15 ft. at the tower to 10 ft. at mid-span and ends. The trusses and deck are supported by suspenders of $1\frac{1}{4}$-in. wire rope looped over the cables and connected by adjustable U-bolts to the truss verticals. In the main span each cable contains 1,974 galvanized wires of No. 6 Roebling gage, making the net diameter $9\frac{3}{4}$ in., while in the side spans 152 wires were added to each cable to take care of the increase in stress caused by their greater inclination to suit the short length of these spans, making the cable diameter $10\frac{1}{4}$ in. without the wrapping. Direct rock anchorage was available for the cables. The main supports are steel towers 152 ft. high (Fig. 2), resting on concrete piers.

Between trusses the deck, a reinforced-concrete slab 9 in. thick at the crown, is occupied by a 22-ft. roadway; a $7\frac{1}{2}$-ft. concrete sidewalk is bracketed out on either side. The roadway rises southward on a 5 per cent grade from the north anchorage to the center of the bridge and from this point on a 0.2 per cent grade to the south end. This makes the south pier about 18 ft. higher than the north pier.

FIG. 1. RONDOUT CREEK CROSSING OF THE MAIN HIGHWAY ALONG THE WEST SIDE OF THE HUDSON RIVER
Main span 705 ft. [illegible] 22-ft. roadway with reinforced-concrete slab deck

Illumination of the roadway is provided for by twenty 200-watt lamps spaced about 50 ft., staggered, supported on short standards attached to the top chords of the stiffening trusses. At the south approach there are two 300-watt lamps, and at the north or Kingston end four 300-watt lamps.

Construction Plant Arrangement—Work on the main structure began in August, 1920, but at this time the anchor pits had already been excavated under a prior contract. These pits are shafts cut in the rock to a

depth of about 60 ft. below ground surface; they are 6 ft. in diameter and widen out at the bottom to a chamber 6 x 14 ft. by about 6 ft. high (Fig. 4). The two cables have independent anchor pits. The eyebar anchors are embedded in concrete which fills these shafts, but their upper ends are exposed in chambers formed below the roadway level so that the attachment of the cable strands to the anchors is open to inspection.

Fig. 5 sketches the arrangement of plant for the construction of the bridge. Two stiffleg derricks with 60-ft. booms ($S1$ and $S2$) were erected at the ends of the bridge for placing the anchor steel and the shore-span trusses. Near the tower piers two steel guy derricks with 90-ft. booms ($G1$ and $G2$) were set on timber towers about 100 ft. high, for erecting the steel towers and part of the main-span trusses; derrick $G1$ also served as an unloading and handling derrick. All steel was received by rail and sorted at the base of the north tower, and the material for the south half of the bridge was taken thence by barges to the south pier.

Anchor and Tower Work—Erection of the anchorage material and towers proceeded simultaneously. Each anchor was built of four 24-in. I-beams 12 ft. long, and was connected by a chain of eyebars to the cable shoes. Because of the small size of the shaft the anchorage steel had to be assembled in the shaft. At the angle point in the anchor chain the resultant abutment pressure is taken by a cast-steel shoe against which bear twelve 2 x 21-in. steel pin-plates; the bearing surfaces of plates and castings were machined and lubricated with paraffin to allow for adjustment during construction as the anchorage bars stretched under the application of the dead-load of the structure, and for the same reason the anchor shafts were concreted only up to 8 ft. below the top pin. The full dead-load actually developed a movement of about $\frac{1}{4}$ in. at the abutment bearing. Subsequently the remainder of the shaft concrete was placed.

The north tower is founded on two independent concrete piers 11 x 16 ft., one under each leg. At the south tower an old pier built under a former contract for a different type of bridge was used, with the addition of two pedestals 16 x $16\frac{1}{2}$ ft. by 8 ft. high.

The tower consists of two legs of box section, battered inward from a spacing of 38 ft. at the base to 27 ft. at the top, anchored to the pier by four $2\frac{1}{4}$-in. anchor bolts per leg. In fabrication the legs were built in five sections each, the maximum section weighing 22 tons.

Footbridge Construction—The cable saddles are bolted firmly to the tower tops, and any unbalanced pull of the cables produces a bending of the towers. To make the tension in the strand at both sides of the tower equal while the cables were being spun, and thereby prevent creeping of the wires from the main span into the side spans, the towers were deflected to an initial inclination towards the anchorages amounting to 6 in. for the north tower and $5\frac{3}{8}$ in. for the south tower, in which positions they were held by a $1\frac{1}{4}$-in. wire rope from the top of each leg to the anchorage, with a turnbuckle in the rope for adjustment, and also by wedging under the river side of the tower base with steel wedges.

With the towers held in their deflected position, the erection of the footbridge or working platform for the construction of the main cables was started. Six $1\frac{1}{4}$-in. wire ropes grouped in two sets of three each, spaced 20 ft. 3 in. center to center, were the carrying members of this footbridge. The ropes were socketed at the ends and fastened with U-bolts to a 24-in. I-beam anchored transversely in the center wall of the anchorage, while at the towers they passed over temporary cast-steel

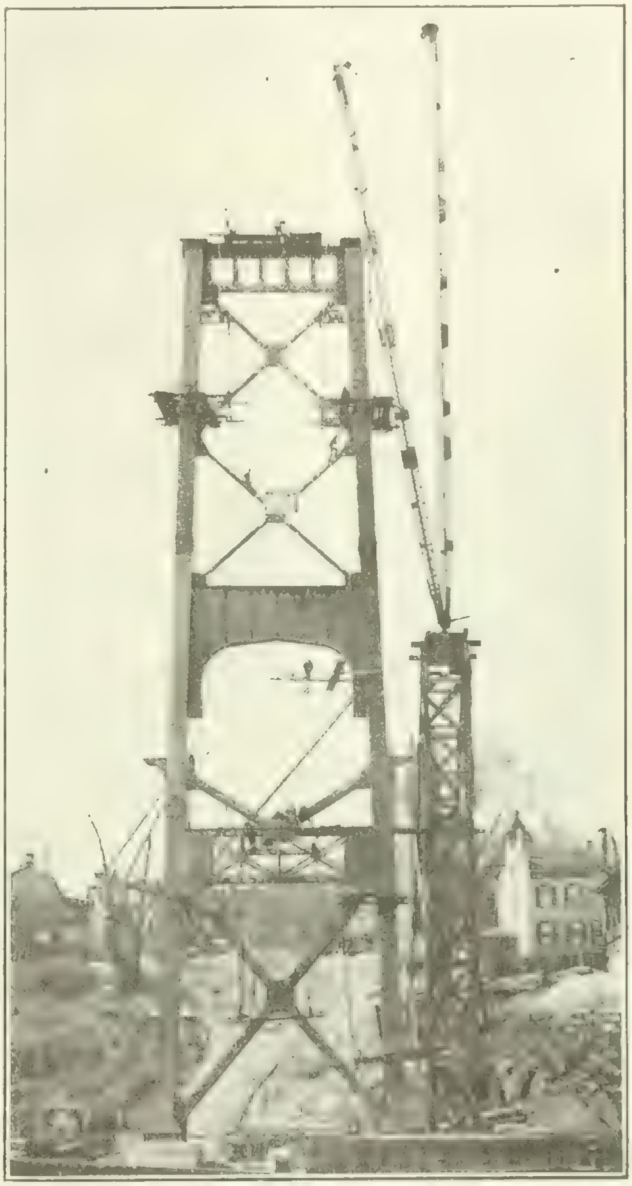


FIG. [illegible]—STEEL TOWERS OF SUSPENSION BRIDGE ERECTED BY DERRICKS ON WOODEN TOWERS

saddles bolted to the web of the top portal. They were hauled from the north anchorage to the south by means of a messenger cable running between the stiff-leg derricks and were adjusted to proper sag before the working floor was erected on them. To place this floor, proceeding from the towers outward in either direction, floorbeams 4 x 12 in. x 34 ft. long, which were fitted with U-bolts to grip the ropes, were slid out into the main and side spans and held in position at points corresponding to the final bridge panel points by means of two 3 x 10-in. stringers at each side. On the stringers was built a 6-ft. walk of 2 x 10-in. plank, guard planks and railing. All material was cut, fitted, and matchmarked on the ground, so that the erection of the footbridge was completed in less than two weeks.

Cable Spinning—The machinery for constructing the main cables comprised (Fig. 3) a 25-hp. motor geared to a 6-ft. double-grooved drivewheel in front of which was set a 5-ft. idler wheel, at the north anchorage; a guide sheave mounted on the timber frame at either side of either anchorage; an endless cable passing over supports at the tower tops and at the quarter points of the main spans, just over the main cable locations; a trolley frame with grooved wheels fastened at diagonally opposite points of this endless cable; and two reel stands designed to carry three reels of cable wire at each anchorage.

The wire was reeled in lengths of about 70,000 to 80,000 ft. Before the actual stringing of the strands was started, one wire was set in the temporary position of the strand during stringing and accurately set by

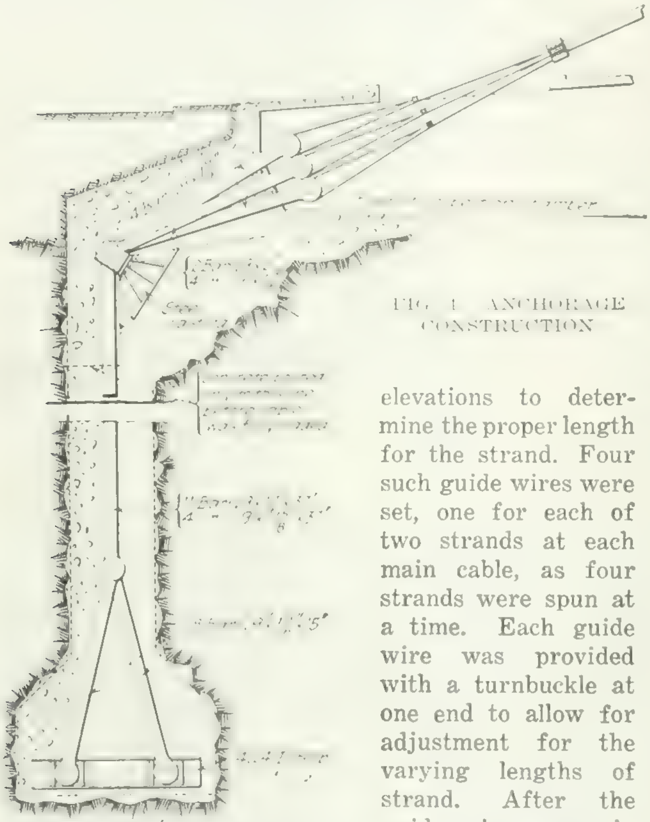


FIG. 4—ANCHORAGE CONSTRUCTION

elevations to determine the proper length for the strand. Four such guide wires were set, one for each of two strands at each main cable, as four strands were spun at a time. Each guide wire was provided with a turnbuckle at one end to allow for adjustment for the varying lengths of strand. After the guide wires were in position the spinning of a strand (containing 282 wires) was started, each wire being adjusted to correspond in sag to the guide wire. The strand wires were carried temporarily in deep grooved sheaves at the towers about 15 in. above the main saddles, so that the temporary position of the strand was parallel to its final position and 15 in. higher (Fig. 6).

In detail the spinning operation was as follows: The

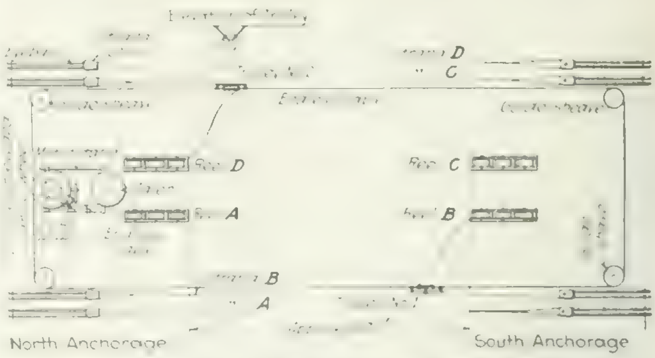


FIG. 3—DIAGRAM OF CABLE SPINNING PLANT

end of the wire from reel *D*, Fig. 3, was secured to a strand shoe mounted on a casting held between a pair of anchorage eyebars, and the bight of the wire was passed over trolley No. 2; similarly the wire from reel *B* at the south anchorage was passed over trolley No. 1. The motor then carried the endless cable around so that trolley No. 1 moved from the south anchorage to the north, and trolley No. 2 in the opposite direction. When each had reached the other end, the bight of wire was removed from either trolley and passed around and clamped to a strand shoe, held on a pair of anchorage eyebars as at the opposite end. Then trolley No. 1 was loaded with wire from reel *A*, and trolley No. 2 with wire from reel *C*, the driving motor was reversed, and the trolleys with their wire again moved across the valley. Men stationed at the towers, at the centers of the main and side spans, and at the anchorages, adjusted the wires to the sag of the guide wires.

Thus each round trip of one trolley put in place four wires, and as two trolleys were in operation eight wires were placed on a round trip. When 282 wires were strung in each of the four strands under way at one time, they were squeezed together with hand squeezers, seized temporarily every 4 ft. with wire seizing, and the strands then picked up by a 10-ton chain block on the gallows frame over the tower top, lowered to the main cable saddle, and adjusted to proper sag in each span.

At each anchorage a 12-ton hydraulic jack was used for holding the strand shoe back in position while it was being lowered by the stiff-leg derrick to its vertical position between the eyebar heads and pinned in place, and also for adjusting the strand to final sag. The strand was made slightly longer than its calculated length, and the adjustment was accomplished by setting shim plates between the pin block and the strand shoe.

The four extra strands in the side spans were spun by a similar process, except that the trolley ran only to the main tower.

All the wire as received was not as uniformly straight

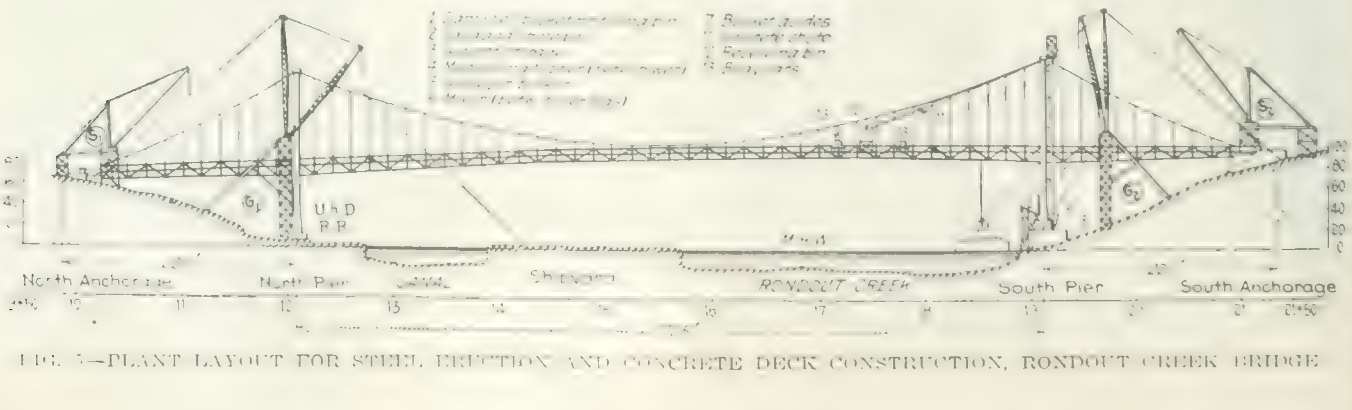


FIG. 5—PLANT LAYOUT FOR STEEL ERECTION AND CONCRETE DECK CONSTRUCTION, RONDOUT CREEK BRIDGE

as would have been desired. To provide for the wavy condition which tended to result from stringing wire that was deficient in straightness, allowance was made in setting the individual wires to the elevation of the guide wires. Wherever a sharp kink occurred in the wire it was cut out, the ends of the wire were threaded and a sleeve splice was inserted, before continuing the stringing. No trouble resulted other than momentary delay.

When all the wires were strung, the temporary seizings of the strands were removed, petroleum grease was slushed between the individual wires, and the cable was squeezed by a hand squeezer to the required diameter and again held by wire seizings placed about 2½ ft. apart.

Suspenders—The position of the cable bands was computed and marked on the cable, and the bands placed and bolted into position. It was then possible to lash the footbridge to the cable bands and remove the footbridge ropes. These ropes, cut up into proper lengths, were used for the suspenders; they were socketed and placed in position over the cable ready to have the stiffening trusses attached to them.

Truss Erection—The side trusses were erected on timber falsework, set to grade and riveted while the cable was being squeezed and the cable bands were being put in position, in order to expedite the work. The main-span truss erection, however, could begin only after the suspenders were in place.

The first four panels of these trusses were erected by means of steel guyed derrick at the tower, but the remainder were erected in part by a traveler moved ahead on the stringers as each succeeding panel was erected, and in part by runner tackle hung from the cables. Because of the sensitiveness of the cables to local loading, and the relatively large weight of the floor travelers, it was found expedient when approaching the center of the span to bring the travelers back to the towers and use them as stationary hoists, handling the rest of the floor steel by runner lines suspended from the main cables.

After the complete erection of the stiffening trusses in the main span, the bottom chords and the floor system as well as the wind chords were fitted up and riveted. The rest of the riveting, however, was postponed until the full weight of the concrete roadway and sidewalk was imposed, in order to bring the truss to line and grade.

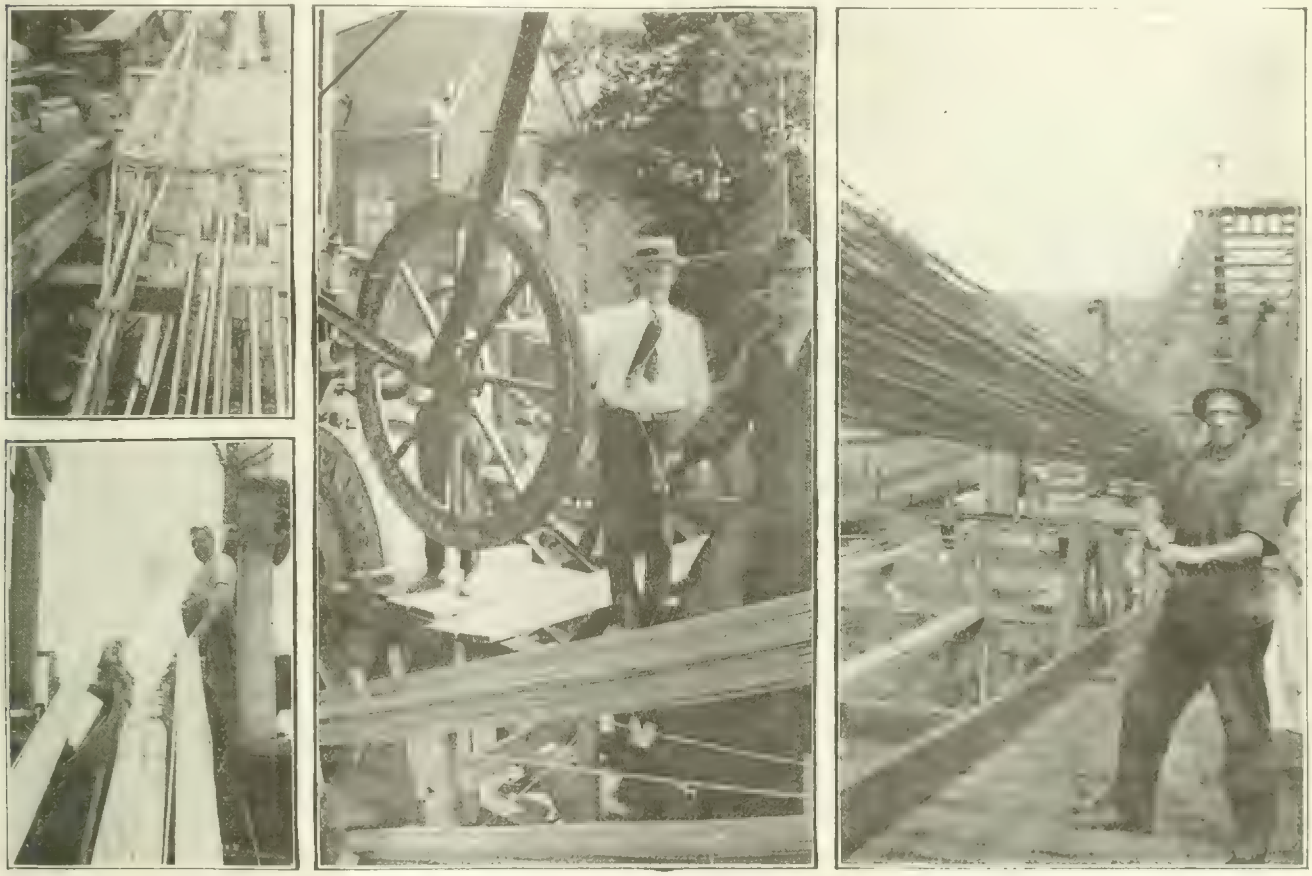


FIG. 6. CABLE-SPINNING OPERATIONS ON THE RONDOUT CREEK BRIDGE

Strand shoes at one of the anchorages in temporary position for the spinning of a strand, with jacks attached for adjustment—Trolley wheel for spinning a main cable wire starting a trip across the span—Cables at saddles showing strands in temporary and final position—Squeezing the strand wires into the complete cable

Concrete—Plant for the floor-slab concreting was laid out as indicated in Fig. 5. The sand and stone were received most economically by barge, and for this reason there was erected at the south tower a bin with a capacity of 60 yd. of sand and 50 yd. of stone. A clamshell bucket rigged to the floor system of the bridge hoisted the material from the barge to this bin, where a measuring hopper discharged into a half-yard mixer, which in turn discharged into a hoist bucket. The latter traveled on guides to the top of the steel tower and there discharged into a chute which carried the concrete to a bin on the bridge floor, where bucket cars running on tracks and operated by cables from the hoists at the towers delivered the concrete.

Later, when the sidewalks were poured, the volume and area did not warrant continuing this elaborate plant in use, and the work was taken care of by a one-bag mixer using material stored at points on the bridge deck.

A traveling scaffold designed to operate on the wind chords of the main span served for placing, stripping and removing the deck forms.

Wrapping—After the full load was on the main cables, they were finished by wrapping with No. 9 galvanized wire. The wrapping machine carried two bobbins, each holding about 200 lb. of the wrapping wire, and was rotated about the cable by a 1½-hp. motor carried on saddles resting on the cables and held against transverse movement by a frame supported on the cable bands. The wire was fed off the two bobbins and wrapped around the cable under the pressure of a shoe which, due to a lip on its bearing surface, served to slide the motor carriage along the cable. On an average about three panels of cable were wrapped per 8-hr. day.

FIG. 7. STEEL ERECTION IN MAIN AND SHORE SPANS

Distortion of stiffening trusses in main span corresponds to the absence of the weight of the concrete deck at this stage—In view at right, the derrick is building the wooden falsework for carrying the side-span trusses.

Finally, the footbridge was removed and the trusses were adjusted to final grade by means of the U-bolts connecting the trusses to the suspenders. All structural steel was given a field coat of red lead paint and two finishing coats of battleship gray, having previously received two shop coats.

Personnel—The bridge was built for the New York State Highway Commission. It was begun under the administration of Frederick Stuart Greene as Commissioner, and was completed under Herbert S. Sisson, Commissioner, and Fred W. Sarr. First Deputy. The plans and specifications were prepared by Daniel E. Moran and William H. Yates, consulting engineers, New York City. The Terry & Tench Co. was the general contractor. Charles Michaud, of Kingston, was sub-contractor for the concrete piers and anchorages.

The writers were resident engineers for the State Highway Commission and for Terry & Tench respectively. B. I. Hall was assistant engineer for the commission. For the contractor, H. D. Robinson was consulting engineer, W. D. Jordan engineer in charge, and A. Spooner superintendent.

Utilizing Existing Road Metal in New Construction

Detail Surveys Determine Usable Material—Three Conditions of Old Road Classified—Different Section for Each

BY G. F. SCHLESINGER
Consulting Engineer, Columbus, Ohio

A CONDITION survey of an old macadam road in which the findings were plotted in detail enabled a considerable part of the original structure to be utilized. With an equally careful study in the substitution of local materials this survey enabled a high class improvement to be carried through at a moderate cost.

Without extreme detail, which naturally will vary with different improvements, this article considers: (1) The methods employed in surveying and planning to insure the saving and utilization of the existing road metal in the construction of the proposed pavement and (2) the use of local material deposits in the construction and design of the pavement.

The improvement was 5,409 miles of Intercounty Highway No. 30, a portion of the main route between Cincinnati and Portsmouth, O. It was originally a traffic-bound macadam. In many places the old structure was in excellent repair and well suited for a foundation for a modern surfacing. There were also a number of places where the bottom had dropped out and the road was practically impassable in bad weather. The original plan contemplated two types of pavement, bituminous macadam and waterbound macadam 16 ft. wide, with a uniform thickness of 11 in. the entire length. This was in line with the usual practice and did not take into consideration the varying conditions of the original road nor the possibilities of utilizing the existing road metal in the proposed construction. The estimates placed the cost of waterbound macadam at $166,-080 and of bituminous macadam at $182,362, but no bids were obtained. A stone which met the specifications could not be had short of a rail shipment of 100 miles which brought the cost to $3.33 per ton.

Attention was then turned to the use of a local bar gravel and boulders which had come to notice and as the result of the study it was decided to use gravel with the provision that "gravel shall be taken to mean a mixture of crushed and uncrushed boulders mixed with fine gravel—not less than 65 per cent of the material shall be crushed boulders." With a source of cheap material provided a study was made of how to reduce cost by utilizing as far as practicable the old surfacing.

It was decided to make a detailed investigation of the road metal then in place, with a view of using it in the base course of the proposed construction. The existing macadam was located in the field with reference to the proposed center line at every station and at intermediate points when necessary, and its condition was determined

and noted. The existing condition was classified as follows:

A Condition, where the present macadam could be used for base course without addition of new material.

B Condition, where the present macadam could be used for base course by filling ruts and depressions and bringing it up to the required shape and elevation with gravel, all such additional gravel to be rolled in place. The entire area of *B* sections required an average depth of 3 in. after being rolled.

C Condition, where an entire base course of new gravel would be required; depth, 6 in.

Of course the limits of the existing road metal did not coincide with the edges of the proposed pavement, and where *A* and *B* conditions existed a base course of new waterbound gravel 6 in. deep was required to fill the space between the outside line of the old macadam and the outside line of the proposed pavement.

The location and condition of the existing macadam pavement was shown on a diagram to a longitudinal scale of 1 in. = 100 ft., and to a lateral scale of 1 in. = 10 ft. (See Fig. 1). The area of the existing pavement, classified into the three conditions, was measured from this diagram. The typical pavement section adopted provided a base course of 6 in. of waterbound gravel, an intermediate course of 5 in. of waterbound gravel, and a top course of 3 in- bituminous macadam. (See Fig. 2). The top course of bituminous macadam was to be built according to standard specifications, for which it would probably be necessary to ship in the limestone aggregate. In locating the proposed profile line it was necessary to avoid cutting into the existing road metal where it was worth saving, that is, where *A* or *B* conditions obtained. The condition and location of the existing macadam was also indicated on the cross sections. Of course the quantity and character of new construction required for the base course varied in accordance with the condition of the old macadam. The items appearing in the new estimate under "Pavement" were as follows:

31,082 sq.yd. waterbound gravel base course, 6 in. depth
14,006 " " " " " " 3 in. ave. depth
52,203 " " " " second " 5 in. depth
52,203 " " bituminous macadam top course, 2½ gal. bituminous material per square yard
1,000 " " extra waterbound gravel base course, 6 in. depth at locations to be designated by the Commissioner

The items of extra waterbound gravel base course was to take care of inaccuracies in the field investigation. The engineer's estimate on the revised plan was \$183,629 for asphalt macadam, and \$176,408.70 for tar macadam. Bids were received April 4, 1921, and the contract was awarded to the T. D. Van Camp Co., of Columbus and Cincinnati, on tar macadam at their bid of \$169,757.07. The base and second courses were completed in 1921, and the bituminous macadam top course is now being constructed, using shipped stone.

The equipment used consisted of two jaw crushers, 150 tons daily capacity each, installed on Nine Mile Creek, about 1¼ miles from the road, two rollers, two stone spreaders and an average of 15 trucks and 10 teams hauling material. The local stone was crushed to a maximum size of about 5 in. and contained 8 to 10 per cent clay and silt. In order to increase progress the contractor was given permission to "sledge" a portion of the stone, and probably a third of the base course was constructed of hand broken material. The construction has resulted in a base course of excellent quality comparable in every way to a waterbound macadam constructed with separated aggregate and screenings. The road was open to traffic during the winter and spring months, and at no point were ruts or depressions of any material depth formed, although the truck traffic in this territory tributary to Cincinnati is heavy.

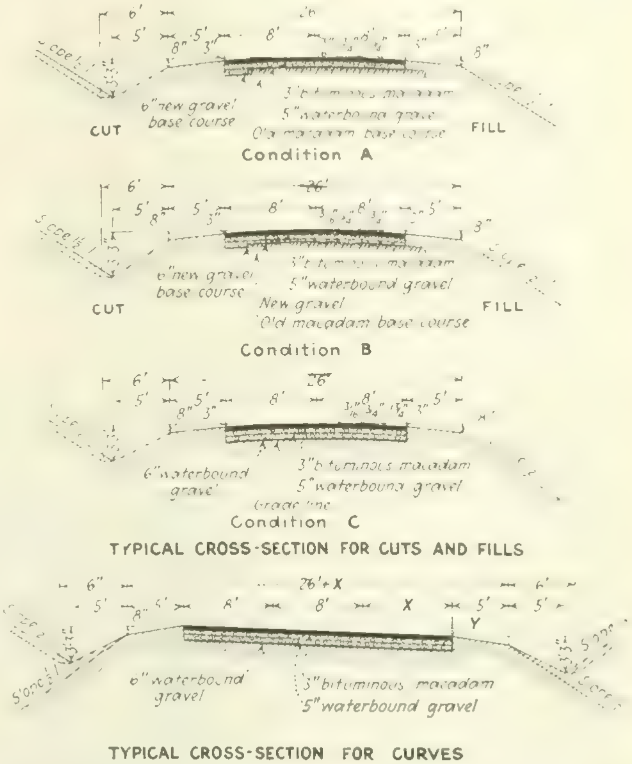


FIG. 2. CROSS-SECTIONS FOR DIFFERENT CONDITIONS OF OLD ROAD

It is believed that in many similar cases of road design, time and money spent in a detailed survey and investigation of existing conditions and in the consequent preparation of plans would be warranted many times by the resulting economy in construction. To lay a profile line that will require the excavation of road metal already bound in place by years of traffic, in order to balance cuts and fills is in most cases an economic waste no matter what the type of pavement proposed.

The survey and plans were made by J. A. Lilly, resident engineer, under the direction of G. F. Schlesinger,

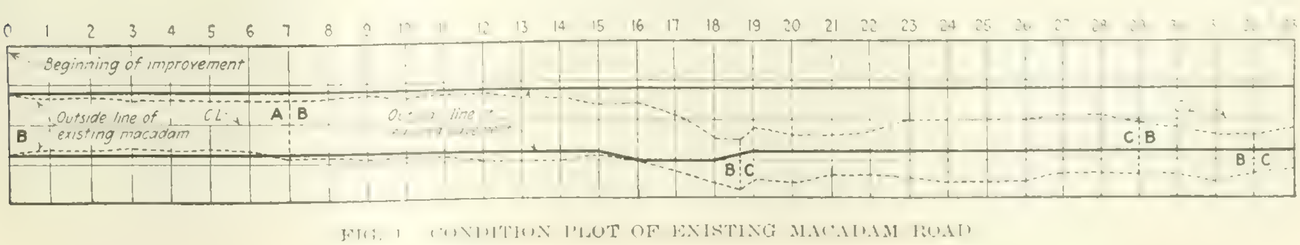


FIG. 1 CONDITION PLOT OF EXISTING MACADAM ROAD

division engineer. A. R. Taylor was State Highway Commissioner of Ohio. The contract was let by Leon C. Herrick, present Director of Highways and Public Works. The construction has been principally under the direction of E. R. Justice, resident engineer and W. W. Fisher, division engineer. Federal aid was used to finance the improvement, it being known as Federal Aid Project No. 151. W. M. Wilbur, chief of the Ohio office of the Bureau of Public Roads, approved the plans and inspected the construction for the Federal Government.

Pollution of Water from Deep Well

AN UNUSUAL case of pollution of water from a deep well is reported by C. M. Baker, state sanitary engineer of Wisconsin, in the report of the Wisconsin Department of Engineering for the quarter ended June 30, 1922. Mr. Baker says:

An investigation at Fond du Lac was of special interest because by especial tests it was demonstrated that there was a leak in the casing of one of the wells; also that pollution could find its way into the water through the exhaust of the air-lift and booster used to pump the water from the well and force it into the storage reservoir. The booster and air-lift are located below the surface of the street in a pit provided with concrete walls. To determine whether there were leaks in the outer casing of the well, arrangements were made whereby air could be forced into the space between the outer casing and the air lift under pressure. This test disclosed two very pronounced leaks where the booster is connected with the well casing. Further observations disclosed the fact that when the air lift was started in operation there was a distinct suction through these leaks or openings, this probably being due to the lowering of the water level in the well during the pumping. The exhaust from the booster had been connected to the storm sewer in order to eliminate the noise of the exhaust which was objectionable in the neighborhood. This exhaust pipe was disconnected and dropped into a barrel partly filled with water. Forty minutes after shutting off the air lifts of the well the water was syphoned out of the barrel back into the bell or drum of the booster, thus demonstrating conclusively the possibility of pollution finding its way into the well in this manner.

An English Railway of 15-in. Gage

A miniature railway handling regular passenger, mail and freight traffic is the Eskdale & Ravenglass Ry. in England, a 7-mile line of 15-in. gage connecting with the Furness Ry. at Ravenglass. The closed passenger cars of the compartment type are about 5 ft. high and seat two passengers in each of the four compartments.

Motorized Laboratory for Resort Sanitation Work

Michigan Department of Health Spends $5,000 Annually to Protect the $100,000,000 Summer Resort Business

By W. C. Brockway and George C. Stucky
Assistant Engineer, Bacteriologist,
Michigan State Board of Health, Lansing, Mich.

PROTECTING the health of pleasure seekers from June to October is protecting the fourth largest industry in Michigan. Boasting 15,000 miles of improved highways, half a hundred camp sites provided for the traveling public by the state, 5,176 lakes, a network of rivers and small streams, virgin forests and 1,624 miles of shore line, Michigan is advertised as the "Nation's Summer Playground" by both resort owners and their patrons.

INTERIOR OF MICHIGAN MOTORIZED LABORATORY

[illegible] Hose from water tank to sink. 5—Sink, [illegible] space at right. 6—Sink hinges. 7—Sink outlet; hose through floor to ground. 8—Pressure cooker used as autoclave. 9—[illegible] 10—[illegible] 11—[illegible] 12—Wheel housing. 13—Removable door front, oak cupboard. 14—Incubator, Electric, 12 x 12 x 12 in., inside dimensions [illegible] from head light circuit or from storage battery [illegible] 15—Cleats for extra seat. Capacity of seat, four people. 16—Folding work bench. 17—Cupboard for sterilizer and other [illegible] 18, 19 and 20—Stack of drawers. 21—Folding microscope. 22—Microscope lamp. [illegible] burner, [illegible]. 24—Rear door.

It is good business for Michigan to "deliver the wares" it advertises, since each summer at least $100,000,000 is spent in the state by vacationists who go to the country or to the lake and river resorts. To help safeguard these vacationists from avoidable diseases is recognized by the Michigan Department of Health as one of its duties. It is therefore spending about $5,000 annually on a motorized laboratory for resort work alone.

In 1913 one representative of the department inspected 77 resorts in the southern part of the Lower Peninsula. Seven men in 1916 inspected 173 resorts

in 29 counties. In 1917 one inspector visited 48 resorts in 15 counties. Common carriers were used for transportation.

Reason for Motorized Laboratory—It was concluded early in 1920 that travel by train and a hurried inspection without comprehensive testing of water or investigation of food supplies did not give the tourists and resorts the attention they were entitled to and fell far short of accomplishing all that we desired. Train travel was expensive, involving livery hire to reach isolated resorts and considerable time in waiting for transportation and making connections. Further, very little educational literature could be carried for distribution.

Trained men equipped with a portable laboratory for making examinations of water and food supplies was the best means of looking after summer resort sanitation, officials of the department concluded. The laboratory could be set up at a central point in a group of resorts. Then from such a location inspection trips could be made with a passenger car carrying literature and water sample bottles necessary for the individual inspection trips.

Specifications—Accordingly the motorized laboratory was designed and equipped under the joint supervision of the directors of the Bureaus of Engineering, Laboratories and Communicable Diseases. The aim in planning the car was to provide for all of the required equipment in as limited a space as possible, having only as much working space as would be required by two laboratory workers.

The car consists of a stock chassis on which is mounted a bus body 12 ft. long, 5 ft. wide and 6½ ft. high. This is a standard design except that the height is increased 6 in. to insure ample head room.

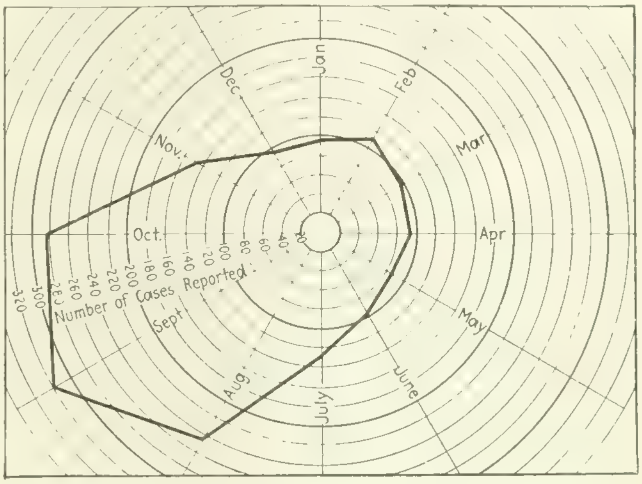
Laboratory equipment consists of the necessary glassware to make bacterial examinations of water in accordance with "A.P.H.A. Standard Methods." There is also included a kerosene stove, a dry-heat oven, an autoclave, a 37-deg. incubator, a Lorenz milk tester, a water storage tank, a sink and a supply of bottles for collecting water and milk samples and for holding media and chemicals. Supplies of bulletins on sanitation are carried for distribution. The bulletins treat of various public health subjects, including water supply, sewage disposal, sanitary privies, chemical closets and fly and mosquito control. Placards on resort sanitation and fly and mosquito control are included. A roadster supplements the motor truck. A 9 x 9-ft. officer's wall tent, folding army cots and a blanket roll are carried for use in case suitable hotel accommodations cannot be found.

In 1920 the personnel consisted of a sanitary engineer, a bacteriologist and a driver. In 1921 the staff consisted of a sanitary engineer (for sanitary surveys), a bacteriologist, who had been in the employ of the department long enough to become thoroughly familiar with its practices and policies, and two food and milk specialists.

Field Work—The truck was located at a suitable central point in a group of resorts. The bacteriologist was left with the laboratory to carry out analyses and to interview people interested in public health work who visited the truck. Other members of the unit visited nearby resorts and made inspections. Resorts as far as 40 miles from the truck were sometimes visited in the roadster. It was advantageous for the laboratory to be moved as infrequently as possible. This condition had to be balanced with the necessity of keeping within easy distance of the resorts to be visited.

The laboratory was always located in a conspicuous place to encourage visitors and facilitate educational work. Technic and methods of analyses were explained and various questions of public health discussed. Talks were also given to various groups, such as clubs, city councils and resort-governing organizations.

Publicity was considered important. Nearly every community visited had a newspaper and these were made use of in every instance. Most editors preferred to receive articles ready for publication, since the subjects treated were of a semi-technical nature. This work was done by the men in the field, and articles on the general feaures of public health and on the experiences and the information collected concerning local conditions were prepared.



SEASONAL PREVALENCE OF TYPHOID FEVER IN MICHIGAN

Chart shows average number of cases reported each month for the years 1898 to 1919 inclusive.

Rating Resorts—An agreement had been reached in June, 1921, between Dr. R. M. Olin, commissioner of health, and Hugh Gray, secretary of the Michigan Tourist and Resort Association, which provided that resorts inspected should be rated according to sanitary conditions and that such ratings should be published so as to make the resorts comply more fully with the principles of sanitation recommended by the Michigan Department of Health. Resorts were classed as A, B, C or D, indicating excellent, satisfactory, dangerous or unsafe conditions. Ratings were based on the character of the water, food and milk supplies, the sewage and garbage disposal service, housing conditions, bathing beach sanitation, drainage, mosquito control and general conditions of premises and grounds.

Work Done—In 1920 the three men with the motorized laboratory and roadster visited 59 resorts in 12 counties. Of 168 water analyses, 48 per cent indicated safe and 52 per cent unsafe supplies. Five resorts, or 8 per cent, were found to be in excellent sanitary condition, 21 resorts, or 35 per cent, were in poor sanitary condition. In 1921 the four men working in ten counties inspected 123 resorts and hotels and made reinspections of 33. Thirty-two resorts were given a Class A rating, 75 a Class B, 15 a Class C and only 1 a Class D rating.

Outstanding Conditions at Resorts—Among the most

prominent defects discovered at resorts inspected are: Lack of resort government; absence of food and milk control; no control of water supplies; lack of sewage disposal; stream and lake pollution; insanitary outdoor privies; imperfect garbage disposal. Some adequate governing organization seems to be the outstanding need at resorts. Often the resorts are closely built up and densely populated. Dwellings are frequently occupied by more people than commonly occupy dwellings of the same size in cities. Hotels are usually crowded during the rush season. Dealers in food stuffs do a thriving business and sometimes are poorly equipped for conducting such business carefully. A majority of the people coming to resorts are from large cities where water and food supplies are carefully guarded so that they give little or no thought to such utilities at the resorts.

Without an efficient governing organization it cannot be expected that these conditions will be properly controlled. They offer opportunities for the careless and dishonest dealer in foodstuffs. Water supplies in thickly populated districts are almost certain to become dangerous unless given proper protection. The temporary nature and overcrowded conditions at most resorts would seem to call for the most careful supervision. When it is considered that many of the patrons at the resorts are persons in a state of impaired health, the dangers are increased.

Many instances of stream and lake pollution were found that were not only nuisances but also endangered bathing beaches and detracted from the desirable features of lake fronts.

Milk supplies, especially those inspected in 1921, were found to be poor in many cases. Work done to improve them was of great value. Few laboratory analyses were made because they were considered unnecessary due to the fact that the milk was produced and handled carelessly and under insanitary conditions.

The attached typhoid curve indicated a relation between high typhoid rates in the late summer and early fall and the insanitary conditions found in summer resorts. One large city in the state claims that 50 per cent of its typhoid is brought from summer resorts.

Since the Michigan Department of Health cannot do all that is desirable, it strongly recommends that resort associations be formed to retain technical advisers to assist their members in solving sanitary problems and to maintain the individual resorts in a proper sanitary condition. Each resort, or group of resorts, should have some officer to perform this type of work. Though the department stands ready at any time to advise and assist resorts in solving their sanitary engineering and health problems, this does not relieve the individual resort of its responsibility.

Irrigation Statistics for 1920 Ready

Statistics of irrigation collected at the census of 1920 for the seventeen arid and semi-arid states are contained in a bulletin just issued by the Department of the Commerce, Bureau of the Census. The number of forms irrigated in 1920 was 231,541, a 42.3 per cent increase over the figure for 1910. The area irrigated was 19,191,716 acres, being an increase of 33 per cent in the ten-year interval. There were 26,020,477 acres capable of irrigation, an increase of 5,735,074. The total area irrigated was 35,890,821 acres.

High Piers of Railway Viaduct Braced by Trusses of Main Span

SLOW progressive yielding of the abutments or shore piers of a railway viaduct across the Rhine at Eglisau, Switzerland, recently led to the adoption of an unusual expedient to hold the piers and prevent their possible future collapse. As described in the *Schweizerische Bauzeitung* of March 18, 1922, this consisted of using the steel truss span crossing the river as a means of bracing the piers by strutting them apart. At the fixed end of the truss span the steelwork was blocked against a thrust bearing built out from the backwall of the pier, and at the movable end a bell-crank lever system (Fig. 2) was installed, bearing against the backwall and against the bottom chord of the truss. Cast-iron weights at the outer end of the horizontal lever arm apply a compression of 110 tons to

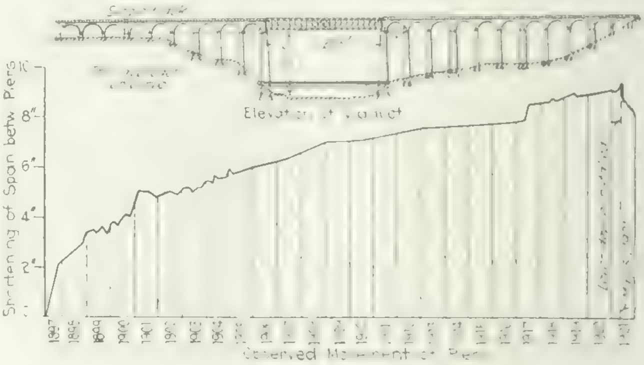


FIG. 1. RIVER SPAN SHORTENED NEARLY A FOOT DURING 23 YEARS

the bottom chord of each truss and thereby force the abutments apart by a total pressure of 220 tons.

The conditions that led to this course are to be gathered from Fig. 1, which shows a diagrammatic side elevation of the bridge and a plot of the shortening of the river span during the twenty-four years from 1897 to 1922. The bridge consists of limestone full-spandrel approach arches about 50 ft. in span, and a steel truss span across the river 295 ft. long. The main piers are about 165 ft. high from top of footing to bridge seat, or about 130 ft. high above water. Evidences of movement of the main piers were noted shortly after construction of the approach arches; the arches next the high piers settled slightly, and cracks developed in the arch barrel and spandrel walls. Subsequently these movements were kept under careful observation. From April, 1897, to June, 1921, the two main piers came together by 220 mm. (nearly 9 in.). At the expansion end the rockers were moved over so far that they had to be re-set in 1899, 1905, and 1920, and on the last occasion the bed plates also were shifted.

Sudden increase of the movement was observed in 1917. It was concluded that the masonry of the high piers had begun to crack on the tension side, and that further abrupt movements might be looked for. Means for remedying the condition were at once taken into consideration.

Replacement of arches by girder spans, which would have involved, of necessity, a considerable number of the approach spans, seemed impracticable because of high cost and because the work would have to be done under traffic. Study was therefore directed toward means of absorbing part or all of the unbalanced arch thrust at

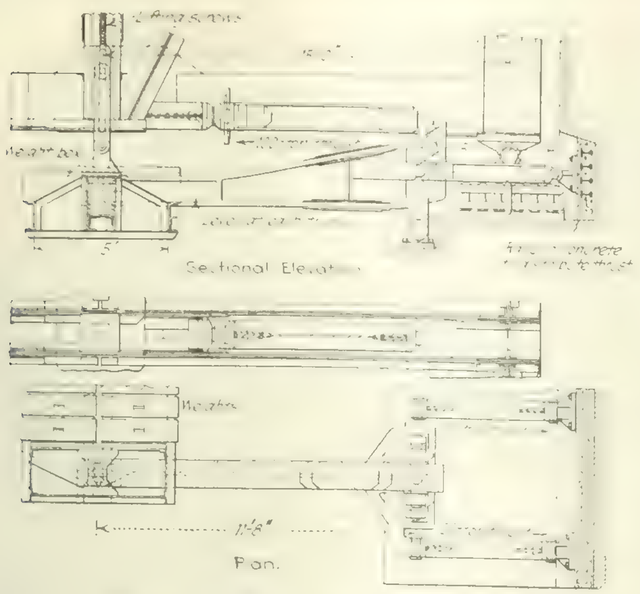


FIG. 2. WEIGHTED LEVER SYSTEM TRANSFERS 200-TON THRUST THROUGH TRUSSES

the main piers. The lever scheme shown in Fig. 2 was adopted. It was put in service by lowering the releasing screws at the first truss post on May 31, 1921. There is one lever at each of the two trusses, the weight box extending across the width of the bridge and being carried by both levers. Temperature expansion in the steelwork is taken care of by the pivoting of the levers. Expansion or other movements of the approaches have the same effect, the thrust of the steel span against the masonry being maintained unchanged. The effect of the device in seven months' service is reflected in the sharp drop of the pier movement curve, Fig. 1.

Some doubts were entertained as to the satisfactory working of the arrangement under trains. It was feared that resonant oscillation of the counterweights might develop, with possibly harmful effect on the masonry. Observations showed, however, that the longitudinal movement of the expansion end of the bridge under a heavy test train was negligibly small, perhaps partly due to the fact that the bridge has a ballasted solid floor. However, tests to verify the smoothness of action of the device were made after it was installed. Strain-gage measurements and other observations on the piers and arches were made at the same time.

Strain gages on the inner and outer surface of the barrel of the arch adjoining the right-hand main pier

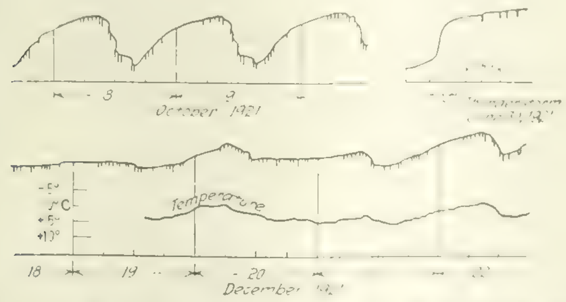


FIG. 3. LEVER MOVEMENTS DEPEND ON TEMPERATURE

Drawing shows part of record from ... drawn ... tometer placed so as to show the rise and fall of the lever weight. The movements are shown to one-tenth scale and are drawn inversely, i. e., pen moving up for lever moving down, or steelwork shortening.

showed the following effect when the thrust levers were put in operation: At first there were large and apparently irregular movements which were attributed to the closing up of cracks in the masonry. When the weights were then lifted clear, and again lowered into action, the gages showed that in the extrados a tension of 35 lb. per square inch and on the intrados a compression of about half this amount were developed. Levels placed on the pier showed that at the bridge seat the pier was tilted backward, while at floor level the pier tilted slightly forward, as might be expected from the resistance of the masonry above the thrust line of the levers. Strain-gage measurements in the steel span showed only about 33 tons compression (reduction in tension) near the fixed end, of the 110 tons applied at the opposite end; the unaccounted for compression is believed to have been transferred to the top chord and thence into the rails.

The computed dead-load thrust of the approach arches is about 195 tons, the lever thrust exceeding this by 25 tons. Nevertheless, the curve in Fig. 3 indicates that summer expansion of the approach masonry was sufficient to overcome the applied thrust. In general a progressive backward motion resulted, however. By the end of 1921 it produced a rise of ½ in. at the crown of the arches adjoining the main piers.

Recording gages were installed to register the vertical rise and fall of the weighted end of the lever due to the action of trains and temperature changes. Three such diagrams are reproduced in Fig. 3; in these the lever movement is given to one-tenth scale, and downward movements of the lever are plotted upward. The small lines projecting downward from the curve are due to the passage of trains. At the right the abrupt influence of temperature change in a thunderstorm accompanied by hail is made evident. The lower curve gives a direct comparison of the bridge movement and the change of air temperature, showing remarkably close correspondence.

The work was planned and carried out by the Swiss Federal Rys., under the direction of A. Bühler, bridge engineer. The C. Zschokke Co. of Döttingen, built the lever system. The total cost of the work was about 100,000 fr.

Railway Terminal Train Water Supplies

As a result of a study of methods employed in supplying drinking water and ice to an average total of 1,642 cars daily at 13 coach yards in Chicago, supplemented by similar observations in other cities, Arthur E. Gorman, assistant sanitary engineer, United States Public Health Service, concludes: "The value of standardization became more and more convincing as the many and widely different variations in the simple procedures were noted. In discussing this matter with yard and coach foreman, these men were invariably of the opinion that standardization would be of value. It is believed that railroad and health officials could discuss standardization of coach yard design and practice with mutual value." Descriptions of the various methods of filling and cleaning water coolers, including the risk of pollution by the dragging of the rubber hose used for filling purposes through dirty yards, and methods of sterilizing coolers, are set forth at some length in *Public Health Reports* for June 16, 1922. Some of the various methods employed and chances for improvement in this work are illustrated by half tone views.

Survey of Electric Traction on American Railroads

Systems Now in Service Described and Compared for the Railroad Engineer — Trend of Locomotive Design—Tabular Review of Present Status

By George Gibbs
Consulting Engineer, New York

So much of what has been written on railroad electrification has regarded the subject from the electrical viewpoint that many railroad engineers and operating men have found it difficult to keep abreast of developments as affecting their broader and more general interests. This abstract of a remarkable report on the subject prepared by George Gibbs for the Ninth Congress of the International Railway Association, in which he surveys the present status of heavy electric traction from the railroad man's viewpoint, is addressed to those who want to keep in touch with this development but who have not been able to follow the more voluminous literature of the subject.—Editor.

In 1910 electric traction was in service in the United States and Canada on eleven different railroads covering 411 miles of route, 873 miles of track, and employing 136 electric locomotives and 613 motor cars. At the end of 1920 these figures were: nineteen railroads covering 1,526 miles of route and 3,370 miles of track, employing 371 electric locomotives and 1,508 motor cars. Of these nineteen roads, five are equipped for city terminal operation of passenger trains, five for long tunnel operation both passenger and freight, three for suburban passenger operation, two for heavy-grade freight operation, and four for main-line operation of both passenger and freight.

The trend of American development has been primarily to secure better operating conditions, as, for example, (1) for terminals in large cities with tunnel approaches and elsewhere where steam locomotives are objectionable; also to reduce shunting and idle car movements by the use of motor-car trains instead of locomotives; (2) on heavy grades, to increase the capacity of the line and effect substantial operating savings; (3) for short-haul suburban passenger service to make more comfortable traveling and quicker schedules, and (4) for long-haul services to secure operating economy where coal is expensive and cheap hydro-electric power can be obtained. In such cases the direct operating savings plus the indirect advantages are sufficient to justify the adoption of electric haulage.

General Features—All electric traction systems comprise the same main features: (1) Power generation and transmission; (2) means to make the power available at the moving train; (3) motive power apparatus on the train. Three systems are in use: (1) Low tension, direct current, third rail; (2) high tension, direct current, overhead wire; (3) high tension, alternating current, overhead wire. Electric power may be generated at any desired voltage for any one of the three systems. For direct current systems, however, the power may be generated in the form of three-phase current at any of the established frequencies, while the alternating current systems require a low frequency. The primary current is carried from the generating station to local substations where it is transformed or converted to the kind and voltage required in the train motor.

Working Conductors — The working conductor, which is used to make the power available in the moving train, is perhaps the most important feature of the installation and is the one of most serious concern to the operating staff. It is everywhere present and must be installed and readily maintained under all physical and traffic conditions. It must be reliable and durable. A local failure of this element means failure of the system as a whole. Two kinds of working conductors are in use, third rail and overhead.

Third Rail—The third rail has the following advantages: (a) it permits the conduction and collection of very large volume currents; (b) it is located conveniently for inspection, repair, and replacement. The disadvantages are: (a) it does not provide continuous contact through complicated tracks, switches and crossings; (b) it obstructs the track structure and interferes with maintenance of permanent way and track, and obstructs the spaces between tracks, thereby menacing the safety of employees in shunting work; (c) it cannot be entirely inclosed and involves risk of contact by employees and others, (d) power is subject to interruption when snow or sleet collects on the conductors; (e) the economy and flexibility of low-tension current, which is necessary with this conductor, is inferior to that of high tension distribution. Because of these objections, third-rail traction may be considered obsolete for heavy railroad electrification.

The standard voltage for third rail has been 600, although 1,200 has been used in two cases of interurban railroads for cross-country lines. The writer does not believe that voltage even as high as 1,500 is sufficient for economical results and believes it impracticable to install a conductor for such a voltage that can be adequately safeguarded.

Overhead Working Conductor—This promises to become standard. The important features desired in designing this structure are sparkless collection, strength, durability, and cheapness. It is also important to avoid hard spots in the collector wire at the suspension points, which may cause sparking. As the collector wire is essentially a device for small current, the higher the working voltage the more successful becomes the overhead contact system

The advantages of such conductors for heavy traction are: (a) it provides continuous contact at the train in places of complicated track layout; (b) it does not interfere with the maintenance of permanent way and track and may be employed safely at high voltages; (c) it insures uninterrupted service during sleet storms to a greater extent than does a third rail. Its disadvantages are: (a) the difficulty of collecting large currents; (b) the difficulty and delay in making repairs to the contact system where traffic is heavy, and (c) the difficulty of installation in cases of limited clearance at bridges, tunnels, etc.

The advantages, however, appear controlling, especially when the amount of current to be collected has been brought within practical limits by raising the voltage.

Voltage Limitation—In the single-phase, alternating current system, maximum voltage is determined by the requirements for economical maintenance of electrical insulation of live wires. In Europe, 16,000 volts has been used successfully and is probably as high as is desirable in the close clearances in tunnels and under bridges. In this country, for very heavy traction, 11,000 volts has been generally used and has been found suitable for the sparkless collection of current.

In the case of the three-phase system, voltage is limited by necessity of maintaining insulation between two con-

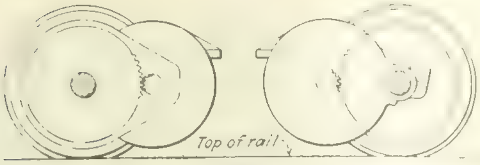


FIG. 1

FIG. 1 TYPE 1. DIRECT AXLE-GEARED DRIVE

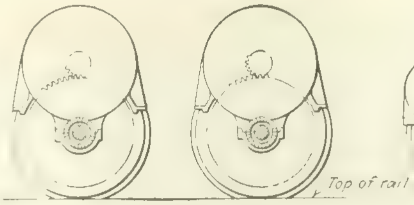


FIG. 2

FIG. 2 TYPE 1. SINGLE MOTOR GEAR AND QUILL DRIVE

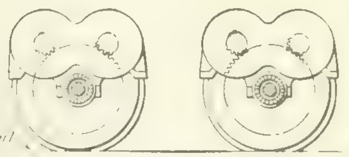


FIG. 3

FIG. 3. TYPE 1 TWIN MOTOR GEAR AND QUILL DRIVE

ductors of opposite polarity placed in close proximity. European experience places the practical limit at about 3,000 volts. The use of the three-phase system has not been seriously proposed for American railroads, chiefly because of the complications and expense of installing and maintaining two overhead contact wires with high voltage.

In the direct-current system having an overhead conductor the voltage is limited to the maximum suitable for generating apparatus and in the control and motors on the train. At present 3,000 volts appears to be the maximum allowable. This is too low to insure reliable collection of the large currents required for heavy service especially at high speeds. It has been sought to remedy this by using two contact wires side by side, but this increases the complication at switches, curves, etc.

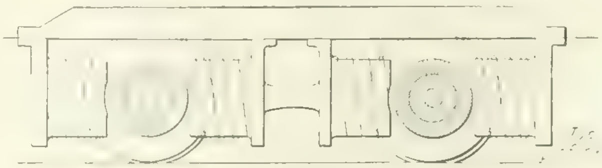


FIG. 4

FIG. 4. TYPE 2 DIRECT AXLE-MOUNTED ARMATURE DRIVE

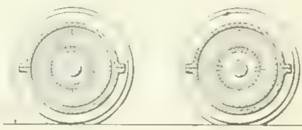


FIG. 5

FIG. 5 TYPE 2. GEARLESS MOTOR QUILL DRIVE

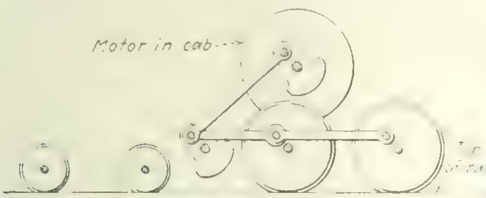


FIG. 6

FIG. 6 TYPE 3 ROD DRIVE WITH GEARLESS MOTOR
Pennsylvania Terminal in New York

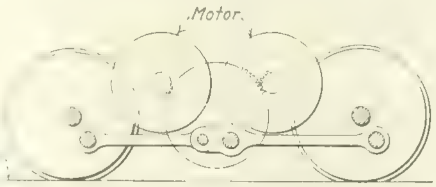


FIG. 7

FIG. 7. TYPE 3. ROD DRIVE WITH GEARED MOTOR
Norfolk & Western Freight Locomotives

Substations — Alternating-current systems require transformers only in substations to alter the voltage of the current, together with necessary switching and safety apparatus. Direct-current systems require transformers, switching apparatus for high-tension current, and rotary converting apparatus to change it into direct current together with the low-tension switching and safety appliances. The combination is costly and complicated and requires the presence of attendants.

Motive Power—For freight service and for through passenger trains electric locomotives are required, while for local passenger service motor cars are preferable. The self-propelled passenger vehicle for this service is one of the great advantages of electric traction over steam.

Locomotives—No approximation even to a standard electric locomotive design has been reached. The problem still ahead for solution are both electrical and mechanical. The former await the selection of a system, and the latter concern methods of transmitting power from the motors to the driving wheels and the best type of locomotive structure. The most serious present problems, however, are mechanical. In the opinion of many, axle weights of steam locomotives have been carried beyond advisable limits and in adopting electric traction thought should be given to a return to moderate wheel-weights for locomotives without disturbing present operating methods. This can be done by stringing together locomotive units to make one compound structure, singly controlled. This has not yet been carried into effect chiefly because of the high first-cost of such a locomotive. At present it is sought to reproduce mechanically the high concentrated wheel-weights of the steam locomotives, because of compactness and low first cost. This means using weights as high as 70,000 lb. per axle, which has accentuated the difficulties of applying and coupling the motors to the wheels in a proper manner.

Types of Drive—There are three general types of drive in service: (1) motors geared directly to the axles, (2) gearless motors mounted on or around axles, and (3) geared or gearless drive by means of cranks and rods.

Out of 390 locomotives in use on American railroads, 223 have some form of direct-geared drive with or without flexible connections. Fig. 1 shows the simplest direct gear, in which one-half or more of the motor weight is rigid on the axle. Fig. 2 shows a type in which the weight of the motor is carried on a quill which surrounds and is held free of the axle. Fig. 3 shows a similar design for a twin-motor gear. In both of these the axle is free of motor dead-weight and the center of gravity of the motors is raised with respect to the track.

Two principal forms of the gearless direct drive are in use. In the New York Central type (see Fig. 4) the motor armature is rigidly mounted on the axle and free to revolve

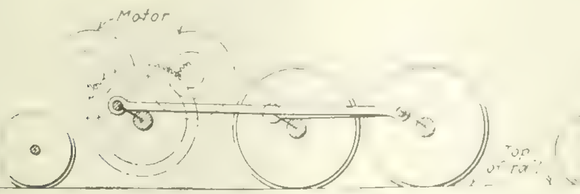


FIG. 8

FIG. 8. TYPE 3. ROD DRIVE WITH GEARED MOTOR
Proposed freight locomotives for Norfolk & Western R.R.

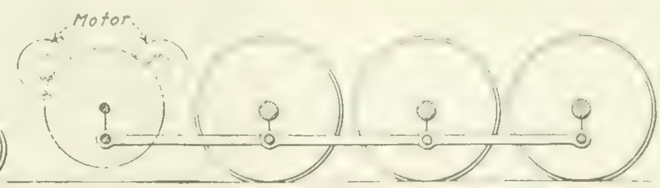


FIG. 9

FIG. 9. TYPE 3. ROD DRIVE WITH GEARED MOTOR
Freight locomot[illegible] R.R.

between bipolar fields carried on the locomotive truck frame. This has been used on high-speed passenger locomotives on the New York Central R. R. and on the Chicago, Milwaukee & St. Paul Ry. The driving wheels are of small diameter and the center of gravity of the motors and running gear is low. This type is not suitable for slow speeds because of the low output per pound weight of the motors. In the type used by the New York, New Haven & Hartford R. R. (see Fig. 5) the motor is mounted on a quill around the axle and carried by the spring-supported frame of the locomotive. The motor armature drives by means of a spider which carries pins inserted in spring pockets in the wheel centers. This permits the use of a large motor having its weight wholly spring-supported.

Several designs for geared or gearless rod-drives have been used in Europe, but the type has been adopted for only two important installations in America; the Pennsylvania R. R. terminal at New York and the Norfolk & Western heavy freight line over the Allegheny Mountains. The Pennsylvania terminal type is illustrated in Fig. 6, this being a gearless drive. The Norfolk & Western type now in use is shown in Fig. 7 and a proposed freight locomotive in Fig. 8. Each of these is geared from two motors. Fig. 9 shows a gear and side-rod drive built by the Pennsylvania R.R. for a projected mountain-grade electrification. The geared motor rod-drive permits of great tractive capacity with a high center of gravity both for the heavy masses and for the locomotives as a whole.

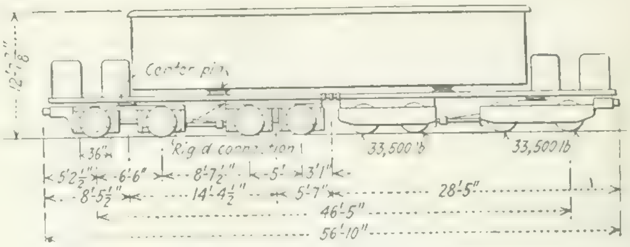


FIG. 10. NEW YORK CENTRAL PASSENGER
Wheels, 0-4-4+4-4-0—Eight Motors—Type 2 Drive; Fig. 4—10 in use—In service 1917.

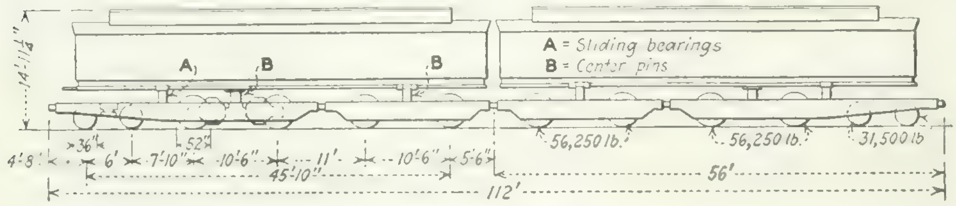


FIG. 11. CHICAGO, MILWAUKEE & ST. PAUL FREIGHT
Wheels, 4-4-4 + 4-4-4—Eight Motors—Type 1 Drive; Fig. 1—12 in use—In service 1916-1917.

Recent American Types—The earliest electric locomotives were for light service and were modeled upon the design of a motor-car; that is, with two bogies having axle-mounted motors and carrying a frame and body to house the control apparatus and the motorman. It was found necessary to modify this arrangement of parts to provide increased tractive effort and stability, especially at high speed, and numerous designs for the mechanical portion of the locomotive have resulted. Figs. 10 to 16 show outline sketches of some of the more recent American designs.

Trend of Locomotive Design—Engineers are not in entire agreement as to the development of these several mechanical arrangements for electric locomotives. Some of the divergence results from difference in viewpoint. The electrical engineer may lay stress upon features of the electrical design and prefer a type of locomotive which follows tramway practice. The railroad engineer, however, generally considers the problems he must meet to produce very powerful steam locomotives, especially those which have to do with proper tracking qualities, ease of access to parts for inspection and repair, etc.

It is difficult to indicate precisely the probable future trend of American practice. Evolution of types is proceeding in a normal manner as has been the case with steam locomotives, but general conclusions may be drawn. Some of these are as follows: Type 1 drive (motors geared directly to axles) is suitable only for slow-speed locomotives on shunting or freight service. For the heaviest freight requirements, however, it is doubtful if this type will be best, as it is difficult to produce a stable wheel grouping and as the heavy motor masses have low center of gravity with considerable weight not spring-borne. Large motors, furthermore, produce heavy side shocks in curving and with track in poor surface, and hub-liner wear is likely to be great.

Type 1 with quill-driven geared motors should produce better results, but only in degree. The quill drive is not entirely satisfactory for very heavy service as it is difficult to find space for conservatively designed springs and unless the quill is maintained normally concentric with the axle, severe bending stresses in addition to the normal torsion are set up in the springs at each revolution.

Type 2, which has the motor armature mounted rigidly on the axle, requires many axles for heavy traction and a wheel arrangement that is somewhat complicated and unfavorable for tracking. It has been used for high-speed work, however, where track construction is of the heaviest character and its maintenance of the highest order. Because of the low output of the motors at low speed its field is limited to high-speed service.

Type 2 drive, having gearless motors flexibly suspended around the axles, may be used for high-speed passenger locomotives with either d.c. or a.c. traction, but it is not an economical type as regards first cost of motors. It has a low center of gravity of the running gear and is subject to the difficulty already mentioned in securing durable, spring-driving mechanism.

Type 3, having gearless motors and rod drive, is suitable for high-speed passenger work with both d.c. and a.c. motors and allows the most desirable wheel arrangement and weight distribution for perfect tracking qualities of the locomotives. The motors, however, are large and costly because of their low speeds, and their capacity is limited. The type is not suitable for low-speed service.

Type 3, having geared motors and rod drive, offers the most flexible and promising solution of passenger and freight locomotive construction because of the allowable variation in wheel arrangement and in motor mounting and

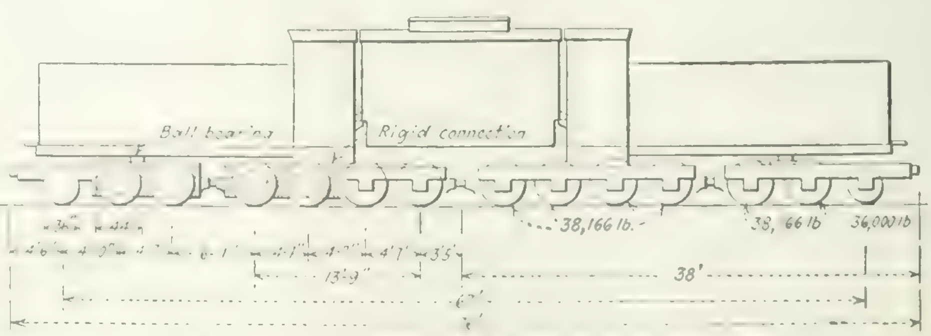


FIG. 12. CHICAGO, MILWAUKEE & ST. PAUL PASSENGER
Wheels [illegible]—Twelve Motors—Type 2 Drive; Fig. 1—5 in use—In service 1920.

capacity. It permits most perfect tracking qualities for a great variety of designs and running speeds, and is suitable both for d.c. and a.c. systems.

Side rods, connecting the various driving wheels, are desirable in all types to prevent slipping of independent axles and thus to obtain maximum traction, especially with d.c. motors having series multiple control. A combination of driving and carrying axles is desirable, also an unsymmetrical wheel distribution to assist in proper tracking.

Motor Cars—Because of the high schedule speeds and the many stops, suburban or "commuter" service is exacting and necessitates very high power requirements per car as compared with long distance runs. In addition to the power question, the suburban service demands maximum flexibility of operation in and out of terminals, so general practice tends toward making each car of suburban trains a motor car. Best economy in equipment and maintenance cost is obtained by using two motors mounted on one truck. A modern steel car about 70 ft. in length overall will satisfy these conditions and will weigh, without electric equipment but including full seated passenger load, about 100,000 lb.

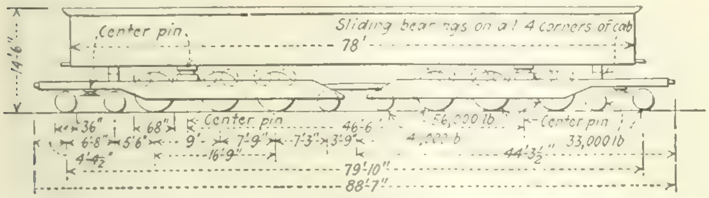


FIG.13

FIG. 13. CHICAGO, MILWAUKEE & ST. PAUL PASSENGER
Wheels, 4-6-2 + 2-6-4, Six Motors, Type 1 Drive, Fig. 3—10 in use; In service 1920.

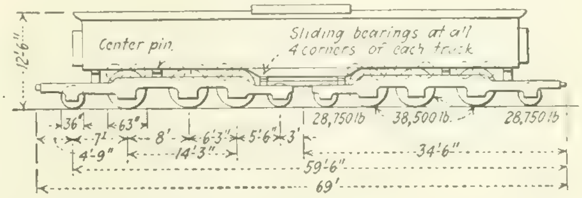


FIG.14

FIG. 14. NEW YORK, NEW HAVEN AND HARTFORD PASSENGER
Wheels, 2-6-2 + 2-6-2, Twelve Motors, Type 1 Drive; Fig. 3—5 in use; In service 1919.

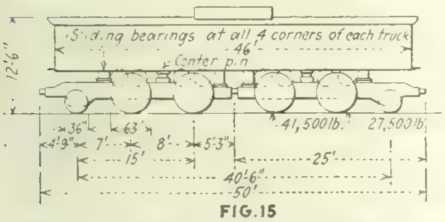


FIG.15

FIG. 15. NEW YORK, NEW HAVEN AND HARTFORD FREIGHT AND PASSENGER
Wheels, 2-4 + 4-2—Eight Motors—Type 1 Drive; Fig. 3—3 in use—In service 1912.

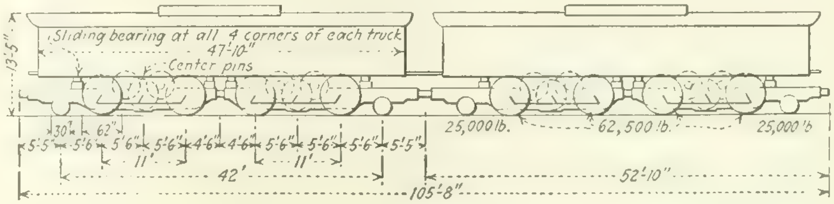


FIG.16

FIG. 16. NORFOLK AND WESTERN FREIGHT
Wheels, 2-4-4-2 + 2-4-4-2—Eight Motors—Type 3 Drive; Fig. [illegible]—12 in use—In service 1915.

Two motors will give a capacity of about 500 hp. for the car.

In analyzing the relative advantages and disadvantages of various systems of electric traction it is desirable to keep in mind the importance of providing for suburban service of this character in the most economical and flexible manner.

Choice of Systems—During the past ten years the number of roads employing high tension current traction has considerably increased, while the third-rail system has not extended materially except to increase the mileage of existing installations. The high-tension installations all use the overhead contact, and on the basis of the number of installations the alternating-current system is most generally used. The field is narrowing to the use of two systems which appear in the present state of the art best adapted for heavy and for long distance railroad operation; the 3,000-volt, direct-current, and the 11,000-volt. single-phase alternating current.

Recently there has been a tendency to standardize practice. This is desirable if it does not stop evolution and result in a premature fixing of practice before technical and practical knowledge is sufficiently advanced. The writer believes it is somewhat early to fix upon standardization to an important degree for any system, much less to exclude any promising system. Development is proceeding along normal and logical lines and there is no reason to force a conclusion at this time by hasty action in any direction.

There is some reason to feel, however, that orderly consideration of the subject will not continue because of the views that are being generally expressed by those who are not engaged in operating the railroads but are connected with other industries. One of the two great electrical manufacturing companies in America is committed at present to advocacy of the direct-current system and does not offer train equipment for the alternating-current system; the other company has been responsible for the development of the alternating-current system and advocates its use but will furnish direct-current apparatus if the customer prefers.

The telegraph and telephone companies are unfriendly to alternating-current traction because of their fear of inductive effects on their lines from the traction currents. The commercial central power-station companies appear to consider it to their interest to advocate the use of direct-current traction as being the easiest system for them to supply. This is because they find it advantageous for their commercial lighting and power loads to use 60-cycle current, which is suitable for direct-current traction but cannot be used for alternating-current traction in the present state of the art without changing the frequency, which means added expense.

While these interests have views and are expressing them, the railroads have not taken a definite position as they are trying out what they have and awaiting further

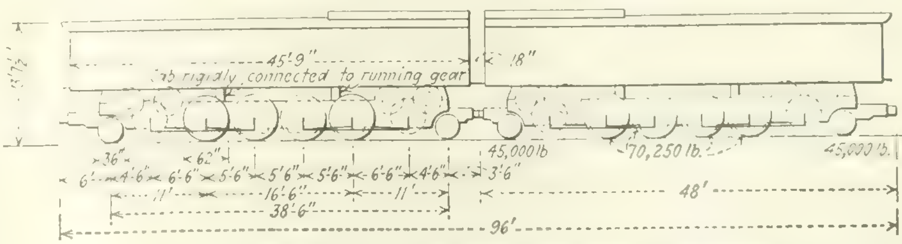


FIG. 17. NORFOLK AND WESTERN PROPOSED FREIGHT
Wheels, 2-8-2 + 2-8-2—Eight Motors—Type 3 Drive; Fig. 8—Proposed 1919.

HEAVY ELECTRIC TRACTION INSTALLATIONS, 1910 AND 1921

Railroad	Service F = Freight P = Passenger	System: Kind of Current	System: Type of Contact	Voltage: Trans.	Voltage: Contact	1910 Mileage: Route	1910 Mileage: Track	1910 Rolling Stock: Locos.	1910 Rolling Stock: Motor cars and Trailers	1921 Mileage: Route	1921 Mileage: Track	1921 Rolling Stock: Locos.	1921 Rolling Stock: Motor cars and Trailers
Baltimore & Ohio	F & P	L.T.D.C.	3rd R.		650	3.70	8 40	8	0	3.75	8.00	8	0
Long Island	P	L.T.D.C.	3rd R.	11,000	650	43.90	110.00	..	218	90 30	227 20	1	654
West Jersey & Seashore; P. R. R.	P	L.T.D.C.	3rd R.	33,000	650	74 60	162.70	...	89	75 00	160 38		107
New York Central & Hudson River	P	L.T.D.C.	3rd R.	11,000	600	22 50	101 00	47	180	57.90	268 30	73	241
Spokane & Inland	F & P	L.T.D.C.	O.H.	45,000	600					54 53	84.77	3	20
		H.T.A.C.	O.H.	45,000	6,600	135 00	135.00	9	36	129 18	135 42	7	19
New York New Haven & Hartford	F & P	H.T.A.C.	O.H.	22,000	11,000	21 50	100 00	41		87 90	530 60	108	79
Erie	P	H.T.A.C.	O.H.	60,000	11,000	38 00	38 00		6	34.00	40 00		12
Grand Trunk	F & P	H.T.A.C.	O.H.		3,300	3 80	12 00	5		4 00	12 00	6	
Great Northern	F & P	H.T.A.C	O.H.	33,000	6,600	4 00	6 00	4		4 00	7 00	4	
Southern Pacific	P	H.T.D.C.	O.H.	13,200	1,500 !,200	51 60	124 60		84	197 92	316.32		220
Pennsylvania; New York Terminal	P	L.T.D.C.	3rd R.	11,000	650	12 90	75 00	24		13 41	110 08	34	8
Michigan Central	F & P	L.T.D.C.	3rd R.		650					4 60	26 40	10	
Boston & Maine	F & P	H.T.A.C.	O.H.	11,000	11,000					7.92	20 91	7	
N. Y. Westchester & Boston	P	H.T.A.C.	O.H.	22,000	11,000					21 75	73 41	1	45
Butte, Anaconda & Pacific	F & P	H.T.D.C.	O.H.	100,000	2,400					25 30	122.30	28	
Norfolk & Western	F	H.T.A.C	O.H.	44,000	11,000					29 13	108 26	12	
Pennsylvania; Padi & Chestnut Hill.....	P	H.T.A.C.	O.H.	44,000	11,000					30 00	224.77	1	115
Chicago, Milwaukee & St. Paul	F & P	H.T.D.C.	O.H.	100,000	3,000					646 70	860 40	62	
Total; U.S.						410 60	872 70	138	613	1,517 29	3,346.52	365	1,500
Canadian National....................	P	H.T.D.C.	O.H.	11,000	2,400					9 00	23 00	6	8
Total; U. S. and Canada..						410 60	872 70	138	613	1,526 29	3,369 52	371	1,508

Summary		System: H.T.A.C.	System: H.T.D.C.	System: L.T.D.C.	Totals
1910	Number of roads	5	1	5	11
	Route miles	202.30	51 60	156 70	410.60
	Track miles........	291 00	124 60	457.10	872 70
1921:	Number of roads......	9	4	7	20
	Route miles......	347 88	978.92	299.49	1,578 29
	Track miles	1,162 57	1,322.02	885.83	3,369.52

Note
H.T. = High Tension
L.T. = Low Tension
A.C. = Alternating Current.
D.C. = Direct Current.
O.H. = Overhead Conductor
3rd R. = Third Rail.

information. Electrical engineers competent to pass upon operating as well as the technical aspect are neither numerous nor influential as compared with the powerful interests that are taking a stand on the subject. These engineers, moreover, are divided in their views.

The writer would not advocate one system to the exclusion of another and favors further trial of both alternating

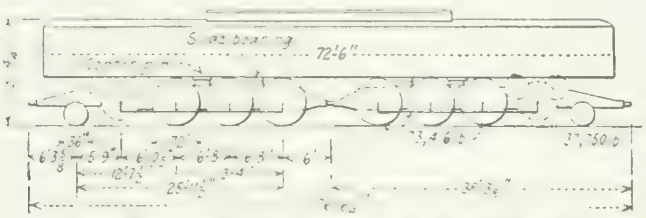


FIG. 18. PENNSYLVANIA RAILROAD FREIGHT [illegible]
Wheels, 2-6 + 6-2—[illegible] Motors [illegible]

and high-tension direct-current systems. He considers, however, that the high-tension alternating current has at present the greater number of demonstrated advantages for general railway use and holds out the most promise for the future. If, therefore, it were necessary to standardize now, it would seem to him illogical to select the high-voltage direct-current system, which has not yet been applied to all railroad operating conditions and which appears difficult of application to some, and to discard a system which has been so applied and is operating economically and well in all cases.

Tar-Treated Concrete Resists Salt Action

Investigations carried on by the Bureau of Public Roads on the waterproofing properties of water gas tar have indicated the possibility of utilizing this material as a means for protecting concrete from the action of saline solutions. It has been found that crude water gas tar having a specific viscosity of from 6 to 12 will enter freely, under atmospheric pressure, into dense concrete and mortar and is largely absorbed by the hydrated cement. Cement drain tile so treated have shown no signs of disintegration under test.

Respirator Will Protect Engine Crews Against Fumes in Tunnels

THE development of a pocket canister or respirator which will largely alleviate the discomfort to which engine crews are subjected by sulphurous locomotive smoke when passing through tunnels is announced by the United States Bureau of Mines. The canisters, which fit conveniently into a coat pocket, are filled with an absorbent mixture of activated charcoal and soda-lime, and contain filters of Turkish toweling. These small smoke respirators have had the hearty approval of the men who have used them, and retain their effectiveness for months. They may be cheaply made and are a great improvement over the sponge respirators and handkerchiefs and towels now used by engineers and firemen when passing through unventilated tunnels.

In a tunnel the crown deflects the smoke from the stack upon and around the locomotive. Mixed with air and exhaust steam, the smoke enters the cab, surrounding the engineer and fireman with a hot, vitiated atmosphere. Discomfort produced by the sulphurous smoke is intensified by the heat and humidity.

The experiments of the Bureau of Mines were conducted in 23 tunnels of the Baltimore & Ohio R.R. between Grafton and Parkersburg, West Va., in the Gallitzin tunnels of the Pennsylvania R.R. near Altoona, Pa., and in the Schenley tunnel in Pittsburgh. Various types of gas masks were worn by the experimenters in the cabs and by the engine crews in these tunnels; gas samples of smoke-contaminated atmospheres were taken in the locomotive cabs or at the cab windows and carefully analyzed in the gas laboratory of the Pittsburgh experiment station of the Bureau of Mines. Other tests were made by trackworkers and by the experimenters while in a tunnel on foot. Details of these experiments are given in Technical Paper 292, by A. C. Fieldner, S. H. Katz, and S. P. Kinney, which may be obtained on application to the Bureau of Mines, Washington, D. C.

Slag-Concrete Roads—Their Construction and Wear

Conclusions Based on Inspection of Over 100 Miles of Concrete Road Built With Slag Aggregate and in Service from One to Nine Years—Some Difficulties in Manipulation and Peculiarities of Wear

By C. S. Hill

Associate Editor, *Engineering News-Record*

Slag as concrete aggregate has been used for concrete roads for about nine years. In some places it is the most economical and easily obtained aggregate, but many engineers and contractors are not acquainted with its use or fear its wear. The present study is the result of an extended observation of slag-concrete roads under construction and in service. The conclusions are that while there are certain peculiarities of slag both as to manipulation and wear, concrete roads with it as the aggregate are in the main in as good shape as those using natural aggregate.

About 225 miles of slag concrete highways are in service in the United States. Practically all of this road has been constructed in six states, Ohio, Pennsylvania, Georgia, Indiana, New York and West Virginia, and a very large proportion of the mileage is county road. Ohio leads all other states with between 90 and 100 miles of slag concrete pavement dating from 1913 to 1921. All of these pavements are in service and considering their ages, the practice of the time and the maintenance they have received they exhibit no greater structural deterioration than is common to concrete roads of comparable age and construction in which stone or gravel aggregate was used. Surface imperfection in the form of pitting is almost invariable in slag concrete roads of any age which has permitted some amount of traffic wear and weather action to take place.

Slag is a compound of the impurities in the iron ore and of the limestone used as a flux in blast furnaces. It comes molten from the furnace and when it is intended for crushing it is poured in relatively thin layers on slag banks and allowed to cool. The cooled slag is excavated, crushed and screened for commerce. Crushed slag is a hard though very porous material, and makes an aggregate of considerably less weight than gravel or crushed stone. Offering a rough pitted surface for the adhesion of cement it produces a strong concrete. The larger producers take great care in selecting and curing the slag and in crushing and screening it for concrete aggregate.

Slag is an available aggregate in a number of states where steel manufacture is extensive. In sections of these states it can be laid down in stock piles for road construction at less cost than can stone or gravel aggregate. It is, therefore, in these localities a commercially logical aggregate for concrete roads. The only question of its utility is whether it gives as serviceable a pavement which can be constructed with no increased difficulty because of the nature of the aggregate. Tnere are varying opinions on both points.

It is probably not unfair to assert that generally the fitness of slag as an aggregate for concrete roads is regarded with a shade of doubt and in specific instances with actual distrust.

It is also generally assumed that pavement fabrication of slag concrete is more of a care than it is with gravel or stone concrete.

Specifications—Very few state highway departments provide specifically for slag as an aggregate for concrete roads and in these the specifications vary greatly in their quantitative provisions. Ohio has perhaps the most precise requirements. They are as follows:

The broken slag shall be clean, sound, durable, reasonably uniform in density and free from thin or elongated pieces. The chemical composition shall be not less than 32 per cent silica, not over 45 per cent calcium oxide and not over $1\frac{1}{2}$ per cent sulphur. The slag shall show not over 10 per cent wear by the stone test or 20 per cent by the gravel test; have a toughness of not less than 5, and weigh not less than 70 lb. per cubic foot. It shall show no signs of checking, cracking or disintegration in the sodium sulphate test for soundness.

Colorado calls for a 78-lb. slag and Pennsylvania for a 75-lb. slag. These weights virtually eliminate all but a few slags which can be produced commercially. In general a 70-lb. slag, as specified in Ohio, can be produced from most slag banks without excessive picking and choosing. Most slag concrete roads and pavements of county and town construction have been built of slags weighing between 65 and 70 lb. per cubic foot.

Practice with respect to pavement sections and proportions does not differ essentially from that when stone or gravel concrete are used. The more recent sections are 5-7-5 in. and 6-8-6 in. in thickness and from 16 to 20 ft. wide. Older roads show various widths down to as narrow as 9 ft. and thicknesses of 5, $5\frac{1}{2}$ and 6 in. Proportions vary in different states but run curiously uniform in all parts of the same state. In Ohio all but 8 of 44 sections are a $1:1\frac{1}{2}:3$ mixture. In Pennsylvania a 1:2:3 mixture is nearly universal and in the south, Georgia and Alabama, it is nearly always 1:2:4. The size of slag runs from $\frac{3}{8}$, $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ to $1\frac{1}{2}$ in.

While the proportions givan are the nominal proportions, actually, in slag concrete paving, there is almost always some juggling of the proportions until the easiest working mixture is determined. As an example, the 18-mile slag concrete section of the Cleveland-Akron road built in 1921 was nominally a $1:1\frac{1}{2}:3$ mixture and actually a $1:1\frac{3}{4}:2\frac{3}{4}$ mixture. Generally speaking a moderately over-sanded mixture is easier to work.

Tests—Slag tests for the specific purpose of determining its qualities for concrete roads have been comparatively few. A series of investigations is now being conducted by the Bureau of Standards. Also some

study of the material has been made at Lewis Institute for the Portland Cement Association. In neither case have the records been announced for publication. Standard laboratory crushing tests indicate strengths quite as great as are required for pavements in ordinary construction practice. In fact no test results of slag concrete, which are known, give reason to doubt the satisfactory physical properties of this material for pavements.

Construction—Slag is light in weight compared with rock aggregate and it moves harshly, with perhaps more friction in chutes and a greater disposition to arch and "hang up" in bins. To these two qualities are due the chief concern in constructing slag concrete roads.

Because of its light weight the slag "floats" to the top of the slab and makes a somewhat harsher surface under the finishing roller and belt. The floating particles "drag" under the belt and float and do not permit the "soapy" finish that can be got under the belt or float with a stone and gravel concrete. These obstacles to easy finishing should not be exaggerated. They necessitate more care and somewhat different methods but not much more labor or expense. It is said by contractors experienced in slag concrete road construction that "one has to learn how to handle slag but afterwards it is no more troublesome than other aggregates."

The tendency of slag to arch and hang-up requires steeper slopes and larger passages in bins and chutes. It "shovels" with a little more difficulty than broken stone but its weight is less and larger shovels can be used. It is not appreciably more difficult to dig and lift with clamshells and generally larger buckets can be employed. Compared with stone or gravel it is a clean and dustless material to handle.

To finish slag concrete satisfactorily does not require different processes and tools but different ways of using the tools and performing the processes. On the whole perhaps belt finishing is least adaptable. In addition to "pulling down the crown," an objection general to the process, the belt catches the sharp slag particles and shuttles them back and forth scoring the surface. A better tool is the float, or a thin board used like a belt but capable of being lifted and laid down and so used to press down the floating particles until the mortar submerges them and slightly stiffens around them. Machine finishing is entirely practicable to strike off and tamp the slab but not for belting. In some recent large slag concrete road operations the belt, after a brief experience, has been taken off the machine and hand tools substituted for the fine finishing.

Service—Inspection of some 20 slag concrete roads built from 1913 to 1921 and aggregating approximately 100 miles has led to the following conclusions:

1. No disintegration of slag concrete roads certainly due to the slag content of the concrete were observed. In one instance a slag concrete base for a bituminous surface was found where many blow-ups were attributed to temperature action on concrete water-soaked because of the porosity of the "second class concrete base." Nowhere was evidence presented of any unsoundness of concrete because of any chemical content of the slag aggregate.

2. Slag concrete roads exhibit longitudinal and transverse cracking, corner breaks, shattering due to blow-ups and heaving subgrade and heavy traffic loads, and practically every other sort of failure characteristic of paved roads but to no greater degree than other concrete pavements of corresponding ages and construction practice.

3. Most of the slag concrete roads inspected appeared at a disadvantage because of poor maintenance. These were county maintained roads. Old cracks had not been filled and corner breaks and zones shattered by heaving or other cause had been allowed progressively to develop until the pavement presented a ruined appearance which it would not have presented had repairs been promptly made.

4. Practically all slag concrete roads exhibit surface imperfection due to general pitting. This pitting is caused by the breaking and crumbling out from the mortar matrix of the pumice or light friable slag particles which come to the surface during construction. It is a curious circumstance of this condition that the small pits ranging from $\frac{1}{4}$ to $\frac{1}{2}$ in. in diameter and depth left by the disappearing soft slag, do not often enlarge by breaking down at the edges. They are a defacement rather than a structural damage, as they were observed in some scores of areas minutely examined at random.

Development—The critical task in developing slag concrete pavement is to eliminate pitting and to eradicate the impression that there is some danger to concrete soundness in the chemical constitution of slag.

Pitting, as stated, is due to light friable particles, or pumice, which are a content of every slag, rising or floating to the surface of the wet mixture and then breaking up after the pavement is in service and leaving a pit in the mortar matrix. The weight requirements of slag aggregate specifications, as they are quoted in a previous paragraph, are designed to reduce the percentage of pumice. No practicable weight requirement, however, can correct the difficulty entirely without putting slag out of consideration commercially as a road concrete aggregate.

To separate the pumice from crushed slag by some mechanical process which is economically practicable is the big technical problem in slag production. There is a margin of only a fraction of a dollar a ton within which slag can compete in price with crushed stone or gravel. Any process of pumice separation to be commercially practicable must operate well within this narrow margin. This limitation has so far put out of consideration any flotation or jigging process and of course screening does not meet the situation. The problem as yet has proved unsolvable.

Overcoming the mistrust of chemical troubles from the use of slag is a matter of proof and education. The proof lies in the structures built and remaining invariably sound and in the laboratory studies now in progress.

For Improved Cast-Iron Car Wheels

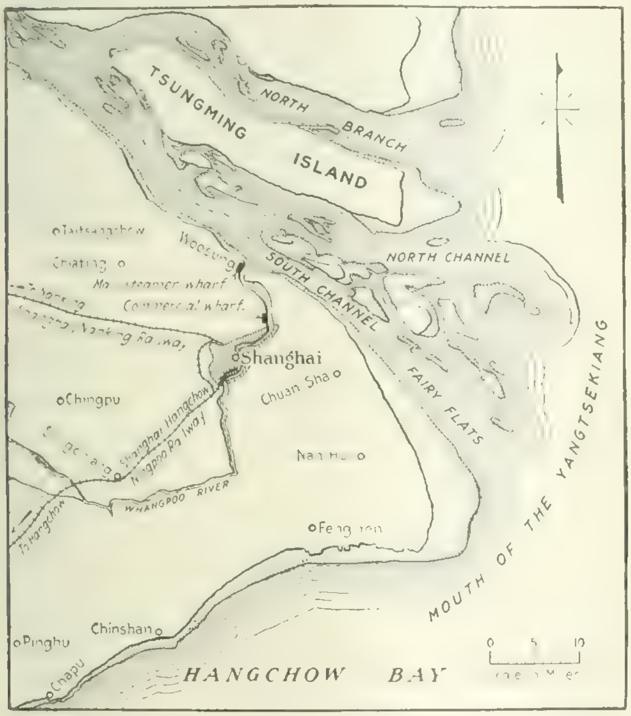
Thermal stresses in chilled cast-iron car wheels were investigated at the Bureau of Standards recently by G. K. Burgess and R. W. Woodward, with the result of suggesting possible improvement in wheels to make them more resistant to cracking under the heating developed by prolonged brake application. The investigation is reported in Technologic Paper No. 209.

Report Plans for Development of Shanghai Harbor

International Commission Recommends Creation of New Port Authority and Plans Whangpoo River Wharf Improvements

EXTENSIVE improvements to the approaches and the harbor proper at Shanghai have been recommended by a special committee of consulting engineers which has been studying the subject under the direction of the Whangpoo Conservancy Board.

The actual work of the commission was to consider and report on the further harbor development possibilities at Shanghai: (a) with the approaches to and limit of draft in the harbor remaining as at present, 28-30 ft.; (b) for the probable maximum draft of ships



SHANGHAI AND ITS HARBOR APPROACHES

on the Pacific. A consideration of these questions involved, among other elements, the possibility of improving the Yangtze estuary bar, the alternative question of a Hangchow Bay approach, and the provision of improved berthing accommodation and general port improvement, even with approaches remaining as at present.

The schemes submitted to the committee included a general consideration of all conceivable possibilities, but more especially various suggestions for dredging or training the great Yangtze bar, known at the Fairy Flats, design for a *port de vitesse* on the Hangchow Bay as an alternative to an improved Yangtze approach and layouts for first-class wharf accommodation in the Whangpoo and elsewhere.

The report includes among its recommendations the revision of the agreement as to the Whangpoo Conservancy between the Chinese government and the foreign powers, so as to provide a proper harbor authority, the dredging of the Yangtze bar, and the provision of a mail-steamer wharf near the mouth of the Whangpoo and a commercial wharf and docks below Shanghai. The immediate expenditure of 11,000,000 taels is recommended and the general lines are laid down for future development. The report has been forwarded to the Chinese government for its consideration.

Proposed Organization—The board proposed to administer the port authority is to consist of Chinese officials, representatives of shipping and trade in Shanghai, and a general manager to be appointed by the board who shall be, *ex officio*, vice-chairman. The chairman shall be selected from among the Chinese officials, who shall include local representatives of the customs and railways, appointed by the government to hold office so long as they fill the position by virtue of which they sit on the board.

Draft of Ships—The committee is of the opinion that the trade of the Pacific will in future be carried in vessels of greater draft than those now in use and that in a few years a draft of 33 ft. may be reached in the larger vessels. It proposes therefore a first improvement to enable ships of 33 ft. draft to enter at neap high tide with provision for progressive increases in depth as required.

Approaches—The committee recommends that improvement of the south channel be carried on by dredging only and that extensive and continuous observations be instituted to provide further information for future operations. It recommends for immediate action the dredging and maintenance of a channel through the Fairy Flats attaining as soon as feasible a bottom width of 600 ft. for ships drawing 33 ft. at ordinary neap high water.

Dr. Hiroi filed a reservation on this point to the effect that before being committed to dredging as a definite scheme of improvement, experimental work should be undertaken by means of trenches through the Fairy Flats with systematic observations of the time and manner in which the filling of the trenches takes place. The other members of the committee dissent from this and urge that there is no reasonable doubt as to providing and maintaining a greater depth by dredging. The one condition they wish to lay down is that the dredging operations should be on a really extensive scale.

The committee recommends the acquisition of at least two dredges of the most powerful type which can be operated on the Fairy Flats in a depth not exceeding 18 ft.

Harbor Improvement—The committee recommends that public quays and moorings be provided, that a commercial dock be installed on the west bank of the Whangpoo as near Shanghai as practicable, and that mail steamer accommodations be arranged also on the left bank near the mouth of the river, both works to be designed to admit of further extension when required. They recommend that existing foreshore areas and conservancy land be utilized so far as possible and that sufficient adjacent land be acquired for future development. They propose further that the Whangpoo regulation be continued to whatever depth may be required and practicable and that cross river communication be by ferries.

For immediate needs the committee recommends that 600 ft. of wharf be built on the left bank of the river near its mouth to serve mail and passenger steamers, and that 2,500 ft. of wharf with necessary transit sheds, warehouses, canal frontage and provision

for rail connections be installed just below the city.

Estimates of Cost.—The cost of the improvements is estimated as follows:

	Taels.
Improvement of approaches:	
Survey equipment: Seagoing survey ships, instruments, etc.	200,000
Dredging equipment: Two dredges, auxiliary plant, barges, tugs, buoys, etc.	1,200,000
Incidental equipment: Small towboats and other appurtenances	125,000
Harbor work:	
Equipment for Whangpoo River regulation (for training walls, reclaiming land, etc.)	725,000
Commercial wharf and dock: 2,500 linear feet of public wharf; 3 transit sheds (120 by 500 feet); warehouse, 3-story (120 by 500 feet); open storage, 360,000 square feet; lighter and native craft accommodation, 100 by 1,800 feet; appurtenant terminal works, such as railway, roadway, paving, mechanical equipment, lighting, etc.; total cost, including interest during 3 years' construction period	4,500,000
Mail steamer wharf: 600 lin. ft. of wharf; transit shed, 50 x 250 ft.; appurtenant rail, roadways, paving, lighting, etc.; cost, with accrued interest during construction period	620,000
Purchase of 19 moorings	380,000
Total capital cost	10,750,000

The par value of the Shanghai tael is about $0.67, but the present exchange value is about $0.77.

Personnel of Committee.—The committee consisted of Maj. Gen. W. M. Black, formerly chief of engineers, U. S. A., now of Black, McKenney & Stewart, Washington, D. C.; F. Palmer, of Rendal, Palmer & Tritton of London; P. G. Hornell, Hydraulic Engineering Bureau, Stockholm, Sweden; P. Ott de Vries, until recently head of Department of Public Works, Netherlands, India; L. Perrier, chief engineer of the Corps des Ponts et Chaussees, Paris; Dr. Isamu Hiroi, member of Harbor Investigation Committee, Tokyo, Japan, and Capt. H. von Heidenstam, engineer-in-chief, Whangpoo Conservancy Board, to whom we are indebted for the foregoing information.

Emergency Revetment on River Diversion Channel

Caving of Bank Stopped by Brush Mattress Built on Berm by Unskilled Labor and Hauled Over Slope by Cables

By E. S. Blaine

Resident Engineer, Little River Drainage District, Cape Girardeau, Mo.

TEMPORARY protection of an eroded slope in anticipation of coming floods was built in haste this spring on the headwater diversion channel of the Little River Drainage District, in Missouri. The engineering works of this extensive drainage district were described in *Engineering News* of Aug. 24, 1916, p. 342, and *Engineering Record*, June 24, 1916, p. 826.

During the March flood of 1920 this channel was eroded through to the sand stratum at a number of places. The November flood of 1921 washed sand from one of these spots, undercutting and carrying away the berm to a maximum width of 30 ft., so as to leave only a few feet of berm at the middle of the section affected. Some temporary protection had to be placed here before the regular March and May flood periods. The only equipment available was a small barge and this was used to transport willows as it was too small to use for weaving a mattress.

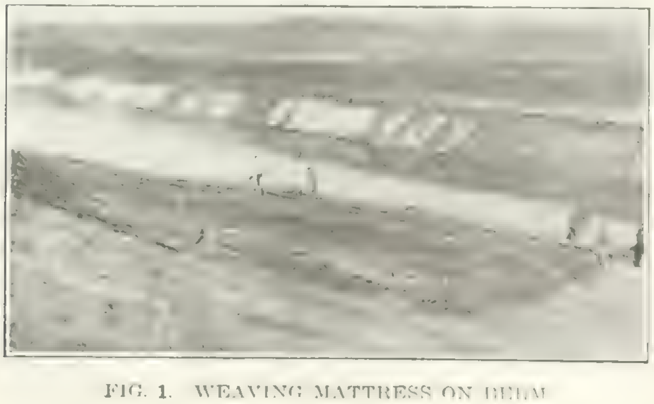


FIG. 1. WEAVING MATTRESS ON BERM

It was decided to build a mattress on the slope and pull it in as constructed, but by the time work was started the bank had caved so close to the levee in the central part of the reach that the slope could not be graded flat enough to permit men to work on it.

FIG. 2. MATTRESS IN PLACE AND WEIGHTED WITH STONE

For this reason the mattress was built on the remaining berm and levee slope, as shown in Fig. 1, and launched by two small man-power stump pullers on the opposite bank. The mattress was made up to suit the existing conditions. No labor was available with experience in weaving the basket mattress used on the Missouri River or the fascine type used on the Mississippi River.

Picks and shovels were used to grade the bank to as flat a slope as the remaining berm would permit. Deadmen were buried at 15-ft. intervals in the toe of the levee. Loops of ⅜-in. galvanized strand fastened to the deadmen were left projecting from the ground for use in anchoring the mattress. Transverse cables of ⅜-in. strand were cut long enough to go under the full width of the mattress and back over the top. These cables were laid in place opposite each deadman with half the length of the cable coiled up at the location of the lower edge of the mattress. Longitudinal cables of ⅜-in. strand were laid at 10-ft. spacing the full length of the mattress and cut long enough to lap back over the top of the mattress for its full length. The intersections of the cables were fastened temporarily by wiring.

A layer of willow brush about 5-in. thick was placed on this cable net so that each lap in the brush came over a longitudinal cable. The brush was laid at an angle of about 60-deg. to the longitudinal cables, which was as near 45-deg. as the length of the brush would permit on this cable spacing. A second layer of brush of the same thickness was laid with the angle the opposite way. The transverse and longitudinal cables were then brought over the top of the willows and the intersections of the bottom and top cables were clamped together with four-part clips.

Transverse cribbing poles were placed at 7½-ft. intervals and the mattress was tied together with No. 10 galvanized wire ties running under the bottom cables

and over the top cables. These ties were spaced at 30-in. intervals along both transverse and longitudinal cables. Longitudinal cribbing poles were then fastened to the mattress by ties of ⅜-in. strand at each cable intersection and at each intermediate transverse pole. The strand ties were twisted tight on top with heavy mattress hooks.

Hitches for launching the mattress were made at the four-part cable intersections. A two-ply length of ⅜-in. cable was fastened to the lower edge of the mattress at each cable intersection. A loop on the end of each of these launching cables was stapled to a cypress block which permitted successive hitches to be made when the edge of the mattress was under the water, as was the case until two launchings had been made, when, enough mattress was in the water to permit it to float.

After the mattress was placed in its final position, it was sunk in the usual manner by weighting with riprap unloaded from the barge. Fig. 2 shows the completed work.

This mattress patch was 375 ft. long and 50 ft. wide, containing 187 squares. About 265 cu.yd. of riprap were used to weight it. For 25 or 30 ft. at the upstream end the rock was placed nearly solid to prevent drift from catching and turning the mattress back. Almost double the actual amount of rock necessary to sink it was used because the hole was irregular and the bank entirely too steep for this type of protection, so that it was desired to have the mattress weighted down close to the surface.

The construction was done by district forces under the direction of T. G. Whitelaw, maintenance overseer. Its cost was $2,800 including the grading, or about $15 per square.

This protection has already gone through two fair-sized floods with no signs of further caving of the banks. It is intended only for temporary protection as plans are under way to provide protection of a more permanent nature.

The original design was prepared by the writer and approved by L. L. Hidinger, chief engineer.

Just Suppose

Just suppose all union labor should adopt a new way of paying their leaders, giving them an increase of salary when their men had obtained higher wages, a reduction when the wages of the men had been reduced and no salary at all when there is a strike, how many strikes would there be in ten centuries? Think of the amount of real hard work the leaders would do to get their men a raise. Think of the desperate efforts they would make to prevent a cut. But not by striking. Heaven forbid. Think of all the tricks the leaders would learn to accomplish their object, whereas now they know only one. Maybe they know more, but anyhow they *use* only one. Think how everyone would work up, and perfect and polish up his own union, so as to get a higher price for his wares. Think of all the union leaders' weeklies, monthlies and quarterlies to spread and promote scientific union management. But no, this will never happen, it is not practical. We should not expect the union leader to introduce such revolutionary methods, and if they don't, who will? The men? What have they to say about such matters? No, this will never come to pass, but—Just suppose.—*American Machinist.*

Ontario "Hydro" Replies to the Murray Charges

Denies That Government Utilities Are More Expensive Than Private—Says Charges Are Incorrect and Misleading

IN a 53-p. pamphlet the Hydro-Electric Power Commission of Ontario has replied to the so-called Murray report on electric utilities made by W. S. Murray, of Murray & Flood, consulting engineers, New York City, for the National Electric Light Association and published in March of this year (abstracted *Engineering News-Record,* March 16, 1922, p. 453). The Ontario pamphlet is entitled "Refutation of Unjust Statements Contained in a Report Published by the National Electric Light Association entitled 'Government Owned and Controlled Compared With Privately Owned and Regulated Electric Utilities in Canada and the United States Respecting the Hydro-Electric Power Commission of Ontario.'" The pamphlet is prefaced by an abstract of the conclusions of the commission written by Sir Adam Beck, chairman of the commission. There is no signature to the main report which follows. In effect, the commission's pamphlet is a denial of the main charges made by Mr. Murray and a violent fling at Mr. Murray's methods of argument. The substance of the reply may be given in the following paragraph from the pamphlet:

"In entering upon this discussion of the true character of the Murray report it is charged that, in addition to misrepresenting the achievements of the Hydro-Electric Power Commission of Ontario, Mr. Murray has made grossly incorrect and misleading statements; he has garbled documentary and other data, and then employed them as premises from which to draw conclusions; he has made pronouncements based upon comparisons so inadequate as to be puerile; he has made charges which he fails to substantiate; he has ignored important factors, even disregarding most pertinent engineering data; he has seriously miscalculated the cost of Niagara power; he has omitted to describe the confines of districts he discusses; he has not shown how summaries have been derived; he has made comparisons between unlike units; with respect to the cost of power he has shown himself painfully lacking in the application of engineering economics; and he has failed to supply data essential to the integrity of the claim of reporting in an 'exhaustive and impartial' manner. In a word, the charge of Mr. Murray has employed methods demonstrably reprehensible and unprofessional."

The separate points taken up in the pamphlet are too long to be more than abstracted here. They will be given, however, in such abstract.

It is charged that Mr. Murray purposely confuses government ownership with municipal ownership. It is contended that the Ontario system does not have the special obloquy attached in the United States to the term government ownership, which not infrequently carries as a concomitant political domination in the appointment of employees, in the purchase of supplies and equipment and in various other more or less hidden ramifications, which inevitably tends toward inefficiency and mismanagement. These destructive agencies, according to the pamphlet, are completely lacking in the functioning of the hydro-electric power system within

the province of Ontario. There is no political interference there.

It is charged that Mr. Murray misrepresents powers legally vested in the commission and misquotes the laws constituting the commission. This is important in respect to the Murray charge that no suit can be brought against "Hydro" except by fiat from the Attorney-General, "and to date no fiat has ever been granted." The pamphlet states that this is utterly without foundation and contrary to facts, that since 1912 more than twenty-five fiats have been granted to the Attorney-General to permit legal action to be brought against the commission. It is claimed, too, that the fair dealing of the commission cannot be successfully denied.

Street Lighting—The Murray report said that in Buffalo the per capita cost of street lighting is lower than it is in Toronto. According to the pamphlet, this statement disregards the fact that out of a total of 15,000 street lights in Buffalo over 8,800 were not electric, and that if this is taken account of the cost of street lighting in Toronto per capita is less than in Buffalo.

Mr. Murray is also charged with misrepresentation in his comparison between the average cost of power to the people of California and of Ontario. The criticism is made that he carefully builds up a comparison between the Niagara district of Ontario and the California hydro-electric districts so as to create in the reader's mind the idea that he is going to compare rates there and then switches over to a comparison between California and that part of Ontario "served by other than the Niagara system." These "other than the Niagara" systems are one-seventh of the total load of "Hydro," according to the pamphlet, so that they are the most expensive units in the province. The comparison made by Mr. Murray, therefore, it is claimed is not fair.

Mr. Murray contended that the principle of service at cost adopted in Ontario is not sound and according to the "Hydro" report believes that rates should be determined rather on the basis of expediency. In defense of the "Hydro" system it is stated that the municipalities of Ontario are not at all in accord with Mr. Murray's views in this respect, and are convinced that the supply of service at actual cost is the greatest safeguard which they could have against any unfair or discriminatory process in fixing rates. In determining rates at which service can be supplied to the various municipalities, the commission takes into account all factors entering into the cost of operation on definite principles, which results in each municipality paying its full and proper share, no more and no less. In answer to Mr. Murray's feeling that the application of rates based on the actual cost must result in concentration of industries in municipalities close to the source of power, the report says that the cost of power is only one of a large number of factors governing the decision of manufacturers as to their points of location. "Those familiar with the municipalities in the Province of Ontario which are partners in the co-operative municipal enterprise, know without further argument that Mr. Murray's contention is entirely fallacious, and that no such concentration of industries close to the source of power, as he fears, has resulted or is likely to result from the broad based and soundly constructed rate structure of this enterprise."

The Murray report charged that the cost of power supplied in Montreal and Buffalo by private companies is lower than the cost in Toronto as supplied by the Hydro-Electric Power Commission; to prove this point, Mr. Murray took the total revenue of the power companies in each city and divided this figure by the total number of kilowatt hours generated. This latter figure included all of the power supplied to a number of electro-chemical companies at exceedingly low rates, many of which companies have a directorate interlocking with that of the power company. The true comparison between the rates for service in the cities of Toronto, Montreal, Buffalo and Detroit, according to the "Hydro" defense, can only be made by comparing consumers' bills based on the published rates at which current is supplied in these cities. This comparison, set out in the report, is intended to demonstrate that the rates for service in Toronto are lower by an exceedingly wide margin than the rates in any of the other cities with which comparison is made.

In answer to the charge that "Hydro" pays no taxes, and that part of the necessary revenue for the operation of the system is collected through taxes of the municipalities, the report states that the commission and the hydro-electric systems in the various municipalities are subject to taxation on all lands which they occupy, and there has never been a single cent collected in the taxes of any municipality to be used in connection with the operation of any hydro-electric utility.

Nipigon and Chippawa—There is, finally, an elaborate defense of the technical features of the Nipigon development, which was classed as unnecessarily elaborate by Mr. Murray, and of the cost of the Queenston-Chippawa development, which Mr. Murray criticized as over expensive. In connection with the latter system Sir Adam Beck's summary reads as follows:

> In presenting his estimates of the cost of Niagara power with the Queenston-Chippawa development operating under various deliveries of power, Mr. Murray commences by making a number of gratuitous assumptions respecting the amounts of water which will be available, the extent to which he states existing installations will have to be scrapped, and so on, and then, he proceeds in a most astonishing manner to inflate estimates by millions of dollars. For example, in an important instance he has employed an interest rate of 8.15 per cent, thereby imposing a fictitious annual charge upon the commission's operations of over $1,600,000. In another instance he has provided over 2,000,000 annually for the renewal of plant equipment which he proposes to scrap, and which would not be renewed at all. By inflation and other devices, he has estimated a total annual production cost for power of $12,310,000 instead of what this total would be if correctly estimated under his own assumptions, namely $7,200,000. In this instance, he has overestimated the cost of power to the Niagara system by about $11 per horsepower or 75 per cent. Evidently Mr. Murray's views of engineering economics demand serious attention and revision.

Reversible Rails Approved in India

Double-head rails of the old reversible type, originally used on British main-line railways, are preferable to the more modern type of bull-head non-reversible type now generally used, according to a paper by R. Strachey, chief engineer of the East Indian Railway. Double-head rails as laid originally had the lower head resting on the cast-iron chairs and thus became indented so as to form a rough surface when inverted or reversed. With the cast-iron plate and pot ties used extensively in India, the rail is supported by its upper head resting on bearings, the lower head being free of any support.

Modified U-Type of Abutment As Used in Wyoming

Economy Obtained Over Wing-Wall Type—Length of Structure Increased at No Extra Cost Enhancing Appearance

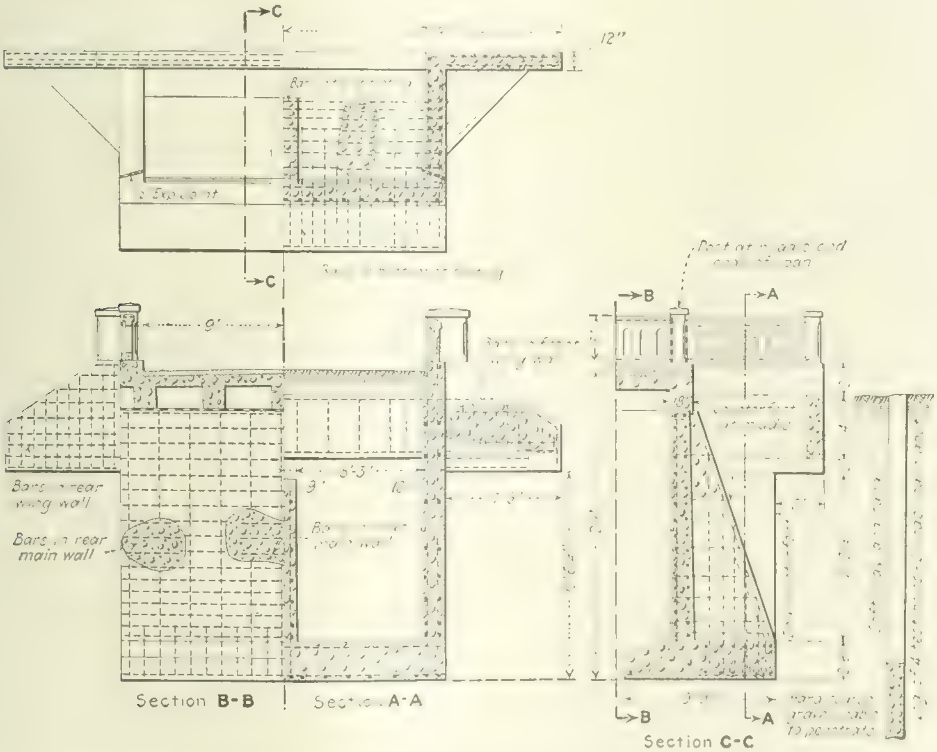
By J. F. Seiler
Engineer of Bridges, State Highway Department of Wyoming, Cheyenne

Since the beginning of its existence the State Highway Department of Wyoming has faced the vexatious problem of economically bridging the many narrow but deep streams or draws crossing her highways. The conditions usually existing are narrow waterways with steep banks on one or both sides, the soil being a loamy clay, usually with sand or gravel beds at some considerable depth below the surface. Not infrequently it is necessary to design 30 or 40-ft. spans resting on abutments 24-ft. high. Thus in the abutments of these structures a large sum of money is expended far out of proportion to the balance of the structure. The great cost of such bridges is not understood by the public.

The department recently has designed a modified U-type abutment which gives considerable economy over the old wing-wall type. In addition the new type yields other favorable results. In this design the side walls of the abutment, which also serve either as counterforts or buttresses depending on the position of the resultant pressure, may be carried back as far as necessary to take care of the slopes of the approach fill. A tie beam is furnished to take up the lateral pressures between these side walls, and is located at their rear in line with the wing walls, which extend out at right angles to the center line of the roadway. These wing walls may also be carried out as necessary to take care of the slopes of the roadway fill. Between the side walls and wing walls in the exterior quadrant are furnished one or more horizontal buttresses which transmit and to some extent equalize the pressures on the opposite faces of these walls.

The footings of large abutments may be greatly decreased by extending the side walls beyond the limits of the footing, thus producing, by means of their weight and that of the wing walls and tie-beam together with the frictional resistance of the earth resting against them, a very large righting movement. One or more counterforts located between the side walls reduce the stresses in the front wall set up by the horizontal beam action, while the side walls nearly approach the condition of a slab supported on three sides. The tie beam acts as a fixed beam supporting such loads as may come upon it.

BRIDGE WITH U-TYPE ABUTMENTS OVER BIG MUDDY CREEK NEAR CASPER, WYO.



CONCRETE ABUTMENT FOR [illegible] FT. SPAN BRIDGE OVER BIG MUDDY CREEK

In order to simplify calculations and at the same time design very conservatively, the highway department uses the equivalent fluid pressure method, using 27.5 lb. as the weight of the fluid for calculating the horizontal forces. Ordinarily this gives about 0.5 as the ratio between width of base and height of abutment. While this approximate ratio has thus far been adhered to even in this type of abutment, the department expects to make very considerable reductions in this ratio and take full advantage of every economy to be had in this type.

The department has recently constructed one of this type of abutment at a point on the Yellowstone Highway about 15 miles east of Casper. While no explanations are needed in connection with the view of this bridge, it is interesting to note at least one important feature which appeals to the engineer from a psychological standpoint, and that is the additional length of structure secured at no extra cost. The view shows a clear opening or waterway of 30 ft. whereas the total length of the structure lacks only 6 in. of being 50 ft. long.

For shorter openings, the length of the structure may become even more than double the length of the clear

span. With a gravel or selected material wearing surface similar to that on the roadway, placed on the slab or bridge proper, to all intents and purposes traffic is "on the bridge" as soon as it reaches the wing walls or rear ends of the side walls. This fact helps to overcome the unsightliness of short deep structures. A concrete hand rail extends the entire length of the side walls, which are in line with the curbs of the slab.

The ease of construction of this type of abutment is also to be noted. Cofferdams or sheetpiles are driven around the neat line of the footing only. The sidewalls should extend up to the point above water line before cantilevering back, thus effecting much economy in the cost of wet excavation. Horizontal buttresses are poured with the walls, an opening being left on top at a point farthest away from the walls to facilitate puddling or spading.

If any danger of scour exists which might get in back of the footing and carry out the roadway fill, sufficient rip-rap should be provided and placed in the exterior quadrants to prevent such an occurrence.

Swiss Technical Notes

The Post-War Financial Status of a Neutral Nation —Zurich's Municipal Participation in Winter Reserve Power Development

IN CONNECTION with the brief note in *Engineering News-Record*, Dec. 15, p. 999, concerning the budget of the United States of America, some comparison figures taken from the 1922 budget of the small country of Switzerland (population 3,900,000 on an area of 16,000 sq.mi.) may be of interest. The figures are well adapted to bring out how the after effects of the World War bear heavily even on a neutral country. Most markedly these effects appear in a sharp economic depression, affecting nearly all fields of industry.

The figures given below refer only to the regular governmental expenditures. They do not include the direct cost of mobilization during the war, whose separate balance sheet shows expenditures of about 1,200,000,000 francs, nor the corresponding profit-and-loss figures of the Swiss Federal Railways, which also are carried on separate books. The cost of mobilization, by the way, already has been covered to the extent of 50 per cent by war and profit taxes, but the balance of 600,000,000 francs is yet to be raised by future war taxes.

As the distribution of expenditures between the different branches of the government is of chief interest, the following tabulation of receipts and expenditures lists the several departments separately:

Receipts	Million Francs	Expenditure	Million Francs
I. Capital income	22.8	Interest and sinking fund	113.[illegible]
II. General administration, federal council, federal court, and federal insurance court	0.3		3.7
III. Departments			
A. State	2.4		[illegible] 6
B. Interior	1.3		26.7
C. Justice and Police	2.[illegible]		6.7
D. War	2.0		81.6
E. Finance and Tax....	170.3	....	25.0
F. Public Welfare	4.0	....	36.2
G. Post and Railway	210.9	....	225.1
IV. Miscellaneous	[illegible].7		[illegible]
Total	422.2		[illegible]

Budget Deficit—A prospective deficit of 106.4 million francs appears, which is to be brought down to 100 millions through reduction of the bonus or cost-of-living allowances of government employees. It will be seen that the cost of the War Department is relatively very high; this includes the division of federal topography.

The Federal Technical College and Testing Laboratory are under the Department of the Interior. The year's expenditures for these two institutions (exclusive of the cost of extensive new buildings just being completed) amount to about three millions, against which there are receipts from fees and the like of about 900,000.

As already remarked, the formidable deficit of the budget gives an indication of how Switzerland also is in the grip of the general heavy industrial crisis. The principal cause of this crisis is the depreciation in exchange of the other states of the European continent, and the closely related stagnation of trade and industry. A prominent effect is that industrial unemployment has reached appalling magnitude, particularly in the fields of construction, wood-working, metals, textiles, and clock-making.

Unemployment—On Dec. 31, 1921, the whole of Switzerland had 142,937 unemployed (88,967 totally without employment, 53,870 only partly employed), against 137,561 on Nov. 30. The industrial canton of Zürich (population 536,000), which had 1,817 wholly unemployed persons in December, 1920, had no less than 7,322 unemployed on Dec. 31, 1921.

As emergency work for unemployment relief, building to the value of 42 million francs is to be carried out in Zürich, with financial assistance from communities, the canton—the latter alone is providing for this purpose a credit of 10,000,000 under the heading of employment and housing relief—and the federal government. This corresponds to about 1,200,000 days of labor, and thus would furnish a year's employment to about 75 per cent of the unemployed of the canton. Further, courses for the unemployed in trade and agricultural training were instituted.

In a specially gratifying manner the voters of the city of Zürich at the close of last year gave approval to the proposal of the city authorities for municipal participation in the Wäggital Power Co., or the "Aktiengesellschaft Kraftwerk Wäggital." This participation is in the amount of 20,000,000 francs, representing one-half the initial capital of the company. The support of this undertaking is likely to assist greatly in the relief of unemployment. Some data on the proposed plant are given below, taken from an interesting informative statement of the city authorities to the voters.

Stored Power for Winter Supply—For twenty-seven years past the project of the Wäggital development has been under discussion. The original plan, proposed by private parties, contemplated single-stage development with a storage reservoir of 18,600 acre-ft. The present plan is for a two-stage high-head development with a reservoir of 114,000 acre-ft. capacity, and the plant is to serve exclusively as a winter reserve. The reservoir, which at spillway level will have a surface area of about 1.6 sq.mi., will be large enough to impound the total precipitation even of a wet year and hold it for use at the time of maximum energy demand. The mean annual inflow to the reservoir amounts to only 87,000 acre-ft. Provision has been made to pump up 27,000 acre-ft. from the intermediate storage reservoir at Rempen, which lies about 795 ft. lower. The power required for this pumping, summer-

night power, will be surplus output of the low-pressure plants of the company, the "Nordostschweizerische Kraftwerke und Elektrizitätswerke der Stadt Zürich."

The plant will have an upper stage of 852 ft. gross and a lower stage of 637 ft. gross. With an annual consumption of 106,000 acre-ft. of water drawn from the reservoir, it will develop a total energy of 111.5 million kw.-hr. This total power is to be concentrated in the winter months, that is to say in the time of the maximum demand for energy and the greatest shortage in the low-head plants of the company. The plant capacity will be 140,000 hp., enabling it to develop the output stated within a period of 1,200 hr., chiefly in the months of November to March. The maximum fluctuation of water level in the reservoir under these conditions will be 148 ft.

The dam which will form the storage reservoir is to be a concrete gravity dam of 318 ft. maximum height (220 ft. height above valley bottom) and a volume of 280,000 cu.yd. Four years will be required for its construction, so the plant is likely to start operating in October, 1925. The contract for the dam construction was recently let to the two well-known Zürich concerns of A. Hatt-Haller and Ed. Züblin & Co., for 11,000,000 francs.

Municipal Supply and Consumption—Full development of the plant, including the pumping station, is expected to cost about 94,000,000 francs. While this might appear to mean a rather high price of current per kilowatt-hour, it is to be remembered that the power in question is high-value winter power. Further, the plant will bring about an improvement in the flow of the streams dependent upon it.

The Wäggital plant is only about 24½ miles distant from the city of Zürich. By its financial participation in the development, the city secures control of one-half of the total of 111½ million kw.-hr. production. How valuable this new winter source of supply will be to the municipal electrical supply of the city may be gathered from the fact that during the winter of 1920-21, for example, the city consumed between Oct. 1 and April 30 a total of 72 million kw.-hr., of which 51.5 million was furnished by municipal supplies while 20.5 million came from outside supplies. Growth of power demand, and heating demand especially, makes it necessary for the city to count on an annual increase of at least 2 million kw.-hr., so that in the winter of 1935-6 the city would depend on outside supply to the extent of 55 million kw.-hr., which will now be covered by the city's share in the Wäggital plant. The total electrical supply resources of the municipality then (1935) will be, counting the Wäggital plant and the existing Albula and Heidsee plants, 55+40+10 or 105 million kw.-hr. winter and peak energy.

By granting the necessary credit the city has given the best evidence of its efforts to maintain and increase the independence of the community in supplying its energy needs. The great efforts on the part of the city in the fields of gas, water, and electrical supply are brought out by the following table:

ZÜRICH MUNICIPAL PLANT [illegible] 1920

Plant	[illegible]	[illegible] Written off	Book Value
Gas works	[illegible]	[illegible]	10.6
Water-works	[illegible]	[illegible]	[illegible]
Electric supply system	[illegible]	[illegible]	40.0
Total	[illegible]	50.5	[illegible]

Construction of the Wäggital power plant by the joint enterprise of the city of Zürich and the "Nordostschweizerische Kraftwerke," one of the largest public utilities of Switzerland, is to be welcomed also for the reason that by its means the city's electrical supply is withdrawn from purely private interests and placed in the hands of the public itself.

New Railway Bridge Loading Under Discussion

Bridge Stresses Under Actual Traffic—Adequacy of Cooper Loading—New Composite Loading Proposed in Three Forms

IN AN elaborate study of bridge stresses under modern railway traffic, presented before the American Society of Civil Engineers at a meeting in New York on Sept. 6, D. B. Steinman advanced the conclusion that the Cooper system of loading is no longer adequate for safe and economical design, and proposed in its place a new conventional loading based upon the effect of the heaviest modern locomotives. Active discussion of the paper by the meeting indicated a remarkably general approval of both these points.

Dr. Steinman's paper, for whose details reference is made to the May issue of the *Proceedings* of the society, investigated the relation of the Cooper conventional loading system, developed in 1894, to present-day traffic weights by means of actual stress calculations under maximum freight trains. The results of the calculations were expressed in terms of the equivalent uniform load which would produce the same stress in a particular bridge member as the actual locomotive and train load. Seven of the heaviest locomotives in actual use in the United States were taken for comparison with the Cooper locomotives. By comparing their equivalent uniform loads it was shown that a bridge designed to Cooper's loading will be seriously deficient in certain members or else needlessly strong in others, by amounts of 15 to 35 per cent or more, so that logical designing is possible only when different Cooper loadings are applied to different parts of a bridge and to bridges of different span lengths. A new form of loading which would not have this defect was developed by the following process: The equivalent uniform loads corresponding to the seven different actual locomotives for various members of bridge trusses of various spans being compared, the heaviest figure for each point of comparison was selected, and the resulting maxima were compiled in a chart of equivalent uniform loads, similar in arrangement to a diagram published by the author in *Engineering News* of April 22, 1915, p. 780. An engine wheel arrangement of the Mallet type was then devised, with two groups of five driving axles, to give very closely the same stress effects as the composite maximum of the seven. This engine has 60,000-lb. axle loads in the forward group and 75,000-lb. axles in the second group. In combination with a train load of 6,000 lb. per lineal foot of track, this was called *M 60 loading*.

Two simplified modifications of this loading were also devised. One of these is a constant uniform load of 6,000 lb. per lineal foot with three concentrations of 90,000 lb. at 12- and 48-ft. spacing. The other is a formula for the equivalent uniform live-load for any bridge member so located that l_1 is the length of the

shorter segment of the influence triangle of that member, and l_2 the length of the longer segment. The formula is

$$q = 5{,}000 + 60{,}000 \frac{l}{l + l}$$

In view of the closely identical results of the three alternative loadings (M 60 engine; uniform load with concentrations; formula) Mr. Steinman proposed them for adoption according to the preferences of bridge engineers, indicating, however, that the third or formula method was preferable in his own opinion.

Widespread approval was given the author's proposals in the discussion, although there was also some dissent. Brief notes on some of the comments follow, the favorable views being given first:

Favorable Opinion

R. C. Strachan: The author's first method is preferable, and is an advance over the present loading. The second and third are useful as short cuts in design.

V. H. Cochrane: The proposal to use a formula is valuable and worth adoption. It is the best of the three methods despite the absence of a graphic picture such as is given by the M engine. A modification of the formula will make it fit the stress composite of the seven actual engines more accurately.

B. A. Worthington: A change from the Cooper loading is called for, to avoid waste of material in bridges. The M60 engine is the most desirable of the proposed loadings.

G. H. Gilbert: Cooper's E60 does not provide properly for modern traffic; it is heavy enough for trusses (over 100 ft.), but the floors need 15 to 20 per cent more. The A.R.E.A. has defended the Cooper system, but the argument is not satisfactory. The author's proposed loading is too heavy, but this should not conceal the inadequacy of the Cooper loading.

J. A. L. Waddell: The author has shown that the Cooper system should be abandoned. The proposed system is as good as can be evolved for design. The formula is far the best of the three methods; the engine should be used only as a picture of the loading.

G. Lindenthal: The proposed engine is preferable to the other two proposals. The subject is not as vexing as usually assumed, however. Meticulous accuracy is out of place in fixing a loading standard. Impact affects the question; it seems probable that heavy freight locomotives with their slow-speed impact produce less severe effects on bridges than lighter passenger locomotives with the impact due to high speed.

R. A. Caughey: The first method proposed is best; designers would probably not care to use a bridge loading so intangible as that expressed by a formula. On branch lines the train load rather than the engine controls the stresses.

J. C. Bland: Traffic changes became important with respect to bridge stresses when loads passed E40, Cooper's upper limit, and the E loading is inapplicable beyond this limit. Using different Cooper loadings for different parts of a bridge is not desirable. The abandonment of Cooper's loading for design beyond E40 and the early adoption of one of the author's proposals is desirable. The third one is preferred. The Cooper system should be retained for expressing the capacity of existing bridges, in which field it has been of incalculable service. For design, each railroad should consider its group of engines, form a composite and choose its M loading to correspond.

E. A. Stone: The reasons advanced for classifying the Cooper system as a relic of the past are beyond dispute. The author's first method is attractive, and with diagrams it becomes as simple as any.

H. C. Bird: The plan of specifying either E or M loading is attractive.

A. H. Fuller: The first method is preferable. A formula is not desirable for use unless it can be shown to be adaptable to rapidly changing future conditions.

C. T. Bishop: The loading formula is commendable. A committee should investigate the subject to make sure that the formula is the best obtainable.

Clyde MacCornack: Wheel concentrations should be used for floors and short spans without floors, and uniform loads for all other members. A formula may do for this purpose.

C. P. Disney: All three methods proposed have an advantage over the present method; the third seems the ideal one. For Canada, however, the limiting loadings can be taken care of by the Cooper system, and this is likely to remain true for many years.

H. B. Seaman: The Society's committee on bridge specifications found in the paper what it had hoped for, but finally decided on a double specification, E10 and M10. Probably the M system can be used for all designing beyond E50. Its introduction as quickly as possible is desirable.

C. A. Mead: The author's second method is specially attractive. A change in loading is greatly needed. Probably train loads now are at a maximum, while engine loadings are not.

H. C. Keith: Study of the effects of different engines on the bridges of the New York & New England Ry. long ago led to adoption of a uniform load of 4,000 lb. per ft. with 25 ft. of 3,000-lb. excess. Under modern conditions the author's loadings are worthy of serious consideration. But the fact that branch lines may get heavy trains with light locomotives must be considered.

Dissenting Opinion

C. D. Purdon: Not all classes of locomotives run over every railway, but all kinds of cars do, so that the fairness of specifying a maximum composite engine loading is doubtful. The typical engine proposed does not resemble an engine but is merely a load per foot, and the composite loading might be used as well. The M engine on 0.5 per cent grades would haul more cars than could be handled. The difference between the Cooper and the M loadings is partly one of unit stresses; the latter is practically the same as E60 increased by 25 per cent.

Albert Lucius: The present tendency is toward increased number of drivers rather than toward increased axle loads. It is preferable to specify the maximum local axle loads and spacing, the heaviest typical locomotive diagram, and the maximum train load.

J. M. Johnson: For large mileages in the South, Southwest, and parts of the West, conditions will for a long time limit engine weights. The author's loading proposals are in the right direction, but their application to the entire country is too radical, as there is a large mileage for which Cooper's loading will be satisfactory for a long time.

C. S. G. Rogers: If all the various locomotives used in the composite were used on any one railway the proposed M loading would fit the requirements admirably. As this is not the case, waste will not be avoided by the M60 system but a special loading needs to be developed by each railway for its needs.

O. H. Ammann: The author's data do not prove that the Cooper system is less representative than the proposed one for present traffic, not to mention steam and electric locomotives to be designed in the future. A standard loading may be based on the average service rather than the maximum, leaving the stress peaks to be taken care of by the margin in unit stress and the margin for future increase. A design prepared for the same loading under two different specifications showed greater differences in members than the author's comparisons of maximum engines with Cooper's. In view of the differences in stress effect of the actual engines studied by the author, can any standard give uniformly satisfactory results? Many of the discrepancies found between Cooper's and the actual trains disappear if an equitable combination of engine and train is taken, as 6,000-lb. train load with an E72 engine; the curve for this combination in fact follows the author's

composite curve more smoothly than does the M60 engine. Moreover, if engine and train weights increase at different rates, the M system will soon be as inconsistent as the Cooper.

C. E. Fowler: The Cooper system should be dropped, but in developing a new loading it is desirable to get together with the American Railway Engineering Association and the Engineering Institute of Canada. Some things that need to be done first are standardization of locomotives and reduction of counterbalance impact. A series of engine classes may be formulated after this is done, and future change of loading types and tables avoided. The lower impact of freight locomotives should receive consideration.

C. F. Loweth: Simplification of railway bridge loadings is desirable, but it is not obvious how far this can go at present. Past experience in growth of traffic weights and current increase in rail weights and solidity of track construction suggest the possibility of further increase of loads, but on the other hand a reaction may come, and present loadings may prove to remain the maximum. Electric locomotives will come in as a factor. Standardization of locomotives does not appear to be near at hand, and cannot be carried out at present. To get uniform results in bridge design it is necessary to do more than select typical locomotives; the maximum passenger and freight engines should be considered separately, running at their respective maximum speeds.

New Water Meter Rates for Detroit

INCREASED overhead operating and maintenance charges in Detroit due to the installation of filters which will go into operation early in 1923 and other recent improvements have made it necessary to revise the meter rates. Detroit is 99 per cent metered. The proposed rate is based on a service charge and a charge for water used. For a ⅝-in. meter the service charge will be $2 per year and for a 4-in. meter, $36. The use charge is 50c. per 1,000 cu.ft. for the first 100,000 cu.ft. and thereafter at the rate of 35c. per 1,000 cu.ft. A householder with a ⅝-in. meter using 1,000 cu.ft. or less per quarter will pay $4 per year, as at present.

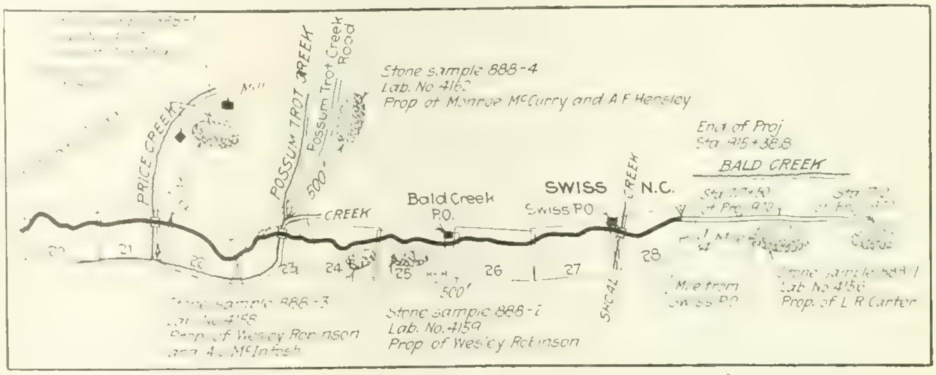
In determining the amount to be raised George H. Fenkell, general manager, Department of Water Supply, in an extended report to the Board of Water Commissioners analyzed the elements on which to base the rate.

The service charge was made to cover a part of the interest on capital invested, some return for the loss of water through the 5 per cent meter slippage and to prevent customers using too large meters.

To obtain a rate for the output charge the consumption of 6,877 meters was studied. Of these meters 15 per cent passed less than 1,000 cu.ft. per quarter, or 695 cu.ft., and 83 per cent between 1,000 and 100,000 cu.ft., averaging 18,827 cu.ft. In order not to make the charge less than the present $4 charge for the smaller meters, the use charge was set at 50c. per quarter for those using less than 1,000 gal. At 50c. per 1,000 cu.ft. the average amount of water used through the meters between 1,000 and 100,000 cu.ft. and the balance at 35c. gave the desired income.

Materials Survey Maps Aid North Carolina Road Contractors

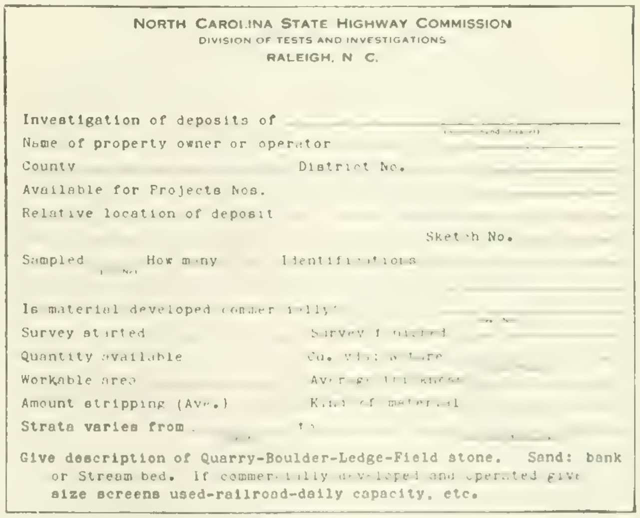
SOURCES of materials suitable for road construction are indicated by the Department of Tests and Investigations in a "report" which accompanies the plans for every highway improvement project in North Carolina. As each project is developed for improvement, a materials survey is made. All local materials deposits are searched out; their location and extent are roughly determined, and representative samples are sent to the headquarters testing laboratory at Raleigh for



PORTION OF MATERIALS SURVEY MAP SHOWING DATA FURNISHED

determination. When the tests have been made a map of the improvement is prepared on which are recorded the acceptable deposits and other useful information as indicated by the portion of the map for Project 888 which is illustrated herewith. This map is bound into a folder which also contains a typed list of the deposits and another typed list of commercial materials plants within the State.

The department does not guarantee the quantity or the continued quality of the deposits located but lays all its data open to the contractor for such use as he may or may not decide to make of it. With a map, which accompanies all plans for a project, showing adjacent railways and stations, the materials survey map gives the contractor a fairly complete notion of the supply and transportation conditions which he has to consider in preparing bids and plans for the job.



NORTH CAROLINA STATE HIGHWAY COMMISSION
DIVISION OF TESTS AND INVESTIGATIONS
RALEIGH, N. C.

Investigation of deposits of
Name of property owner or operator
County District No.
Available for Projects Nos.
Relative location of deposit
Sketch No.
Sampled How many Identifications
Is material developed commercially?
Survey started Survey finished
Quantity available
Workable area Average thickness
Amount stripping (Ave.) Kind of material
Strata varies from to
Give description of Quarry-Boulder-Ledge-Field stone. Sand: bank or Stream bed. If commercially developed and operated give size screens used-railroad-daily capacity, etc.

SURVEY PARTY REPORT BLANK

Letters to the Editor

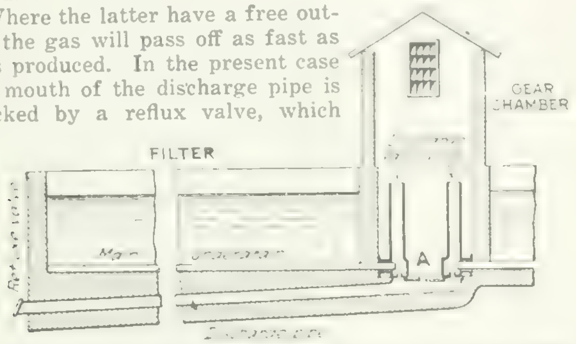
This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Sewage Filter Gas a Danger

Sir—One day last week an assistant of mine who was examining the alternating gear of a contact bed installation was attacked, and rendered nearly unconscious, by gas. The sewage-works manager stated that he had had similar experiences.

As to the origin of the gas there is of course no mystery. A sewage filter in the course of a day oxidizes a considerable amount of carbon, forming a corresponding volume of carbonic acid gas; and the latter, being heavier than air, sinks to the bottom of the filter and flows off through the underdrains.

Where the latter have a free outlet, the gas will pass off as fast as it is produced. In the present case the mouth of the discharge pipe is blocked by a reflux valve, which



UNDERDRAIN CONNECTION WITH GEAR CHAMBER

protects the filters from flooding during a high state of the brook which receives the effluent, the arrangement being as shown in diagram herewith; and the gas, being thus deprived of a free outlet, makes its way back into the chamber through the opening "A" provided for the drainage of the latter.

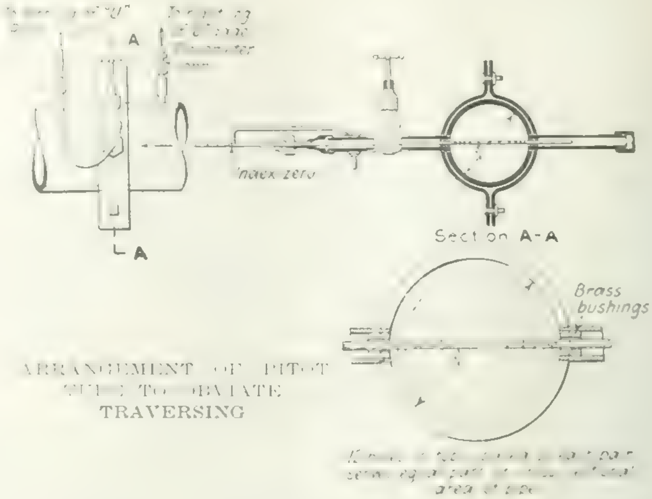
The same thing would happen in the case of a trickling filter having its underdrains converging in a manhole or inspection chamber the outlet from which is for any reason trapped. The gas which accumulates in such chambers may easily become a source of danger to men who have occasion to work in them. ARTHUR J. MARTIN.

London, England.
Aug. 15, 1922.

Pitot Tube to Obviate Traversing

Sir—A modification of the Pitot tube which eliminates the necessity of traversing the section to get a mean velocity by providing a dozen holes lengthwise in the tube with its end plugged was experimented with from May 1 to 15, 1922, by students at the Brooklyn Polytechnic Institute under the direction of Prof. H. P. Hammond. No reference could be found of the previous use of such a tube. I am submitting this in the hope that it may attract the attention of men who will carry the investigation further.

A ½-in. extra heavy tube plugged at one end was used for the Pitot. The tube was tested on a 4-in. pipe. On a scratch line 4 in. long drawn on the Pitot tube (extended across the center of the pipe as shown in sketch) 12 $\frac{1}{16}$-in. holes were so spaced that each served an equal cross-sectional area of the 4-in. pipe. That is, the two inner holes served the small inner circular area and each of the other five pairs of holes served a concentric ring. The end of the Pitot was connected to one leg of a U-gage and a piezometer connection three-fourths of a diameter upstream was made to the other leg of the gage. Pressure head



ARRANGEMENT OF PITOT TUBE TO OBVIATE TRAVERSING

was disposed of in this way and a direct velocity reading could be made on the gage.

To form a basis of opinion the velocity as found by the gage reading was compared with the actual velocity determined by measuring the discharge in a period of time and dividing it by the area of the section.

The tube was tested against a 19-ft. pressure head to suppress any velocity variation due to irregular pumping. The velocity ranged from 1.25 to 11.06 ft. per sec. at intervals of approximately 1 ft., the limit of error being −1.9 to +0.9 per cent. The tests were made at a 180° bend where the velocity distribution would be most irregular and at the end of a straight stretch where the distribution would be normal.

The gage fluid used had a specific gravity of 1.59 and it was found that at velocities less than 2 ft. per sec. the viscosity of the liquid affected the readings so that the limit of error for most of the work was well within ±1 per cent. This small limit of error would lead one to believe that, if this type of tube behaves in the same way for large and small pipes, a new way has been found to rate pumps and make similar water measurements. Until near the completion of the test, the inner circular area was served from a single hole in the tube. The limit of error was then 5 to 10 per cent. George W. Gebhardt, my colleague on the thesis for which the tests were made, suggested two holes to serve the central area, as already described, with the result already stated. WILLIS C. HANNING.

Brooklyn, N. Y.

Foundation Pressures in Multiple Arch Dams

Sir—My attention has only recently been called to the discussion of pressures on foundations which first appeared in your issue of April 13, and which has been answered by Mr. Noetzli and others.

Mr. Noetzli, however, admits that his formula is of no more use than the other, $f = P/A \pm MZ/I$, when the neutral axis falls inside the heel of the foundation. An exact analytical solution of the problem is possible, but the formula deduced will probably be so cumbersome as to make its use impracticable.

However, the problem can be solved by graphics in a very easy manner, as follows:

Divide the area into a convenient number of strips and compute the area of each strip.

Lay off the areas on the load line *o*—23.

Draw the equilibrium polygon *ABC*, and produce the line *AZ* corresponding to string *O-o*.

Drop a perpendicular through *P* to intersect the line *AZF* at *Z*.

From *Z* draw by inspection a line *ZBC* in such a manner as to make the shaded areas *AZB* and *BDC* equal to each other.

Drop a perpendicular from *E* to *C*.

Then the line *EC* is the neutral axis required.

Proof:

The stress varying directly as its distance from the neu-

tral axis.

$$f_x = Kx \qquad (1)$$

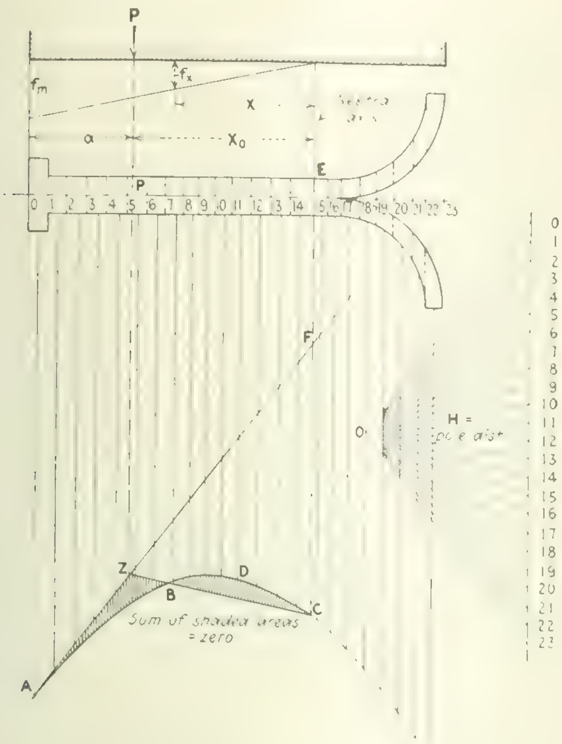
where K is a constant.
Summation of vertical forces = 0.

$$\int f dA = P \qquad (2)$$

Summation of moments around neutral axis = 0

$$\int f x dA = P x_0 \qquad (3)$$

Eliminating f and dividing three by two



$$\frac{K\int x^2 dA}{K\int x dA} = \frac{P x_0}{P}$$

whence $$x_0 = \frac{I}{S} \qquad (4)$$

where I and S are the moment of inertia and the static moment, respectively of the area to the left of the neutral axis around the same axis.

By a well known principle of graphics the ordinate CF (Fig. I) multiplied by the pole distance H gives the static moment of the area to left of CF. Also the area $ABDCF$ multiplied by ZH = the moment of inertia of the same area about the neutral axis.

By making the area AZB = area BDC the area enclosed in the triangle ZFC = *area* $AFCDB$.

$$\text{Area } ZFC \times 2H = I; \; FC \times H = S$$

$$\text{Area } ZFC = FC \cdot \frac{x_0}{2} = \frac{S}{H} \cdot \frac{x_0}{2}$$

$$\frac{Sx_0}{2H} \cdot 2H = I \qquad x_0 = \frac{I}{S} \text{ as required by four}$$

To find the stress at any point

From Eq. 2 $P = \int f dA = K\int x dA = KS$

$$\therefore K = \frac{P}{S}$$

$$f_x = Kx = \frac{P}{S}x \text{ and } f_m = \frac{P}{S}(x_0 - a)$$

So much for a foundation that is symmetrical about its longitudinal axis. But suppose that it were not symmetrical. What then? This problem can also be solved by graphics in a manner almost as simple as the present, but the limits of this letter will not allow the demonstration here.

Brooklyn, N. Y., July 24. EDWARD TAYLOR.

In Defense of the Seattle A. A. E. Chapter

Sir—In *Engineering News-Record,* June 1, p. 893, there was an editorial entitled "Poor Professional Tactics" which evidently refers to one of the activities of this chapter. We heartily agree that it would be "poor professional tactics" for any engineering organization to have done what you have accused us of doing in this editorial. But in justice to our association and the individual members who compose it, we wish, in protest against the unmerited accusations, to deny absolutely ever having made at any time, and particularly in the instance cited by you, any charge of overpayment of engineering employees. Furthermore, we fail to see wherein a fair and just criticism of the administration of any project necessarily implies professional jealousy, and there was no such motive existing or expressed in our report—both members and non-members of our organization being involved in our criticism.

The editorial accuses us of charging gross overpayment of the men. Nowhere have we made any such charges. Under subject 3 of our original report, dealing with salaries, the findings of the committee explicitly state "that the men selected are capable men and are entitled to the salaries paid for their professional services. There is, however, a considerable difference between the salaries paid upon this city undertaking and the salaries paid for similar classification on other city work. . . . We believe that the city should be consistent in its treatment of its various employees and pay adequate salaries to all regardless of what project they may be engaged upon."

As to citing a \$5,000 construction engineer as an example, the summary of the charges reads "The chief engineer, who draws a salary of \$7,500 per year, has employed a construction engineer at \$5,000 per year, when he himself is commonly supposed to be on the job in charge of construction and operating under the city engineer." There is nothing whatever in this statement that criticizes the salary of anyone; but there is a criticism of the employment of a second construction engineer at \$5,000 (or any other salary) when there is already one on the job, and the last sentence in the above quotation explicitly states this. The so-called chief engineer was employed by the city as engineer in charge of construction at \$7,500 per year, and under these conditions we do intimate that another construction engineer is a superfluity regardless of salary. We believe that in all fairness you should have so stated.

The American Association of Engineers is committed to a policy of active participation in civic affairs, and in the pursuance of such activity it is bound to receive opposition and criticism. We shall endeavor to profit by it, especially when it is just and friendly; but in no event will it deter us from pursuing the course laid out for attaining our aims and objects, which we deem most worthy. We wish to cooperate with all who are in sympathy with us in the effort to improve conditions not only for the engineering profession, but for the public generally.

Seattle Chapter American Association of Engineers,
GARRISON BABCOCK, President.
Seattle, Wash., Aug. 17.

[The statement of the motives of the Seattle Chapter is accepted without question but the impression made by the report itself remains. It is hard to see how anyone outside the engineering profession reading the report could fail to believe that the engineers making the report felt that the city's regular engineers, working at less than the \$7,500 and \$5,000 salaries paid the special engineers, could do the latter's work in addition to their own. While the report may have been intended to impress on the public consciousness that the regular city engineers should be paid more—certainly as much as the special engineers—it really leaves an impression of hopelessness of any such good fortune. Editor.]

NEWS OF THE WEEK

New York, September 14, 1922

Federation Executive Board Meets at Boston

Opposes 12-Hour Shift in Industry—To Study Muscle Shoals Projects—Acts on 1926 Exposition

At its Boston meeting held last week, the executive board of the council of the Federated American Engineering Societies approved the report of its committee on work periods which finds in effect that the two-shift day of 12 hours each is not an economic necessity in American industry. The committee holds that the tendency throughout the world is toward the abolition of the 12-hour shift, that plants operating on an 8-hour shift basis are competing with 12-hour shift plants, and that in practically every major continuous industry plants which have changed from 8- to 12-hour shifts have increased the quantity of production per man to as much as 25 per cent. The steel and iron industry was made the subject of a special report, in which it was found that the "change from the 12- to the 8-hour day has secured results sufficient to compensate in whole or in part for the extra cost." Other advantages to be achieved by the change are better morale, elimination of the "floating gang" which is maintained to give 12-hour men a day off each week, and greater prestige of the industry with the public. The investigation has been carried on over a period of nearly two years assisted by the Cabot Fund.

To Study Muscle Shoals

The board authorized the appointment of a committee of engineers to study the Muscle Shoals problem and to submit to the committee on procedure and subsequently to the executive board an outline for an investigation which shall analyze the entire problem and lay its elements before the public for its information and guidance. It is planned to have this committee consist of disinterested and competent engineers who will serve without compensation. It is hoped that the result of the study will help to settle the controversy.

The executive board adopted also the report of the committee on reforestation, which approved plans to co-operate with other bodies that have the subject in hand; approved the universal contract form for building construction devised by the Department of Commerce, and appointed a committee to draft a bill that would incorporate the recommendations of American Engineering Council's committee on licensing of engineers. (See *Engineering News-Record* of June 15, 1922, p. 993.)

It was decided also that the federation would co-operate in the engineering program of the Sesqui-Centennial Exposition to be held in Philadelphia in 1926. It will undertake the presentation of a program dealing with the non-material and non-technical aspects of engineering practice and leave to the national engineering societies the technical subjects that may be considered.

The board adjourned to meet in Washington on Jan. 4, 1923, at which time the American Engineering Council will hold its annual meeting.

Los Angeles at Last Approves $12,000,000 Sewer Loan

A four-to-one majority approving the proposed $12,000,000 bond issue for building a new trunk sewer to the ocean was the result of the election in Los Angeles August 29. A favorable vote had been encouraged by sewer overflows in various parts of the city and active campaigning by city officials and interested citizens. A two-thirds majority was necessary to carry the issue. Votes were cast by about 60 per cent of the registered voters.

The new measure authorizes the city to "acquire and construct outfall sewers, main sewers, disposal plants, and treatment plants for the collection disposal and purification of sewage, together with the necessary machinery, apparatus and other property." Comment on the sewer situation and plans for relief appeared in *Engineering News-Record* April 13, p. 618; May 11, p. 806; May 18, p. 843.

Only about one-tenth the amount authorized by the bond issue is to be spent within the next year, it is stated. About $500,000 will be used to complete the temporary sewer to Culver City and the construction there of a treatment plant to clarify sewage before turning it into Ballona Creek. This work is to be rushed so as to have it completed before the winter rains would threaten the sewers that are already taxed to capacity. The temporary disposal plant at Culver City is to handle the excess flow of the present system for the next three years while the new outfall, screening and treatment plants are being built.

To Take Bids on New Water Supply for City of Memphis

Plans and specifications for contract No. 6 of the new well water supply for Memphis have been practically completed, according to a report from Fuller & McClintock, 170 Broadway, New York, and Produce Exchange Building, Kansas City, designing and supervising engineers for the project. This work comprises all the main grading at the Northern Parkway site, sewers, drains, concrete substructures of pump station and boiler house, and of the 18 m.g.d. iron-removal plant, together with the 10 m.g. covered concrete reservoir. It is expected that bids will be received on this work by the Artesian Water Department of Memphis about Oct. 9.

Brick and Lumber Industries Feel Effect of Strikes

In reply to a request by *Engineering News-Record* for information as to the present and probable effect of the coal and railroad strikes on the common brick industry the Common Brick Manufacturers Association of America has submitted the following:

"As a whole, the common-brick making industry of the United States, although it has been considerably retarded, has not up to this time been seriously affected by either the coal or the railroad strikes. The cost of coal due to the strike has of course increased very materially the cost of manufacture. Contracts at prevailing rates made before the strike were not fulfilled, and manufacturers were fulfilled, and manufacturers often had to pay a 100-per cent increase over contract price.

"The effect has been different however in various sections of the country. In some, coal has been scarce and has retarded the intensive manufacture which the demand for brick induced; but comparatively few plants have actually been closed for lack of burning materials. Some plants have turned from coal burning to other materials or processes on account of coal shortage but with very little delay or retarding of manufacture. Some central western manufacturers were affected by rail transportation in shipping their output to other markets than their own, but in a very large degree home consumption this year has been so large that shipping has not been a serious factor with the producer. Furthermore, trucks are now being used to transport brick within a radius of fifty miles of their production point."

A similar inquiry addressed to the National Lumber Manufacturers Association elicited the following:

"The lumber industry is not dependent on coal because it has its own fuel supply. It will of course suffer from impairment of other industries dependent on coal. Probably at least $10,000,000 loss will result from continuation of car shortage another sixty days."

The National Paving Brick Manufacturers' Association reported as follows:

Coal and rail strikes naturally offer some obstruction to paving brick industry. Up to the time of strikes the industry was on the way to the best year in point of total output it has had since before the war. In fact the demand for brick pavements was brisker than ever and the demand remained at this high point during the most of the strike situation. Shipments are now gradually increasing from the low point of two weeks ago. The industry is beginning to secure coal at prices which permit of production if not profitable production; and various plants which shut down for lack of fuel are resuming operations. In the North, lack of fuel was the greatest handicap and in the South, lack of transportation.

Seek Rehearing of Coronado Suit Against United Mine Workers

Washington Correspondence

Petition for rehearing of the so-called Coronado coal case, in which the United States Supreme Court on June 5 handed down a noteworthy decision holding that labor unions, although not incorporated, are suable and liable for damages resulting from acts of their members on an authorized strike in matters affecting interstate commerce, was filed with the court Thursday in behalf of the Coronado Coal Co. and others, plaintiffs in the original suit against the United Mine Workers of America.

The Supreme Court, while rendering a broad opinion in the case and establishing a new principle of legal procedure against labor unions, held that it could not sustain the award of damages to the original plaintiffs because it had not been established to the satisfaction of the court that the acts complained of were in restraint of interstate commerce during an authorized strike, and expressed regret that this was so.

In the petition for rehearing, the petitioners set forth that, "encouraged by the statement with which the court closes its opinion, and believing that the court will recognize the ready possibility of error in drawing inferences of fact from a record so voluminous and complicated, petitioners venture to assert that the decision of the court debarring petitioners from recovery in the present action is founded upon essential mistakes and misconceptions of the facts presented by the record."

The Supreme Court will act upon the petition for rehearing after it reconvenes Oct. 2.

Federal Reorganization Plan Not Abandoned

Washington Correspondence

There has not been the slightest surrender on the part of the administration of its intention to bring about practical reorganization of the executive departments of the federal government. A tentative report was laid before the President several months ago. It has not been made public due to the fact that the report as submitted is not acceptable to all of the department heads. It is believed, however, that certain changes in the plan can be made so as to secure for it the unanimous support of the department heads or at least any dissenting opinions that may be offered will be of minor importance.

Were the report to be sent to Congress without the endorsement of certain of the department heads, it is recognized that the possibility of securing the legislation would be lessened. Moreover the legislative situation, since the report was submitted to the President, has been such as to preclude action on reorganization. In addition if the report were made public in its tentative form and before unanimous endorsement by department heads had been secured, there is a feeling that it would invoke non-constructive criticism and arouse agitation which would serve no good purpose.

It can be stated authoritatively that the reorganization proposal has not been laid aside indefinitely.

The Engineer in Public Life

R. M. HOSEA

While he has never held public office Raphael M. Hosea, consulting engineer of Denver, Colo., through his advocacy of city zoning has shown his fellow engineers the way to genuine public service. This phase of modern city development is not readily understood by the average citizen and demands much pioneer work of a promotional type..

Beginning by interesting a small group of representatives of various Denver civic organizations, Mr. Hosea, as chairman of the Civic Affairs Committee of the Colorado Society of Engineers, presently had many converts to city zoning. At the opportune time the Denver City Planning Commission was organized. Its members were soon shown the advantage of the zoning plan outlined by Mr. Hosea and they made him chairman of the committee to work in the furtherance of this plan.

Mr. Hosea, many years chief engineer of the Colorado Fuel & Iron Co. and its railroad subsidiaries, has included in his consulting practice irrigation, railroad, coal mining, and water supply. He was born Sept. 13, 1857, at Cincinnati, and received the degree of B.S. in Civil Engineering at the Massachusetts Institute of Technology in 1879. He is a member of the Western Society of Engineers and is now president of the Colorado Society of Engineers.

Public Health Association to Meet in Cleveland

The fifty-first annual meeting of the American Public Health Association will be held at the Hotel Statler, Cleveland, Oct. 16-19. Besides the general session there will be the usual meetings of the various sections, including those on sanitary engineering, laboratories, vital statistics, public health administration and others. The program of the sanitary engineering section will consist largely of committee reports, of which the following have already been scheduled: "Mosquito Extermination," M. Z. Baer, chief engineer, Arkansas State Board of Health; "Bathing Places," C. W. Simonds, Jr., chief engineer, Florida State Board of Health; "Refuse Collection and Disposal," M. N. Baker, of the editorial staff of *Engineering News-Record;* and "Milk Supply," H. A. Whittaker, director, Division of Sanitation, Minnesota State Board of Health. There will also be a paper on sludge disposal by Langdon Pearse, sanitary engineer of the Sanitary District of Chicago.

A feature of this year's exhibit will be a "co-operative book store" in which it is stated that "the leading general publishers and all the most important medical publishers of the country" will participate.

Rail Injunction Continued for Ten Days

Shopmen Consider Peace Plans While Railroads Embargo Freight and P. R. R. Clerks Talk Strike

Following the first day's hearing on Attorney General Daugherty's petition for an injunction against the striking railroad shopmen, and their union leaders, the temporary injunction granted by Federal Judge Wilkerson was continued in effect not to exceed ten days. This will extend the order to Sept. 21.

Representatives of the strikers were denied their motion that the petition be dismissed, but in the course of the argument over the continuance of the restraining order, the Court indicated a possibility that some modification of the present order might be made. The defense protested that some of the statements of the Department of Justice with regard to incidents arising from the strike were inaccurate, but they were admitted as evidence on the understanding that further facts would be adduced in their support. In view of the continuance of the injunction, argument will be offered at once as to a modification of the penalties.

Shopmen Discuss Peace

Meanwhile, reports from Chicago indicate that the policy committee of the striking shopmen are discussing proposals for a settlement of the strike. Much mystery is made as to the nature of the propositions in hand and every precaution appears to have been taken to prevent a leak.

The New York Central, Erie, Lackawanna and Lehigh Valley Railroads have placed an embargo on freight for the announced purpose of throwing all available equipment into the handling of anthracite coal for New York. These four roads have banned from their lines all freight except foodstuffs. This will not interfere with local freight, but applies only to that received from other roads at western connection points.

Union leaders have announced their intention of calling a strike of the clerks, freight handlers and station employees of the Pennsylvania R.R. Ballots are to be mailed at once, and action is expected within the next ten days. Such a walkout would affect about 30,000 men.

Lawsuit Delays Moffat Tunnel

Progress on the Moffat tunnel through the Rocky Mountains is held up pending an action to determine the legality of the enabling legislation. Meanwhile, Maj. L. D. Blauvelt, chief engineer of the tunnel commission, has again assumed his duties as state highway engineer, from which office he took leave of absence to supervise the preliminary tunnel work. It is announced that Maj. Blauvelt will give the tunnel commission such service as it may need until it is ready for construction.

Conference Amends Bonus Bill

The joint House and Senate conference has taken from the bonus bill the provision for free ports and land reclamation as described in *Engineering News-Record*, Aug. 24, p. 330, and Sept 7, p. 410.

Municipal Improvement Society Meets at Cleveland Oct. 2-6

Many committee reports on paving specifications and other topics in the municipal field and a large number and variety of technical papers are scheduled for the twenty-eighth annual convention of the American Society for Municipal Improvements that will meet at the Hollenden Hotel, Cleveland, Oct. 2-6. Some of the reports and advance copies of some of the papers, as well as the lengthy program, may be obtained from Charles Carroll Brown, secretary, St. Petersburg, Fla.

There will be joint meetings on the evenings of Monday and Tuesday, Oct. 2 and 3, with the Ohio State Conference on City Planning, whose annual convention will be held at the same time and place as that of the Society for Municipal Improvements. Monday afternoon will be devoted to sectional meetings to discuss changes in the standard specifications already submitted or to be submitted to the society. It is expected that these meetings will be continued Monday evening.

Refuses to Pass on Bridge Case

The Port of New York Authority has declined the invitation of the War Depatment to act as umpire in a controversy between Newark, N. J., and the Central Railroad of New Jersey over the construction of a new bridge across Newark Bay between Bayonne and Elizabethport. The representatives of the city of Newark had objected to approval of plans of the railroad for a bridge to replace its present timber structure, although congressional authority for the bridge replacement has been granted, as the city wants Newark Bay freed of bridges in order to attract shipping to the bay. The War Department, which ordinarily acts upon its own judgment in cases of conflict between bridge and navigation claims, has twice referred the question to other bodies, first to the New Jersey State Board of Commerce and Navigation and more recently to the Port of New York Authority. The opinion of the former board was adverse to approval of the plans of the railroad company for the new crossing.

Coal Industry Settling Down to Meet Heavy Demands

Following the ratification by the tri-district convention of the anthracite miners of the agreement negotiated by the United Mine Workers and the operators, about 90 per cent of the 155,000 striking miners are expected to resume work at once. The remainder will follow as soon as those mine properties which have deteriorated during the shutdown can be overhauled.

It is expected that at the start some labor shortage will prevail and that full production cannot be counted on for several weeks. The companies, it is estimated, have in hand orders for at least 20,000,000 tons. Normal anthracite production is about 2,000,000 tons per week.

Last week the output of bituminous coal was about 8,500,000 tons. An output of 9,000,000 tons per full week may be expected, but transportation facilities are still the key to coal distribution.

S. L. F. DEYO

S. L. F. Deyo, whose death was noted in the columns of this journal last week, was one of the pioneers in subway construction work in New York City. From March, 1900, to June, 1905, as chief engineer, he organized the engineering department of the Rapid Transit Subway Construction Co. for John B. McDonald, and supervised the subletting of all contracts on both Contract 1 and Contract 2.

The work comprising Contract 1 was all the subway work extending from City Hall station to 231st St., what was then the Broadway line, now known as the Seventh Avenue line; and from City Hall station to the Bronx on the East side. Contract 2 included all the work from City Hall station to Atlantic Ave., Brooklyn. Mr. Deyo had supervision of all this construction work until his resignation from the company in June of 1905, at which time the subways were in operation from South Ferry to 157th St. and to West Farms.

Mr. Deyo was a graduate of Union College in the class of 1870. During the two years after his graduation he was engaged in survey work in Morrisiania, N. Y. From 1871-73 he was engaged on survey work and as resident engineer on the Harlem River branch of the New York, New Haven & Hartford R.R. For the next three years he was assistant engineer on the Fourth Ave. improvement work, New York City.

RAILROAD RECORD

After five years as superintendent of the American Metaline Co., of New York City, he became division engineer of surveys for the South Pennsylvania R.R. in 1881. During the next four years, he was engaged in survey work for the South Pennsylvania R.R., and on its construction, during which time he served as resident engineer. In 1886 he became principal assistant engineer of the Buffalo & Geneva R.R. and then assistant engineer of the Lehigh Valley R.R.

In 1887 he was engaged in railroad reconnaissance work in Northern Alabama for the Pioneer Mining & Manufacturing Co. He returned to the New York, New Haven & Hartford R.R. in 1888 as assistant engineer, serving in that capacity until his association with the Rapid Transit Subway Construction Co.

He also served from 1903 to 1905 as the chief engineer of the subway division of the Interborough Rapid Transit Co. while chief engineer for Mr. McDonald. Resigning from the Rapid Transit Subway Construction Co. in 1905, he joined the Interborough Metropolitan Co. as its chief engineer, a position which he occupied for two years. From 1908 to 1913 he was again chief engineer of the Rapid Transit Subway Construction Co., and from then until his retirement in 1918, engineer of the Interborough Rapid Transit Co.

Am. Soc. C. E. to Discuss Water Power at San Francisco

The water-power problem will be the feature topic of technical discussion at the fall meeting of the American Society of Civil Engineers to be held at the Palace Hotel, San Francisco, Oct. 4-8. Formal papers are scheduled as follows for the session of Oct. 4: Colorado River development, by Arthur P. Davis; new development at Niagara Falls, by Frederick A. Gaby; New York State water power, by John P. Hogan; the Federal Water-Power Act, by Oscar C. Merrill; aerial photography, by Gerard H. Matthes.

For Oct. 5 the papers will be devoted principally to Pacific Coast water-power subjects, the authors being Frederick H. Fowler, John D. Galloway, F. W. Peek, Jr., Harris J. Ryan, and Harry W. Dennis. Charles F. Loweth will discuss hydro-electric development in its relation to railroad electrification, while Prof. Charles D. Marx will deal with the social and economic aspects of hydro-electric power.

The local committee on arrangements, headed by A. H. Markwart, has arranged a number of excursions including trips to Hetch Hetchy, the Don Pedro dam, and the Yosemite Valley.

Railroad Merger Hearings to Be Resumed in West

Washington news dispatches forecast that the Interstate Commerce Commission hearings on the plans for consolidation of the railroads into a limited number of systems may be resumed the latter part of October. Hearings held so far have made practically no progress, as no company has approved a plan that would include itself except in the case of the proposed union of the Louisville & Nashville, the Nashville, Chattanooga & St. Louis, and the Atlantic Coast Line. In this case there is already a community of interest by stock ownership. It is expected, therefore, that the hearings will be shifted to the western district and that discussion will hinge largely on the disposition of the Central Pacific. This road is now owned by the Southern Pacific, but in a recent decision of the United States Supreme Court this ownership has been held to be in violation of the Sherman law. A movement is afoot to have the Central Pacific incorporated into the Union Pacific System which now ends at Ogden, Utah, from which point the Central Pacific handles its traffic to the coast.

Federal Bill to Control Coal Prices Passes Senate

The Senate has passed the bill urged by the administration to establish federal control over coal distribution and prices. Several amendments by Senator Borah designed to shape the fact-finding commission to conform to the agreements between the anthracite operators and the miners were adopted. These required that a separate report should be made on the hard-coal industry and that it should be presented to Congress not later than July 1, 1923.

In view of these amendments, the Senate bill will now go to conference in order that the differences between it and the House bill may be adjusted.

Hydro-Electric Matters Discussed by Canadian Engineers

Hydro-electric developments in the Province of Manitoba constituted the major part of the general professional meeting of the Engineering Institute of Canada at Winnipeg on Sept. 5 to 7, but the social events characteristic of the institute's meeting were not absent.

After an address of welcome from Mayor Fowler, institute affairs were discussed for an hour, the meeting recommending to Council the adoption of the report of the Committee on Policy. The hydro-electric development of the Province of Manitoba formed the theme of the first day's sessions. A paper on the Winnipeg hydro-electric plant was given by E. V. Caton, and the Manitoba Power Company's development at Great Falls was described by F. H. Martin. As guests of the City of Winnipeg, and the Manitoba Power Co., Ltd., about 275 engineers were conveyed by special train to the new Great Falls development of the Manitoba Power Company and the civic plant of the City of Winnipeg at Point du Bois.

Inspect Hydro-Electric Plants

The total development at Great Falls provides for six units to develop 168,000 hp. The initial development, however, provides only for two units. The turbines of single runner vertical shaft diagonal or propeller type will develop 28,000 hp. when operating under a head of 56 ft. and running at a speed of 138.5 r.p.m. The generators will be 21,000 kva. capacity, of the vertical type, generating three-phase sixty-cycle, alternating current at 11,000 volts. The transformers will be 7,000 kva. each single phase, water-cooled, 11,000/63,500/110,000. It is expected to have one unit installed this year. The City of Winnipeg's plant has a present capacity of 68,200 hp. and an ultimate capacity of 112,000 hp. It is located 78 miles from Winnipeg, and has a normal fall of 46 ft. The transmission line includes four circuits on two steel tower lines, all aluminum cable.

Thursday's program included the following papers: "Notes on the Construction of the Moncton Yards and Engine Facilities," by S. B. Wass; "Automatic Grain Car Unloaders for the Canadian National Railways at Port Arthur," by Fred. Newell; "The Fuel Values of the Coals of Alberta," by G. R. Pratt; "Highways in Western Canada," by M. A. Lyons; "The Chemistry of Portland Cement and Its Disintegration by Alkaline Ground Waters," by Prof. T. Thorvaldson, and "Twenty-eight Thousand Horsepower Turbines for Great Falls Development, Manitoba Power Company," by Geo. E. Bell. In connection with his paper, Prof. Thorvaldson gave an outline of the work of the institute's committee investigating the disintegration of concrete by alkaline waters.

The social functions included a luncheon on Tuesday as guests of the Association of Professional Engineers of the Province of Manitoba, and a dinner, the hosts being the Manitoba branch of the institute. On Wednesday, the Manitoba Power Co. were hosts at a luncheon, and the City of Winnipeg Hydro-Electric System for dinner. Again on Thursday the City of Winnipeg entertained at a luncheon at Assiniboine Park, and in the evening a banquet was held at the Fort Garry Hotel. At this banquet the Hon. W. R. Clubb, the new Minister of Public Works of the province, announced that Manitoba was planning a highway program that would place the province in as good a position as Ontario or Quebec.

Urge $75,000,000 Highway-Bond Issue in Tennessee

Sponsored by the Tennessee Good Roads Association, a movement is under way for the authorization of a $75,000,000 bond issue to complete the state highway system of Tennessee. The proposed state bond issue would be issued against an anticipated capitalized fund of $4,900,000, to be raised by combining the present federal-aid and state money with all of the motor-vehicle taxes and by an additional fund of $800,000 to be realized by a tax of 2c. per gallon on gasoline.

According to Morgan T. Nailling, secretary of the Good Roads Association, the bonds would be issued serially at the rate of $10,000,000 per year for a period of 7½ years, the roads to be completed during this period. The bonds would be retired serially at the end of thirty years from the date of each issue.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, San Francisco, Oct. 4-9.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Convention, Cleveland, Oct. 16-19.

The Western Society of Engineers opened its fall schedule of meetings, Sept. 6, with a paper on "Surveying with Aircraft Photographs" by Major James W. Bagley, Corps of Engineers, McCook Field, Dayton, O. On Sept. 11 John B. Hittell, engineer, the Asphalt Association, Chicago, spoke on "Asphalt, Its Occurrence, Production and Use in Highway Construction." For Sept. 18 Albert A. Northrop, Stone & Webster, Inc., Boston, will describe the Caribou hydro-electric development and Sept. 25 H. J. Burt will speak on "Stadium Design as Illustrated by the Grant Park (Chicago) Stadium." On Oct. 2 Jacob L. Crane will present a paper on "City Planning."

The Ft. Worth Chapter, A.A.E., will hold its next meeting Oct. 6 at the Chamber of Commerce when K. Robey, engineer for Ft. Worth Improvement District 1 will speak on water conservation and flood control.

The Engineers' Club of Kansas City held its first fall meeting Sept. 8, at the University Club. Its principal speaker was E. M. Johnston, the district manager of the American Rolling Mills Co., Middletown, Ohio, who talked upon the manufacture of ingot iron and special steel sheets, the talk being illustrated by motion pictures.

The Society of Industrial Engineers will hold its annual convention and exhibition at the McAlpin Hotel, New York City, Oct. 18 to 20, inclusive.

The Roadmasters Association announces that because of the railroad strike it has changed the date of its meeting at Cleveland from Sept. 14-21 to Nov. 21-23.

Personal Notes

E. J. RICHMOND, of Waterbury, Conn., has associated with DWIGHT E. SMITH, engineer, New Haven, Conn., and the firm name hereafter will be Smith & Richmond.

L. J. REESE, county engineer of Dickinson County, Kan., has resigned and has accepted a position with a bridge-construction contracting firm engaged for the most part in building federal-aid bridges in Illinois.

J. BURDETTE BROWN, who for the past several years had been connected with the state Department of Engineering on irrigation work, has resigned that position to join the extension department of the University of California at Berkeley.

MAJ. JAMES C. LONG, until recently connected with the Tarrant County Highway Dept., Ft. Worth, Tex., reporting to R. V. Glenn, has re-entered the local office of U. S. Bureau of Public Roads. His permanent station will be at Baton Rouge, La. Formerly he was located at Albuquerque, N. M.

C. H. TEASDALE has been appointed county surveyor for Johnson County at Cleburne, Tex. Formerly he was assistant engineer in the Johnson County Highway Dept.

Dr. J. W. BEEDE has resigned as geologist for the Bureau of Economic Geology and Technology, University of Texas, at Austin, to become geologist for the Empire Gas & Fuel Co., Bartlettsville, Okla.

J. E. MCANNALLY of Austin, Tex., has been appointed assistant U. S. irrigation engineer for work in the lower Rio Grande valley to succeed P. H. CLEMENTS, resigned. He will report to U. S. irrigation engineer R. G. Hemphill.

M. P. TUCKER, former service director for the City of Akron, Ohio, on Sept. 1 was sworn in as city manager. He succeeds H. C. CAMPBELL, who resigned to accept a position with the Firestone Tire and Rubber Co. W. F. PETERS, former assistant director of the state highway department, takes Mr. Tucker's place as service director.

R. C. BAILEY has recently resigned his position as business manager of the American Association of Engineers and is now with the Federal Electric Co. as sales engineer of multiphase and renewable fuses in the Philadelphia district.

G. H. ZAHNER, of Spokane, Wash., until lately at Orient, Wash., has entered the employ of the Delivuk-Orrino Engineering and Construction Co., Spokane, as engineer and estimator.

SUMNER D. BACON engineer with Ft. Worth & Denver is now engaged in building the Wichita Valley extension to Waureka, Okla.

NOEL OGILVIE, director of the Geodetic Survey of Canada, has left for British Columbia to visit the engineers now engaged in extending an unusually long arc of triangulation along the British Columbia coast. This work is being carried on in conjunction with the United States Coast and Geodetic Survey.

W. J. K. SKILLICORN, chief tariff officer of the South African government, is traveling through Canada for the purpose of obtaining first-hand information as to the system under which grain elevators are operated in conjunction with the railways and steamship lines.

R. L. BURWELL, formerly a specification aid in the United States Naval Experimental and Research Laboratory, is now manager of the statistical department of J. A. W. Iglehart & Co., investment bankers of Annapolis, Md.

JAMISON VAWTER, formerly assistant professor of mechanics at the University of Kansas, has been appointed assistant professor of civil engineering at the University of Illinois. Prof. Vawter has had several years general railroad engineering experience and was a captain in the Engineer Corps, U. S. Army, in France.

A. E. COWELL recently resigned the office of county surveyor of Merced County, Calif., to give his entire time to the engineering and architectural firm of Mayo, Cowell and Bissell of Merced and Stockton, Calif. The firm now occupies new offices in the Bank of Italy Building, Merced.

IVAN VALLEC, chief engineer of the Quebec Department of Public Works, has been appointed consulting engineer for the provincial government of Quebec.

CHRISTOPHER HARRISON, present mayor of Everett, Mass., is to assume the post of superintendent of public works and town manager of Lexington, Mass., on Oct. 1. Before becoming mayor of Everett Mr. Harrison was its city engineer. He was chosen from among 75 applicants.

HARRISON F. GONNERMAN has joined the staff of the Structural Materials Research Laboratory, Lewis Institute, Chicago. Mr. Gonnerman graduated from the Engineering College of the University of Illinois in 1908; from 1908 to 1914 he was assistant and instructor in the College of Engineering, University of Illinois; 1914 to 1920, research associate in the Illinois Engineering Experiment Station on experimental studies of concrete and reinforced concrete under the direction of Prof. A. N. Talbot. During the past two years he has been in business in Los Angeles.

OBITUARY

JAMES G. CHALFANT, for the past 15 years county engineer of Allegheny County, Pa., died at his home in Wilkinsburg, Pa., Aug. 26, aged 53 years. Mr. Chalfant had been a resident of Pittsburgh for 30 years, and had been prominently identified with many of the larger municipal projects, such as the bridge over the Allegheny river at Hulton station, the Sewickley bridge over the Ohio River, and the Monongahela river at Monongahela City. Besides being a member of the Engineers' Society of Western Pennsylvania, he was a member of the American Association of Engineers, and Pittsburgh Chamber of Commerce.

R. W. POWELL, civil engineer of Toronto, recently was found dead from a gunshot wound at Milltown, Bay D'Espoir, Newfoundland. Mr. Powell came to Newfoundland about a month ago in charge of a survey party in connection with a project for timber and water development at Bay D'Espoir. A rifle was found near the body and an investigation has been ordered.

THOMAS B. BRYSON, vice-president of the Holbrook, Cabot & Rollins Corp., died at his home in New York on Sept. 5, after a brief illness. A more extended account of his work will appear in an early issue.

From the Manufacturer's Point of View

Construction Material Deliveries Curtailed by Car Shortage

Contractors, equipment manufacturers, and producers of construction materials are all feeling the combined effect of the railroad and coal strikes. Due to the shortage of cars, deliveries of cement and aggregate have necessarily been curtailed, with the result that a portion, at least, of the work planned for this season has been held up. This condition, according to the views expressed by L. R. Burch, assistant to the president, Atlas Portland Cement Co., in an interview with *Engineering News-Record's* representative, has been more pronounced in the South and West than in the East. In the roadbuilding and general construction field it seems likely that a sizable volume of work scheduled for 1922 will have to go over until next year.

Contractors, of course, have been among the first to suffer from the reduced deliveries of materials, and the uncertainties attending their programs have been passed on to manufacturers of equipment who have been deprived of the volume of business in new plant which would have been theirs if outside influences had not been operating to reduce progress. One large manufacturer of construction plant in the Middle West estimates that orders totaling $110,000, definitely in prospect before the strikes started, have been lost or, at least, postponed. This particular manufacturer is a large producer of concrete and roadmaking machinery, so that in his business, as in that of practically all other construction plant manufacturers, the regular delivery of cement and aggregate is vital.

The Atlas Portland Cement Co., one of the country's largest cement producers, with groups of plants located at Hudson, N. Y., Northampton, Pa., Leeds, Ala., and Hannibal, Mo., has been unable to secure enough cars to handle its output. In the East, according to Mr. Burch, comparatively little trouble has been experienced in getting cars, but in the southern and western districts during the past two months only from one-half to two-thirds of the necessary number of cars could be secured. While this situation is attributable largely to the railroad shopmen's strike, the fact that crop movements have made a demand upon railway equipment also must be taken into consideration. On the whole, Mr. Burch believes, the railways have done everything that could be expected to meet the situation.

OPEN-TOP CARS NO HELP

Box cars are the only satisfactory means of shipping cement. It is true that in 1920 the Atlas Co. made a number of shipments in open cars, and as a result of this experience this method will not be resorted to again except in case of extreme necessity. The cement producer, Mr. Burch pointed out, is in much the same position as the coal operator in that he must meet a widely fluctuating seasonal demand for his product. Last December, for example, the Atlas shipments totaled 400,000 bbl., while in August 1,400,000 bbl. were delivered; the latter quantity, however, was considerably short of what the company considered it should have been. Normally, the heaviest cement shipments occur in the fall, so that a continuation of the car shortage will be a serious factor in maintaining construction schedules. For this year, at least, Mr. Burch sees no prospect of improvement in the car supply. However, he emphasized the fact that construction work not done this season will merely be delayed—not abandoned—and by carrying it over into 1923, together with operations already planned for next year, a tremendous total of work, calling for material and equipment in large volume, is in prospect. Motor trucks, in Mr. Burch's opinion, offer no real solution to the cement delivery problem as a whole.

Since the coal strike started April 1, cement manufacturers have had difficulty in securing sufficient quantities of suitable coal except at prices considerably above the normal market, and none of the cement companies has found it possible to operate without interruption. About 200 lb. of bituminous coal are required for the manufacture of one barrel of cement. A dollar a ton added to the price of coal, according to Mr. Burch, means a ten-cent per barrel increase in the manufacturing cost, and since the beginning of the strike the price of coal has been from $4 to $6 per ton above the normal previous cost. Due to the combined effect of car shortage and coal shortage the cement companies have been unable to carry out their plans for this season's production or to deliver promptly what cement they have been able to manufacture. In spite of these difficulties, Mr. Burch said, the Atlas Co. has been able to keep practically every job served by its product running.

Business Notes

After May 15 the New York office of JOHN R. PROCTOR, INC., constructing engineers, is to be consolidated with the main office at Bayonne, N. J.

ALLEN ASHLEY, for 10 years associated with the domestic sales department of the Westinghouse Electric & Manufacturing Co. and for 4 years with the foreign sales department of the Allied Machinery Co. of America, has established a clearing house to handle surplus machinery and supplies at 152 West 42nd St., New York City. In addition to his service in the sale and purchase of surplus machinery, Mr. Ashley announces facilities for the storage of equipment in a New York warehouse where it can be shown to foreign and domestic buyers.

THE TRAYLOR ENGINEERING & MANUFACTURING CO., Allentown, Pa., has removed its northwestern district office from the Mohawk Building, Spokane, Wash., to the Alaska Building, Seattle. It is believed the best interests of the company will be served by the change inasmuch as the district office will then be nearer to the mining interests of the extreme northwestern United States, British Columbia and Alaska.

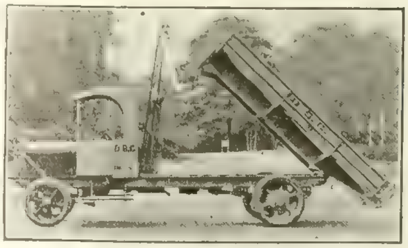
THE LOWER ST. LAWRENCE POWER CO. has been organized to develop electrical energy from the Grand Metis Falls on the Metis River, Que., and provide light and power for some sixteen municipalities extending from Rimouski to Matane. The initial development will be 3,000 hp. from a head of 120 ft. Work will be commenced immediately and it is expected that the development will be completed before the end of the year.

Equipment and Materials

Special Refuse Collection Bodies on New York's 128 New Trucks

Power dumping bodies of 6 cu.yd. capacity, developed especially for refuse collection under conditions existing in New York, will be used on all but eight of the 128 five-ton motor trucks which have just been purchased by the City of New York from the White Co., Cleveland, following a previous order for 212 trucks of the same make. These are claimed to be the two largest orders for motor trucks every placed by a municipality and give New York the largest fleet of standardized heavy-duty trucks. Specifications required bidders to produce verified records showing at least 100 heavy-duty trucks which have covered more than 75,000 miles. This requirement was met by the White Co., which qualified in this respect two years ago.

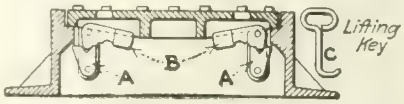
One hundred and twenty of the new trucks will be equipped with power dumping bodies and used for all phases of street cleaning work, including the removal of ashes, garbage and snow. Six trucks will be provided with winches and two will be equipped with apparatus for handling wrecks. To protect the city against the blocking of thorough-



fares by heavy snowfalls, such as happened two years ago when New York traffic was paralyzed for days, provision is made for attaching snow plows to the fronts of the trucks.

Locking Manhole Device

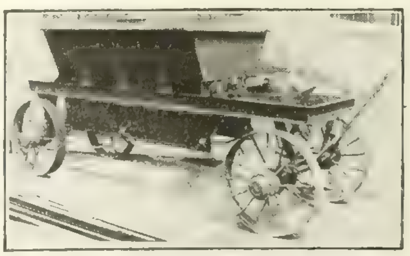
To prevent accidents caused by tipping manhole covers, and resulting damage suits against municipalities, a frame and cover with an automatic



locking device, illustrated herewith, have been developed by the Chalmers Pump & Manufacturing Co., Lima, Ohio. The locking is automatic when the cover is placed in the frame. To unlock, two keys, C, are inserted through slots in the cover, given a quarter turn to engage levers, B, which release the latches, A, during the process of lifting the cover. The locking mechanism is so designed that the parts never become disengaged without the use of the lifting keys.

Two New Models of Trailer Have Roller Bearing Hubs

Two models of trailers for contractor's use, one with a flat platform body and the other with a bottom-dump body, are announced by the Easton Car & Construction Co., Easton, Penn. The



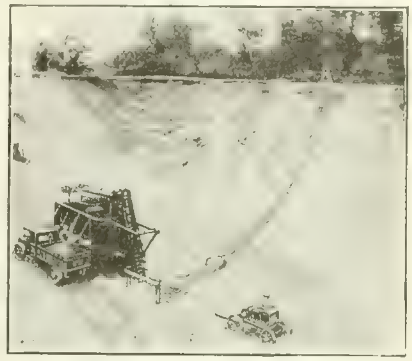
bottom-dump type illustrated herewith is of all-metal construction and has a capacity of 40 cu.ft., although other sizes are built. The platform type is designed for loads of 2 or 3 tons. Both models are equipped with 30-in. wheels with wire steel tires and roller-bearing hubs. The trailers are fitted with couplings to permit of operation singly or in trains. The wheels cut under the body making possible a very short turning radius.

Portable Power Drag Scraper

To meet the requirements of the man who is handling material in a small way, especially the county road commissioner or contractor who wishes to utilize a local sand and gravel deposit, a new type of portable power drag scraper outfit has been placed on the market by Sauerman Bros., Chicago.

The new outfits are equipped with Crescent type power scrapers, designed especially for use with a light power unit as they are easy to pull and travel straight. The double-drum hoist is furnished with gasoline engine, direct-connected, or is arranged for belt drive from a tractor or other motive power. The truck frame is of heavy steel-channel construction mounted on broad-tread, grooved steel wheels with steel axles.

One man handles the entire operation through two levers placed side by side, loading and dumping being accomplished automatically. The front drum of the hoist operates the load cable which leads through a sheave from the drum to the bridle chains on the front of the scraper. The pull-back cable leads from the rear drum through



another sheave out to a guide block at the far end of the excavation, and then is attached to the rear bridle chains of the scraper.

The entire outfit, it is claimed, can be made ready to operate in less than an hour after arriving at a new location.

Out-of-the-Ordinary Trade Publications

Gypsum Plaster — THE UNITED STATES GYPSUM CO., Chicago, in a 32-p. pocket-size booklet, just published, explains how to get the best results from the use of gypsum plaster. The text describes the action of all gypsum plasters, explains how plaster troubles may be prevented, and suggests ways of discovering causes of troubles and remedies. A valuable feature of the booklet is a tabulated list of troubles and how to prevent them. The hints in the tabulation are further elaborated in the text pages. The booklet is a useful, practical guide on improving the character of all types of work in which gypsum plaster is employed.

Roofing Materials — GARDINER & LEWIS, INC., New York and Chicago, have issued a 16-page booklet on Karnak roofing materials, with particular reference to the properties of fluxed asphalts, lake asphalts, and unfluxed asphalts refined from asphaltic petroleum. Physical properties desired in a satisfactory roofing material are summarized and there is included a reprint of the American Concrete Institute's Committee Report on Reinforced Concrete Highway Bridges and Culverts, dealing with standard tests for bituminous materials. Notes are also given regarding the selection of the proper type of membrane for waterproofing purposes.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Production and Materials Stocks in Nine Cities

Car Rather Than Coal Shortage Retards Mill Shipments—Steel Output Down 10 Per Cent—Lumber at Normal

Steel—August output of steel ingots totaled 2,214,582 tons, a drop of over 10 per cent from the preceding month. Production was the lowest since February, when the output was 1,745,022 tons. Compared with the May total of 2,711,141 tons, the highest for the year, August shows a falling off of over 18 per cent. The total for the eight months just past, stands at 18,201,072 tons as against 16,826,946 tons for the whole of 1921. August operations proceeded at an average rate of about 66 per cent of capacity.

Lumber—An average of 381 mills reporting weekly to the National Lumber Manufacturers' Association, for the four weeks ending Aug. 26, show 939,029,583 ft. cut, 834,793,508 ft. shipped and orders for 887,059,993 ft. b.m. This represents an increase of 11 per cent in production, 3 per cent in shipments and 15 per cent in orders over the four weeks of July. Latest reports show production normal; orders 8 per cent and shipments 12 per cent, below normal.

Cement—Output during July totaled 11,557,000 bbl., as against 11,245,000 for June, an increase of 312,000 bbl., according to the Geological Survey. Shipments increased 380,000 leaving a reserve of 8,424,000 bbl. on Aug. 1, 1922, a decrease of 2,294,000 bbl. from the preceding month.

Brick—Latest information as of Aug. 1, received from ninety-four firms reporting to the Common Brick Manufacturers' Association of America, show slightly less than 112,000,000 brick burned as against 106,475,000 produced the month before by ninety-five manufacturers. Of the ten plants closed down, four lacked fuel. In addition, five more plants reported that they must close shortly for the same reason. One plant among those shut down could make no more shipments because of car shortage. While coal is being mined in many districts, transportation to the brickyards is far from satisfactory.

San Francisco—Large stocks of cement, brick and lumber; plenty of sewer pipe, road oils, asphalt and hollow tile. Dealers' stocks of reinforcing bars, manila rope and galvanized steel sheets in good condition; fair supplies of track materials, metal lath, triangle mesh, steel shapes, blue annealed and black steel sheets and wire nails. Stocks of steel rivets and cut nails low. Large stocks of lime at warehouses and nearby kilns. Railroad ties purchased on order only. Cast iron pipe shipped from the East.

Denver—Local lumber stocks ample for current needs but mill shipments hampered by car shortage. About ten cars of asphalt on sidings and 2,000,000 brick on hand in local plants.

Minneapolis—Lumber stocks about normal for this season, with light demand. Brisk buying, at outbreak of the rail strike, has begun to subside. Brick and cement shortage has lowered demand for lumber. Brick, tile and cement stocks reported low; yards and warehouses about stripped and orders are filled direct from cars. Dealers report that if buying were to stop abruptly, it would take from four to six weeks to fill orders already booked.

Detroit—Moderate supplies of sewer pipe in yards; demand somewhat smaller than earlier in the season. Scarcity of cement. Majority of Michigan mills closed down because of lack of fuel. Contractors refusing to bid on some jobs because of uncertainty of cement supply and high prices of available quantities. Lime supply not seriously affected by car shortage. No delays in brick deliveries from yards, but hollow tile requires several days. Moderate retail stocks of lumber and sufficient asphalt to meet demands.

New Orleans—Ample dealers' stocks of pine lumber; but mills refusing orders on account of car shortage. Open cars, commonly used for transporting lumber, ordered to mines to relieve coal shortage. Shortage of crushed stone, asphalt and 36 in. sewer pipe. Small stocks of gelatin dynamite; no black powder.

Atlanta—Plenty of lumber and common brick; large supplies of asphalt. Two carloads of structural steel on sidings; twenty cars of cement and thirty cars of lime. Deliveries on sewer pipe in 24 to 36 hr.; hollow tile, five to six days. Some difficulty being encountered in making deliveries on account of car shortage.

Philadelphia—Sewer pipe stocks entirely used up in face of greater demand than at any time this year. Cement stocks depleted; deliveries about one-half of normal. Lime demand far in excess of supply. Brick shortage continues. Growing scarcity of all grades of lumber in dealers' yards. Plenty of explosives and manila rope.

Montreal—Ample supplies of all construction materials. Especially large retail stocks of lumber. Deliveries, however, on common brick take three days; hollow tile two days.

New York—Plenty of sewer pipe in sizes above 6 in. Ample stocks of common lime. Brick shortage alleviated by slight falling off in demand. No shortage of structural steel in dealers' warehouses.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

(Stocks on hand in approximate figures, example (cement, Denver) 10,000 bbl.; time required for delivery of carload lots to city job, example (sewer pipe, Atlanta) 24 @ 36 hr.; and stocks on hand in general terms, example (common brick, Philadelphia, shortage.)

	San Francisco	Denver	Minneapolis	Detroit	New Orleans	Atlanta	Philadelphia	Montreal	New York
Sewer pipe	Plenty	Del. 24 hr. local plant		Sufficient	Stocks low	Del. in 24 @ 36 hr.	Entirely used up	Ample	Plenty in sizes above 6-in.
Cement	Large stocks	10,000 bbl.	Stocks low	Scarcity. Mills closed.	Enough	20 cars	Depleted	Plenty	No shortage.
Lime	Big reserve	Plenty		Plenty		30 cars	Demand ahead of supply.	Enough	Plenty of common.
Common brick	Well supplied	2,000,000	Yards stripped	Moderate supply	No shortage	Plenty	Shortage	Sufficient del. 3 days	Shortage slightly relieved.
Hollow tile	Plenty	Sufficient	Scarcity	Stocks up to normal	....	Del. 5 @ 6 days	....	Enough; del. 2 days	Shipped by water
Lumber	Heavily stocked.	Dealers stocks ample.	Normal	Moderate retail stocks.	Ample mill shipments delayed	Plenty at present.	Stocks low	Large retail stocks.	Mill del. slow
Asphalt	Unlimited supplies	10 cars		Sufficient to meet demand		Large supplies	Heavy reserves		Refineries well stocked.
Structural steel	Fair	....	....	....	....	2 cars.	....	Warehouse stocks, good	Enough in warehouses

How New Tariff Law Will Affect Building Materials

(Washington Correspondence)

The new tariff law will provide heavy increases on structural steel over the existing duties if Congress accepts the conference report which was submitted to the House Sept. 12, as it probably will do. The Senate rates on building materials generally were accepted by the conferees.

Structural iron and steel, unassembled, carries a duty of ⅕c. per lb., and if machined, drilled or otherwise advanced beyond hammering, rolling or casting, the duty is 20 per cent; while sashes, frames and building forms bear a duty of 25 per cent. The rate under the existing law is 10 per cent on all these.

Shingles remain on the free list, where they were placed by the Senate. House conferees made a vigorous contest for a 25c. duty but finally receded.

Building stone bears a duty of 50 per cent if hewn or dressed and a rate of 15c. per cu.ft. if not dressed or hewn.

Common brick and cement remain on the free list.

Street Paving Cheaper In Dayton, Ohio

Figures Given On Macadam, Concrete, Asphalt, Brick, Wood Blocks, Durax and Other Materials

By Ivan E. Houk
City Engineer, Dayton, Ohio

STREETS are being paved in Dayton this year at costs considerably lower than last year or than at any time since before the war. Asphalt pavements with 3-in. of asphalt are being laid for $3.14 per sq.yd. as against $3.99 last year, brick pavements at $3.37 as against $4.01 and reinforced concrete, 8 in. thick in the center of the street and 5 in. at the gutters, for $2.24 as against $2.40. Concrete alley pavements are being laid at a cost of from $2.09 to $2.50 per sq.yd. as against $2.24 to $3.73 last year. These prices include grading but do not include curb or combined cement curb and gutter. However, in no instance in the street paving work did the grading amount to much more than removing enough material to make room for the pavement, but some of the prices for alley pavements are high due to unusual amounts of grading.

Concrete streets and alleys in Dayton are reinforced with a wire mesh reinforcing having a weight of not less than 28 lb. per 100 sq.ft. Alleys have a uniform thickness of 6 in., the subgrade being shaped to correspond with the surface of the pavement, that is, with the center 4 in. lower than the edges so that the water will drain down the center. Other types of street pavements, such as brick, wood block, durax and asphalt, are laid on a 6-in. concrete base covered with a suitable cushion. Wood block is always laid on a 6-in. concrete base covered with a 1:4 mortar cushion, ½ in. thick. The other types of permanent pavements are laid on a 1-in. cushion of either sand or mortar. A soft filler is used in all cases; sometimes a straight asphalt, sometimes a mastic made by mixing hot asphalt or pitch with equal proportions of heated sand. A 1:3:6 mixture is used in the concrete foundations, and a 1:2:3 mixture in the concrete streets and alleys. Separated and washed materials are specified in all cases. Standard wire-cut paving blocks, 8½ in. long, 3 in. wide, and 4 in. deep, are used on the brick streets. Wood block must average 8 in. in length, although they may vary from 6 to 10 in. and must be 3½ in. deep and from 3 to 4 in. wide. Two kinds of oil are specified for the wood block, oil "A", a distillate obtained wholly from coal tar and oil "B", a more volatile oil produced from coal gas or coke oven tar.

The accompanying table gives the low prices bid on the street pavements completed in Dayton since Jan. 1 of this year or now under contract. Contracts have been let to the low bidders so far. The prices given for wood block pavements are for oil "A". Prices for oil "B" were about 20c. per square yard lower. Bids for brick pavements on a mortar cushion were generally from 5 to 20c. per square yard higher than for a sand cushion. Bids on oil asphalt were about 20c. per square yard lower than on lake asphalt. The streets included in the table involve a total of about 65,700 sq.yd. The total cost of the work, including storm sewers, manholes, catch basins, curb and gutter and other incidentals, will be about $325,000. Alleys paved thus far this year, or now under contract, involve a total of 14,555 sq.yd. and a cost of approximately $37,700.

Prices for combined cement curb and gutter are running about 70c. per lineal foot for the straight sections and about 90c. for the circular, while prices for curb alone are about 10c. per running foot lower. Straight granite curb is costing $1.75 per lineal foot, and circular granite, $2.50, although somewhat lower prices were bid by contractors who were not low on the main items. The prices for cement curb and gutter are about 30 per cent lower than last year; those for granite curb have not changed much.

Some paving materials are cheaper than last year; others are practically the same or slightly higher. This year cement has been delivered f.o.b. cars, Dayton, at prices varying from $2.68 to $2.96 per barrel, whereas in the spring of 1921 the price was $3.51. Brick is about the same as last year; contractors are now paying about $34 per thousand, f.o.b. cars, Dayton, as against $36 last year. Durax block is now being delivered, f.o.b. cars, Dayton, at $2 per square yard. Last year the price was about 10 per cent lower. Wood block, oil "A," is being delivered at about $2 per square yard, whereas last year the price was 30 per cent higher. Sand and gravel are delivered on the job at $1.75 per cubic yard,

(Concluded on p. 460)

LOW UNIT PRICES BID ON DAYTON STREET PAVING WORK COMPLETED THIS SEASON OR NOW UNDER CONTRACT

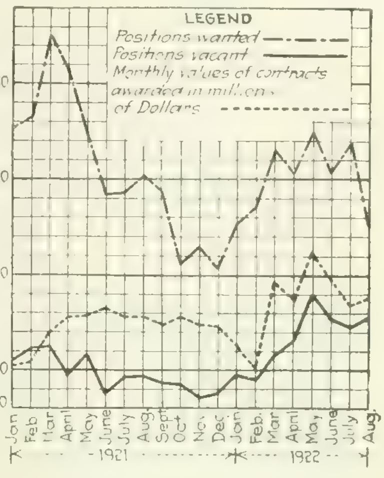
Street	Sq.Yd.	Price Per Square Yard Laid: Mac.*	Conc.	Asp.	Brick	Wood Bl.	Durax	Remarks
Belmonte Park N.	2,125				$3 99			Mortar cushion, asphalt filler.
Cambridge	2,350			$3 45				City to lay asp. at $1.40 per yd.
Dakota	3,605				3 58			Mortar cushion, mastic filler.
Five Oaks	3,525				3.81			Mortar cushion, asphalt filler.
Garland	4,300		$2 34					1:2:3 mixture, std. section.
Johnson	5 750				3.74			Mortar cushion, asphalt filler.
Jefferson St. Culvert	900		1 60					1:3:6 base or asphalt top to be laid by the city.
Kenwood, Section 1	5,050		2 24					1:2.3, std. section**
Kenwood, Section 2	2,300		2 40					1:2:3, std. section.
Louie	4,680				3 79			Mortar cushion, asphalt filler.
Norwood	930				3 79			Mortar cushion, asphalt filler.
North Main	9,325		..			$4.68***		On shoulders
North Main	4,950		.		3 83			In car tracks. Mortar cushion, asphalt filler
North Main	7,395		...	3 95				Lake asp. Alternate plan for shoulders
South Main	3,600					4 64		On shoulders
South Main	750				4 10			In car tracks. Mortar cushion, asphalt filler
Orth	1,055			3 14				City to lay asp. at $1.40 per yd.
Springfield, Sec. 1	4,987			2 85				Alternate plan.
Springfield, Sec. 1	5,397				3 37***			Sand cushion, asphalt filler.
Springfield, Sec. 1	5,485		2 27					1:2:3, std. section
Springfield, Sec. 2	2,500	$2 40						Temporary pavement.
Third St. Bridge	1,390				3.47			On shoulders. Sand cushion, asphalt filler
Third St. Bridge	1,190						$4 78	In car tracks. Sand cushion, mastic filler

* 2½-in. bituminous macadam top on 6-in. water bound macadam base. ** $6,400 sewer job in this contract *** Contract let on this bid.

When Men Look for Jobs and Jobs for Men

Number of Construction Positions Wanted and Vacant Compared with the Volume of Contracts

The chart comparing monthly values of contracts awarded with the number of engineering-construction "positions wanted" and "positions vacant" in 1921 and 1922, as published in *Engineering News-Record*, shows an interesting relationship. To make the curves more



nearly comparable all monthly figures are held to a four-issue-per month basis. That is, where there are five issues of the *News-Record* in a month, the total dollars or positions were divided by five and then multiplied by four.

With value of contracts let increasing each month from March to June of 1921, inclusive, men advertised in numbers in the first month, thereafter in sharply decreasing volume until June. In July the contract volume fell off a little, while "positions wanted" rose in about the same proportion. August contracts were slightly lower than the July total, and advertisements for positions mounted rather sharply.

From August to the end of the year the contract volume remained fairly steady, while the minimum number of positions were sought, indicating that contractors had completed their organizations, and that the majority of engineers were employed.

In the first half of 1922 there are

three peaks in the "positions wanted" curve. These peaks, about on a level, occurred in March, May and July. These are accounted for by the powerful upward thrust of the contracts-awarded curve, which attained the maximum in May as against March in the previous year.

"Positions vacant" were fewest during the period when contracts were being awarded at approximately the same rate, May to December, 1921. Then with the heavy increase in contracts, an increasing number of openings were advertised, the peak occurring in May, 1922, when the maximum volume of contracts was awarded. In August, with fewer men advertising for positions, the announcement of positions vacant increased.

Street Paving Cheaper in Dayton, Ohio

(Concluded from p. 459)

practically the same as last year. Abundant deposits of sand and gravel are found in the Miami Valley around Dayton, some pits being within the city limits. Common labor this year has been available at 35 or 40c. per hour, about 5c. more than last year.

The real reason pavements are being laid, so much cheaper this year than last is that we have had real competition among the contractors. The beginning of the season found several large contractors completely out of work, so that they were willing to take contracts with a small margin of profit in order to keep their men together and keep their equipment working.

Dayton's paving work is beginning to feel the effects of the coal and railroad strikes, particularly the brick contracts. Probably some of the jobs now under way will not be completed until next year owing to brick shortage.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. **The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of September 7; the next, on October 5.**

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	+\$3.04	\$3.65	\$4.20	\$2.92½	\$3.05	+\$3.80	\$3.25	\$3.75	\$3.75
Structural rivets, 100 lb.	3.85	4.35	6.00	3.35	3.52½	4.80	4.25	3.75	6.50
Reinforcing bars, ½ in. up, 100 lb.	+2.94	3.50	3.50	2.82½	2.95	+3.97½	3.00	3.60	2.90
Steel pipe, black, 2½ to 6 in. lap, discount	57%	61.15%	45%	59½%	58.9-5%	43%	45.7@49.1%	50%	30.00
Cast-iron pipe, 6 in. and over, ton	+55.30	+49.50	51.50	+46.86	52.00	+60.00	51.00	53.00	50.00
Concreting Material:									
Cement without bags, bbl.	+2.85@3.00	2.50	2.25	+2.20	2.39	2.85	2.71	2.90	2.78
Gravel, ¾ in., cu.yd.	1.75	1.85	2.25	2.00	1.75	1.75	2.25	1.00	1.50
Sand, cu.yd.	1.00	1.15	2.25	2.00	1.00	0.75	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	1.65	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+55.00	40.00	40.00	+49.00	40.00	50.00	33.00	+24.50	50.00
Lime, finishing, hydrated, ton	15.80@16.17	−22.50	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.14½	−1.75	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	−21.30	11.00	10.90	11.00	18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	.09	−.065	....	.11	.09
Hollow partition tile 4x12x12, per block	.1112	.0776	.115	.0808	.09	−.065	.108	.11	.09
Linseed oil, raw, 5 bbl. lots, gal.	.91	−.95	1.13	.99	1.00	1.12	1.04	.86	1.12
Common Labor:									
Common labor, union, hour	.60	.35	....	.80	......	.50@.55	.56¼	.50@.60	....
Common labor, non-union, hour	.44@.60	.30	.25	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered except sand, gravel and crushed stone, alongside dock, common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars, tile "on trucks", linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net, white is \$1.70 for Kelly Island and \$1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars; other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered, sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.87 cents. Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., \$30; 6-in., \$110.

Changes Since Last Week

With the fuel situation greatly improved, production is rapidly increasing in the steel mills, in contrast with the general slump during August. Steel shapes quoted by leading interest at minimum of \$2 per 100 lb.; \$2.50 obtaining on current trading, for prompt deliveries. Reinforcing bars, \$1.90@\$2.25, f.o.b. Pittsburgh; quotation only nominal owing to scarcity of material. Mill shipments, New York, of reinforcing bars, quoted at \$2.24@\$2.59, or mill price plus freight of 34c. per 100 lb.; shapes, \$2.34@\$2.85. Mill shipments, f.o.b. Denver, quoted at \$3.52½ on bars; \$3.97½, at warehouse, as against \$3.87½, one week ago. Rise of 11c. per 100 lb. on structurals in New York during last two weeks.

Cast iron pipe, 6-in., up \$1.66 in Chicago, \$2 in New York and \$3 per ton in Denver, following coke and pig-iron scarcity.

Improvement in handling shipments, on the part of Southern railroads, is expected to increase the volume of pine lumber movements from mills east of the Mississippi, in the near future. However, structural timbers, long-leaf yellow pine, are quoted at an advance of \$2 in New York and Chicago with Douglas fir up \$1.50 per M. ft. b.m., in Seattle.

The only declines for the week occurred in brick, lime and hollow tile; indicating a let up in the coal shortage as well as a slight falling off in demand. Brick quoted at \$18 per M. wholesale, alongside dock New York, as against \$18@\$20, last week. Hydrated finishing lime down 50c. per ton and common lump, 5c. per bbl. in Atlanta. Hollow tile cheaper in Denver. Montreal reports brick deliveries greatly delayed and labor scarce.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 89 · NEW YORK, SEPTEMBER 21, 1922 · Number 12

Early Settlement Not Likely

IT APPEARS that the hope for an early settlement of the railroad shopmen's strike on the roads that signed the Baltimore agreement for separate settlements is not to be realized. And yet could we have expected that the negotiations for separate agreements would have been quickly and amicably terminated? The Baltimore arrangement, originated by S. Davies Warfield and Daniel Willard, did not settle the real stumbling block in the earlier negotiations, the seniority issue, but relegated it to conferences between the individual roads and their employees. To have expected that this important issue could be easily compromised was hoping too much. Within a week of the settlement, the New York Central broke off conferences with its employees, while strikers returning to the shops of the Chicago, Milwaukee & St. Paul and the Chicago & Northwestern railways at Chicago immediately got into conflict with the officials over the status of the returning men. On the other hand, several roads report the conclusion of arrangements with their men, but the details, particularly on the seniority issue, have not been disclosed. It is apparent, however, that the shopmen's strike is on its last legs. The strikers have been steadily losing. Here and there, they may regain their seniority standing but, by and large, their fight has been lost. From their standpoint, the greatest blow has been the abandonment of their insistence upon a national settlement. Their solidarity has been broken by their agreement to accept individual negotiations.

The Train-Crew Brotherhoods

WHILE the difficulty with the shopmen is not being easily composed, there is ground for gratification at the favorable progress of negotiations between the train-crew brotherhoods and several of the railroads, looking to agreements on working rules and wages for the next year. It is announced that the arrangements have been successfully concluded in this regard by the New York Central, Pennsylvania and Lehigh Valley systems. After all, the train-crew brotherhoods hold the key positions in railroading. If amicable settlements are secured with them, the continuance of uninterrupted railroad service is assured.

The Sounder Course

UPON the conclusion of the new agreement between the train-crew brotherhoods and the New York Central, W. G. Lee, president of the trainmen's organization, declared that in "going backward" to direct negotiations between railroad executives and railroad employees, without the intervention of the government thorugh the Railroad Labor Board or otherwise, the railway industry was getting on a sounder basis. For twenty-five years, he declared, the brotherhoods had successfully done business with the railroad executives direct and that that method was the only way in which peace could be maintained. He recommended the settlement of the affairs of the workers without any meddling by politicians. This is indeed a return to a sounder course and we are particularly glad that Mr. Lee himself is among the converts. If our recollection is right, he is one of the four men who rocked themselves complacently on the portico of the Capitol, while, with the aid of President Wilson, they were holding up Congress and the country in 1916 over the eight-hour law. If Mr. Lee means all he said in his pronouncements at New York last week the conversion is a notable one.

An Evil and a Remedy

IT HAS been evident for some years that we are confronted by a steadily increasing hazard arising from the combination of thousands of old, weak bridges on the roads of the country with rapid expansion of heavy motor-vehicle traffic. The evil of the situation has become pretty generally recognized, however reluctantly. But little or nothing has been done toward remedying the evil. The defective bridges are chiefly in township and county control. Located on side roads they were built for purely local needs and have never been made part of the state highway systems. Statewide traffic needs have invaded the local roads, however, and many of the old bridges have run down, in the hands of haphazard local government. Two failures reported in this issue, one from Oklahoma and one from Georgia, illustrate the part played by these circumstances. To replace or strengthen all of old bridges within a short period is quite out of the question for financial reasons, especially as it is the commonwealth whose traffic demands create the danger and the local communities are therefore unwilling to pay for the work. The only remaining way to limit the danger is to issue clear warning of weakness of each bridge by posting its capacity. This can be done quickly and at little cost. Posting is not an absolute protection, and S. B. Slack, of the Georgia highway department, goes so far as to call the Satilla River collapse an illustration of its inefficiency. But the argument of this one accident is not convincing. Though a bridge warning, like a railway block signal, can be disregarded, in either case the one who disregards it courts almost certain destruction. Block signaling gives us dependable protection of railway traffic, and the posting of highway bridges will reduce, if it does not virtually eliminate, the present bridge hazard.

State Control Desirable

LITTLE good can be expected from attempts to deal locally with a condition arising from a statewide cause, one which in each case is largely foreign to the locality affected. So long as the local highway bridge carried chiefly the traffic of the neighborhood its care was properly reposed in the local government. But under the conditions of today it can not be expected that local authorities will be diligent in building and maintaining bridges to the standard demanded by statewide traffic. The responsibility should now be placed

wholly on the state government. Specifically, every highway bridge in the state should be taken over by the state, and its control, safe maintenance and reconstruction be made the business of the state authorities. It may be said against this proposal that bridges are integral parts of the road, and that they must therefore remain in local control until the state can take over the entire road system. But this objection cannot be sustained, we believe. A local road remains of local interest until the volume of through traffic becomes so great as to make it a thoroughfare, the natural charge of the state; the question is one of character and density of traffic. With the bridge the traffic density is not determining; the maximum load, which is the critical factor, depends on the general highway "business" of the state, independent of local factors. Even though roads remain matters of local administration, bridges are the concern of the state, and their safety calls for state control and state responsibility.

Too Early to Standardize

IN HIS review of railroad electrification, published in last week's issue of *Engineering News-Record*, Mr. Gibbs has emphasized the danger of premature standardization. Mere inspection of the various diagrams of motor arrangement and locomotive designs that accompany his review will demonstrate the truth of his statement that no approximation even to a standard electric-locomotive design has been reached Although the field in this country seems to be narrowing to the use of two systems, that is, the 3,000-volt direct current and the 11,000-volt single-phase alternating current, Mr. Gibbs believes that it is too early to fix as standard any one system, much less to exclude from consideration any system that offers promise. It is true that European practice is tending toward a higher degree of standardization than is our own. The Italians cling to the three-phase system, the Swiss are strongly committed to the single-phase system, while the French and Belgians pin their faith to direct current at 1,500 volts. The British are definitely committed to the 1,500-volt direct current system. But conditions in Europe are so different from our own that standardization may be possible there long before it should be thought of here. Certainly any premature commitment that will obstruct the development of the art may delay the day when electricity will play its full part in the solution of our railroad problems.

New Angles to Old Problems

MR. GIBBS' suggestion that axle weights may have been carried beyond advisable limits in steam locomotives and that in the design of electric locomotives thought should be bent toward a return to lighter loads will strike a responsive chord among railroad bridge engineers. During the recent discussion in the American Society of Civil Engineers on Mr. Steinman's proposed standard bridge loading, reference was made to the possibility of electric traction helping to counteract the present tendency toward heavier and heavier bridge loadings, and to the reduction of impact stresses that may be expected because of the use of electric locomotives. The development of heavy electric traction will develop so many new angles that the railroad engineer in every department can ill afford to lose touch with developments in that field, which, as normal business conditions are restored, seems destined to assume a greater and greater importance.

Maintenance Guarantee Clauses in Highway Contracts

IN THIS time and day few state highway departments stultify their engineers and increase the hazards of their contractors by including a maintenance requirement in their contracts. It is true that occasionally a state specification requires defects, which may occur in a newly built road within twelve months following construction, to be repaired by the contractor, but none has any requirement corresponding to the long-time maintenance-guarantee clause which was of notorious reputation among contractors a decade ago in city paving work.

This is all true of state road work and the rural road contractor has been congratulating himself accordingly, but it is not true of country road work in many counties in numerous states and the contractor is wondering what it signifies in the way of increased hazard. The question is well worth consideration.

County requirements for road maintenance by the builder are partly a hang-over from city paving practice and partly a resort to escape the task and expense of establishing a county highway maintenance organization. It is a way of "beating the devil around the bush" in the matter of road maintenance expenditures which appeals to inexperienced county commissioners because no figures of maintenance cost show up in the annual budget. Obviously the costs exist and it is more than probable too that they represent more than the actual maintenance expenditures by the amount which the contractor has added for risk.

If the county reaps no benefit, then no one does, for the contractor always chances a loss in undertaking a long-term maintenance guarantee. No contractor desires to undertake maintenance as a part of his construction obligation. He does so only because he must. He invariably charges for the service and if on occasion he in error charges too little and the county benefits in that instance, still in the long run the people pay all the cost. The contractor charges for guaranteeing road maintenance and he must make his charge high because he is guaranteeing not merely sound construction and pure maintenance, but also that the engineers have designed the road properly, that they have anticipated correctly the amount of traffic it will receive and that the traffic loads will be regulated.

This is not a theoretical hazard. In frequent instances when a paved road has been completed latent traffic has developed and traffic has diverted to the new good route from older alternate routes. Instances are on record where the traffic has doubled in a few months the volume anticipated for several years. The contractor of whom a maintenance guarantee is required absolutely must for his own protection assume a rate of traffic increase which gives him a reasonable margin of safety. In the most favorable circumstances he is required to add to his estimates an item regarding the value of which his normal construction experience gives him little information.

Obviously some action is required by state and federal highway officials to have counties and minor municipalities conform to state and federal practice which eliminates maintenance guarantee clauses from construction contracts. The practice is economically unsound and is seldom highly effective in getting good maintenance and it never gets uniform maintenance. That it continues is a clear indication that state high-

way departments have not been alert to one of their most promising activities. This is the duty of educating the road officials of small municipalities and the public generally in sound principles of public roads management.

An Unfinished Job

THE American people have been grappling for a long time with the problem of how to protect themselves against two evils. One of these is extortion by monopoly; the other, exploitation by both parties to industrial disputes. Although we are accustomed to think of these as being two distinct problems, as here set down, they are in reality very closely related.

We have made progress. Today, public service corporations are so closely regulated that in some cases they need almost to be protected against extortion at the hands of the public. Capital in general has been deprived of much liberty of action, especially with regard to combinations that might effect restraint of trade to the public hurt. But so far as public utilities and the necessities are concerned, we have only half finished the job. We may have guarded ourselves against the weapon of monopoly in the hands of management or capital, but we are still at its mercy in the hands of labor.

Let there be no mistake as to who is the victim of this weapon. When the necessities are concerned, it is not the employer. It is the public, precisely as when the weapon is wielded by capital. Probably, in view of the experience through which we are now passing, it is unnecessary to dwell upon this point. Before we are through, it will be clear to all of us that in such cases capital becomes but a collection agency for labor. Indeed, there are those who intimate that some of the coal operators have done what they could to extend the monopoly of labor into fields not yet under its sway, and thereby achieve a monopoly for the industry through its unrestrained and unregulated element. And it is not beyond the realm of possibility that one of the operators' grievances against the miners' organization is its failure to turn the trick.

Having set a guard over the one gate, we now face the problem of securing the other. But here we seem to run into a snag. Under no conditions, we are told, must we interfere with "collective bargaining." This is the first obstruction. Then, we are warned, we never should think of restricting "the right to strike." And finally we must abandon any idea of imposing "compulsory arbitration" of disputes. Obviously, these restrictions tie us up completely.

Let us examine the process of our undoing. By virtue of "collective bargaining" the labor engaged in an essential industry, let us say, combines on a national scale to impose its will upon the industry. In other words, it organizes a monopoly of labor, one of the essentials of industry. Its demands take the form, we will assume, of either higher wages or lower output. But capital, another essential of industry, says: "Nothing doing, we won't pay any such wages or consent to any such restriction of output."

"Very well," says labor, "then we'll quit."

And it does.

Just about now the public wakes up. The supply of a necessity has been stopped. Production must be resumed; so it urges the contending parties to arbitrate their differences.

"Oh, no," says labor, "nothing doing; I might lose."

"Well, then," threatens the public, "we'll make you arbitrate, just as folks do in other disputes."

"You cannot do it," returns labor, "for that would be 'compulsory arbitration' and would deprive me of the 'right to strike,' which you must understand is sacred. Furthermore, Mr. Public, you may as well remember that I am irresponsible and cannot be reached under the law."

And just about there the public surrenders abjectly, bluffed to a standstill. Seeing the turn affairs have taken, the employers now meet labor's demands, jack up the prices of their products, and the public pays. Here, we are, still victims of monopoly control over the necessities, just because we lack the sense or the courage to follow our principles through to a conclusion. Summed up in a sentence, the moral of this tale is simply this: *So long as one essential element of an industry can be monopolized, the industry can be monopolized.*

Now just what is there to these potent shibboleths, "collective bargaining," "the right to strike," and "compulsory arbitration"? The first is the device by which employees seek to overcome the economic advantage usually enjoyed by the employer. So used, no one would question that it is thoroughly legitimate. But when this device is perverted into a national monopoly to be aimed through all the employers in an industry against the public welfare, we see no reason why it should be tolerated any longer than would be the collective bargaining of the manufacturers in that same industry when similarly aimed. The "right to strike" is perfectly understandable and legitimate when applied to the individual. No man should be compelled against his will to work for the profit of another. In public service, however, the surrender of such a right may well be a condition of employment; and in many cases it actually is. But even in private employment at an essential industry, when the abstention from work is not the act of an individual performed for his personal interest or gratification, but the result of a widespread agreement or conspiracy to create public hardship, it is not easy to see wherein such a practice should be less subject to public regulation than is similar conspiracy in restraint of trade on the part of employers. All this applies with equal force to "compulsory arbitration." When used to justify the industrial disturbances through which we are now passing, these principles are grossly perverted; and in the public interest their application should no longer be exempt from legal restraint.

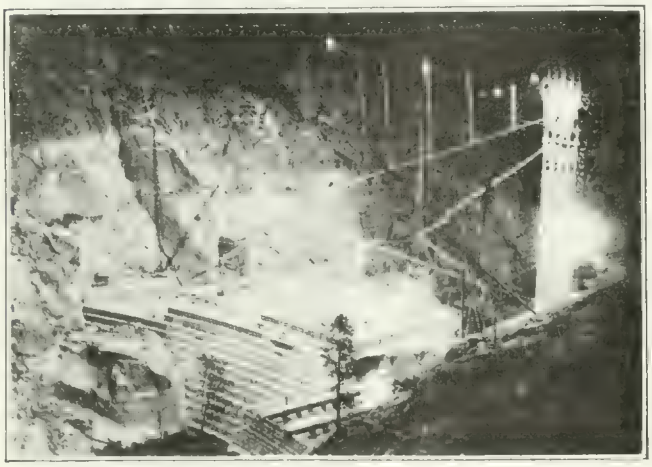
From all this it is a fair conclusion that we never shall enjoy industrial peace and security until we apply to all the elements of industry the restraint we have applied to some of them. We never shall dispense industrial justice until our laws are framed and interpreted in the public interest without regard to whether they affect the wages of current labor or the wages of thrift, commonly known as interest or dividends. Little is needed of additional legislation. All that is needed is the incorporated and responsible labor organization, equally amenable with capital to the laws in restraint of monopoly and anti-social conspiracy. Not more law; but a striking of the shackles from the law we have. And above all else, mental honesty and moral courage.

Plant and Program on the Hetch Hetchy Dam

Average Production 1,600 Cu.Yd. of Concrete Per 16-Hour Day—Bulk Cement Handling Successful—Materials Plant Rearranged as Conditions Change

VERY satisfactory progress is being made in the construction of the Hetch Hetchy Dam which is a part of the new water and power project being carried out by the City of San Francisco. About 500 men are working at the dam site, in material yards, camps and on the dam itself. An average of 100 cu.yd. of concrete is being poured per hour during the usual 16-hour day and in the month of May, working 53 out of a possible 62 shifts, 41,178 cu.yd. were placed. On Sept. 1 about 295,000 cu.yd. had been placed in the structure.

In addition to being of interest because of its size and height (the present contract calls for placing 365,000 cu.yd. of concrete and will carry the structure to a height of 344 ft.) some of the construction features of interest are the use of bulk cement, the success



GENERAL VIEW OF DAM AS LIGHTED FOR NIGHT SHIFT

in developing porous concrete blocks for drainage wells, the use of a 350-ft. concrete tower for the spouting system, an effective system of aligning forms and the method of concreting around large valves to prevent forcing them out of shape. The first concrete was poured in August, 1921, and despite some delay due to power shortage, it is expected that the work will be finished by the end of this year. An article on preparing foundations for the Hetch Hetchy Dam appeared in *Engineering News-Record*, Aug. 11, 1921, p. 222.

The dam is of the gravity type, curved in plan on a radius of 700 ft. and has a maximum cross-section as shown in the drawing on p. 466. The portion shown by solid lines is the part now being constructed; the dotted lines indicate the proposed future increase in height. The siphon spillways shown in the cross-section are to be filled with concrete when the height of the dam is increased. In addition to the 23 x 25-ft. tunnel used as a bypass during construction in which three 36-in. needle valves will be installed, other outlets will consist of four batteries of conduits arranged at different levels, three sets of two 5 ft. in diameter and one set of three 3½ ft. in diameter. All of these will be controlled by balanced needle valves.

During the low-water season the three 3-ft. balanced needle valves are to be put in the bypass tunnel. As a precaution to aid in effecting closure of the dam in case of an unusually wet season next year, a 12-ft. opening of horseshoe shape was left through the middle of the dam at the same level as the bypass tunnel, i.e., just above the level where the full width of the foundation was discontinued. After it has served its purpose this opening is designed to be closed by stop logs on the upper face of the dam while the concrete plug is being placed.

The materials handling plant is located on a slight eminence in the reservoir about half a mile above the dam. This was the most convenient place where sufficient room was available and it was planned to crush there the rock hauled from a pit about 1½ miles farther up the reservoir and to wash fines from the gravel accompanying the rock. Several new factors have entered since beginning work which have required rearranging the plant. For example, after some experiment the material accompanying the rock was rejected and the railroad was continued to a sandpit about 2½ miles farther up on the floor of the reservoir. Thus material from the rock pit is washed and the washings are wasted. Sand from the new sandpit is passed through a screening plant recently added and is stored in a separate stockpile, while the reject goes in with the product of the primary crusher.

Delay due to breaking the single primary rock crusher which was first installed led to the installation of a second crusher that was used until repairs could be made on the broken unit and since then has been kept ready for similar emergencies. The first primary crusher is of the gyratory type, while the reserve unit is of the jaw type. Both are set to pass 4-in. rock and each has a capacity of 200 cu.yd. per hour which is sufficient to keep the mixer plant running at capacity.

The rock is washed once in the rotary screen above the secondary crushers. There are two of these of equal capacity set to clear 2½-in. rock. Neither is large enough to keep the mixer plant operating at full capacity, but by keeping a considerable rock storage ahead, minor repairs can be made without delaying the work.

A stratum of very fine sand that came from the sandpits caked by moisture, rolled up in lumps in the perforated metal screen and passed out with the reject. This was a decided loss as fines were urgently needed. The difficulty was entirely remedied by substituting wire mesh for the perforated metal screens. Crusher dust is screened dry so as to avoid the loss of fines, and everything passing the ¼-in. screen goes into the sand pile.

As an afterthought it has been made possible to store a supply of gravel between ¼-in. and 1-in. size which is very convenient for concrete used in screen racks or wherever gravel serves better than crushed rock. This material is secured by placing an inclined screen with 1-in. perforations in the chute conveying the reject from the ¼-in. sand screen to the rock crushers.

The original plan was to have all materials in one large stockpile, the sand at one end and crushed rock at the other. Since the addition of the separate sand storage pile, only a small amount of sand storage is

maintained at one end of the rock pile. The capacity of rock storage is about 8,000 cu.yd. and the total sand storage is about 5,000 cu.yd. In loading the 12-car trains of 4-cu.yd. dump cars the train first backs under the sand pile and when the sand cars have been loaded the train is moved under the rock storage for the remainder of its load.

At the mixer plant these trains dump into receiving hoppers whence the material is elevated by belt conveyors to a 3-bin bunker. Each bin has a capacity of 250 cu.yd., the center one being used for sand and the two outer bins for rock. This plan makes possible the convenient arrangement of chutes direct from sand and gravel bins to each mixer.

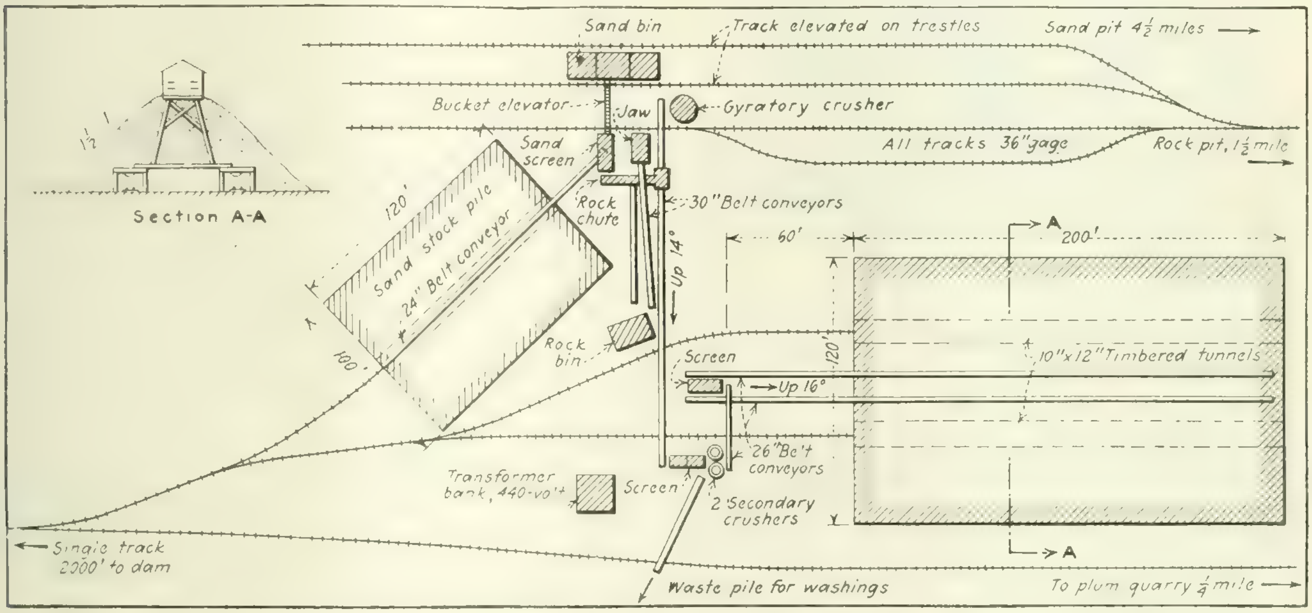
The plant for handling cement in bulk which was described in *Engineering News-Record*, March 2, 1922, p. 352, continues to be very satisfactory. Each charge of cement is still weighed by hand as the automatic feature was not considered dependable. However, with an operator on each machine there has been no difficulty in delivering batches at an average interval of two minutes. With the proportions now used the richer mix takes 960 lb. of cement per batch and the leaner mix 799 lb. per batch.

There was some difficulty in getting this quantity of cement into the weighing compartment without delay and this was overcome by putting a ½-in. air pipe into the cement hopper just above the radial gate and directing its nozzle upward. By turning on the air when the hopper gate is open any tendency to arch or clog is prevented.

White, red or green signal lights are burned continuously on the weighing house to indicate to workmen on other parts of the job whether the rich or the lean mix is being delivered; red indicating for one scale, and green for the other. The same plan is followed at the head of the spouting system so the foreman on the dam knows when to change the point of delivery. A 1:3:6 mix is used in the body of the dam and a 1:2½:5 mixture is placed in the 5 ft. next to the upstream face, along the downstream face of the spillway and at certain other designated sections.

The cement from the measuring room is delivered to concrete mixers through two 8-in. steel pipes which drop the cement about 180 ft. on a 1 to 1 slope. During cold weather when hot water was used for mixing concrete steam rising in these cement pipes had a tendendy to cause clogging. There was also the entrance of some rainwater at pipe joints. The joints were tarred to make them watertight and 8-in. vent pipes about 30 ft. long and curved downward at the upper ends were put into the receiving hoppers at the foot of the cement pipe to prevent the accumulation of pressure and to serve as a vent for water vapor. No pouring was done during zero weather. Cold weather limit was fixed at 20 deg. on a rising thermometer.

The mixing plant consists of two 2-cu.yd. batch mixers driven by 50-hp. motors and which ordinarily turn out 100 cu.yd. of concrete per hour. The maximum pour of 2,000 cu.yd. has been attained in a 16-hour run. The mixer operator manipulates all levers controlling the admission of materials into the mixer. With the exception of the water valve, all these gates are operated by water pressure. The sand and gravel measuring hoppers are located close to the outlet from the bin above so that when the measuring hopper is full it automatically chokes and the radial gate from the bin above can be closed at any time before the outlet from the measuring box is opened again.

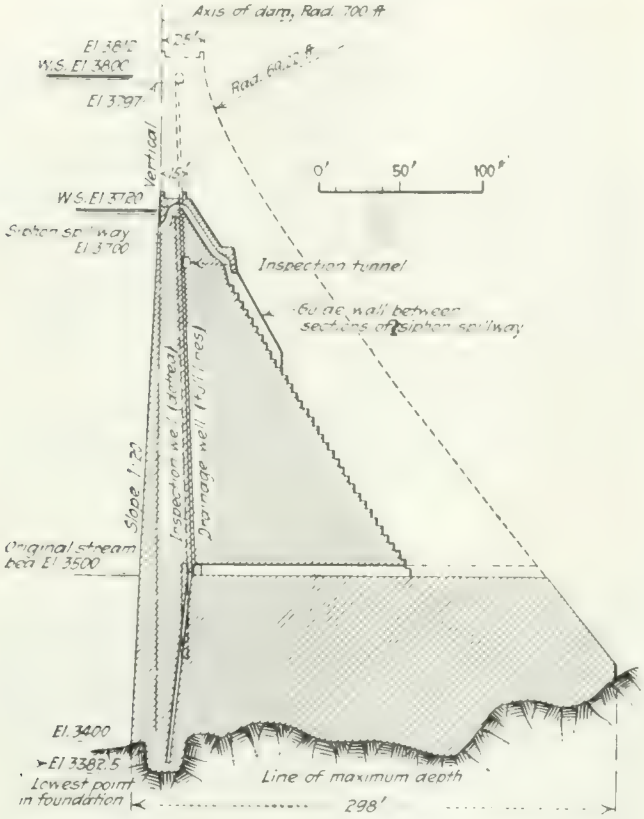


ARRANGEMENT OF EQUIPMENT IN MATERIALS PLANT AT HETCH HETCHY DAM

Each batch is mixed a full minute. Charging and discharging occupy about another minute, so that normally a batch is delivered once every two minutes.

Each mixer discharges through a hopper that delivers to either of two skips which in turn deliver to a hopper which is changed to various levels in the tower at the head of the chute system as the work progresses. At this point a hopper capacity of about two batches has been found convenient in regulating the flow through the chute, in avoiding stoppages and maintaining continuous delivery. A separate chute system is used for each mixer, but the capacity of each chute is sufficient to take the output from both mixers whenever there is occasion for concentrating this delivery.

The surface of the dam on which concrete is being



MAXIMUM CROSS-SECTION OF HETCH HETCHY DAM
Cross-hatched portion being built under present contract

poured is kept higher at the downstream edge than at the upstream edge, giving the concrete a downward slope of about 10 deg. toward the upstream face of the dam. This facilitates hosing off the surface by affording a good slope for drainage and it also eliminates the possibility of any weakness due to existence of construction joints in a horizontal plane or sloping downstream. In addition to this slope of the working surface, risers or vertical steps 5 ft. high parallel to the axis of the dam are occasionally put in to break the uniformity of the slope. This is accomplished by pouring concrete against a longitudinal run of forms which are removed before the next section is poured.

Before pouring concrete on the sloping top of the dam the surface of the previous pour is brushed with wire brushes and thoroughly hosed with water from a 1½-in. hose under a head of 300 ft. This phase of the work involves considerable time as concrete is poured, at maximum section, on an area of about one acre which has to be entirely gone over every six or seven days. In addition to washing and brushing, all surfaces against which fresh concrete is poured are thoroughly wet down just before pouring. During the winter months this calls for minor attention but the hot dry winds of summer greatly increase the hosing.

The standard forms used on the dam are made up in 5x8-ft. panels consisting of 1x6-in. tongue-and-groove flooring on 2x6-in. studding spaced 2 ft. on centers. Some of these panels have been used continuously for nine months. When warped and cracked due to the alternate wetting and drying the flooring is taken off and the panel re-surfaced. No oil is used on the forms.

The accurate alignment of form panels is given careful attention. When each 5-ft. lift of concrete has taken its initial set the up- and downstream faces of the dam are surveyed and exact locations of the prescribed limits of the structure are marked every 8 ft. In placing the next tier of forms the bottom edge is set to match the top of the forms last placed, whether these are slightly out of alignment or not and the exact locations marked by transit are used to true up the tops of the newly placed panels. Thus slight inaccuracies are corrected without abrupt changes in slope.

The level to which each 5-ft. lift should come is also marked on each new tier of forms by the surveyors, and the carpenters tack a molding along the forms at this level to indicate to the concrete foreman the limit to which he is to pour. This level is usually 1 to 3 in. below the top of the panel.

The form panels are held in place by nine pairs of twisted wires and two rows of pipes, three in each row, which serve as struts to take compression as the wires are twisted taut. The wires are slipped through loops embedded in the concrete and are passed around the outside studding of the forms in the usual way. The struts are made of old pieces of pipe, 1 to 2 in. in diameter. Lengths used in the lower row are about 2½ ft. long and in the upper row about 7 ft. long. At their lower ends the pipes are braced against the rough surface of the concrete and at the top they are wedged under the notch in a short piece of dimension lumber cut for the purpose and arranged as shown in the illustration on p. 467. This is tacked lightly into place so the nails can be loosened easily with a shovel used as a pry, after which the pipe is loose and can be removed easily. The pipes are pulled out the same day the concrete is poured, usually as soon as the fresh concrete, by its thrust against the form, balances the tension of the wires.

Forms are moved upward as work progresses so that little or no problem of form storage exists. At the present stage of the work it takes from six to seven days to complete a pour over the entire top of the dam. This gives ample time for setting and the forms are raised about once a week. The usual plan is to pour each 5-ft. lift in two operations, a depth of about 2½ ft. being placed each time and the area worked being small enough so that the second pour can be made before the first has set.

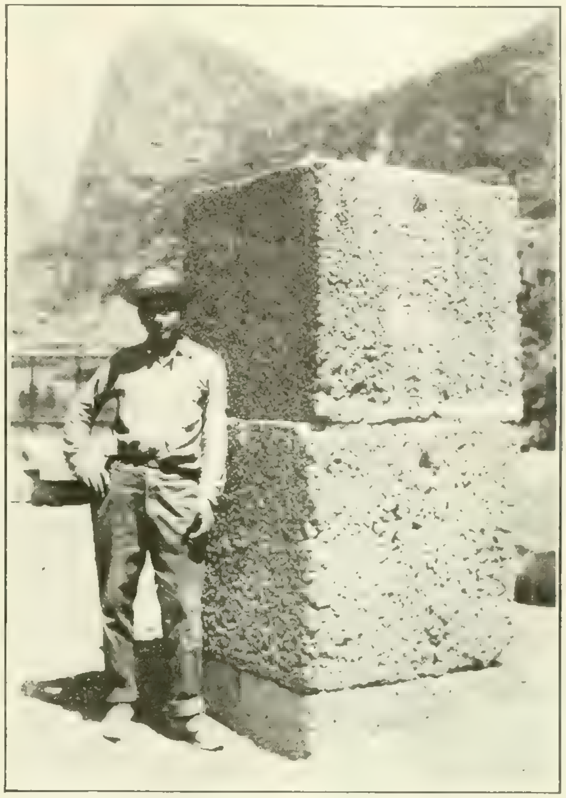
Each concrete gang on the dam consists of six men and a foreman. Five of these men, including the foreman, use shovels a large part of the time and the sixth man is stationed on the chute to clear stoppages and help in manipulating the pulley ropes when shifting the delivery point. The shovel men devote attention chiefly to seeing that the concrete is well spaded alongside of forms, around plums and at the toe of the natural slope of the concrete where honeycombing might otherwise occur. The amount of water in the concrete is so regulated that as delivered on the top of the dam it will take a slope of about 20 deg.

Not less than 10 per cent of the total volume of the dam is to consist of plums, according to the contract, and these are usually placed in large sizes, rock up to 5 tons in weight having been put in. The plums are quarried in a talus slope about three-quarters of a mile above the dam where they are loaded into skips on flat cars which deliver them to derricks on each end of the dam. The plums are delivered to place in the structure by derricks; at the present stage of the work two 10-ton derricks, set on pedestals and equipped with 110-ft. booms serve the major portion of the dam. The

pedestals are about 15 ft. square and as there is need for raising them they are built up 50 to 75 ft. above the surface of the finished work. When a new pedestal is ready the derrick is set up on it in about two days. Plums previously washed and cleaned of soil are placed on top of each 5-ft. layer of concrete at the time of pouring or immediately thereafter. They sink into the concrete by their own weight but project enough to give good bond for successive pours. Only one round of plums is placed in each 5-ft. pour.

Porous concrete blocks were decided upon for drainage wells because it was believed that they would give the maximum drainage perimeter with the least weakening of the structure or sacrifice of weight. The blocks are precast in a yard on the floor of the reservoir and are made 3 ft. 3 in. square and 3 ft. high with a central cored opening 15 in. square. After some experiment it was found that the ideal combination for maximum weight and porosity was a 1 : 1 : 8 mix, using rock from $\frac{1}{4}$- to 1-in. size. Blocks made of this material weigh 3,440 lb. per cu.yd. and show a strength in compression of 994 lb. per sq.in. after twenty-eight days. Satisfactory porosity is shown by the fact that a stream from a 2-in. pipe turned against the side of the block all passes through. They are strong enough to be handled very easily and forms are often removed after three days.

As first cast the blocks were provided with a loop of reinforcing steel embedded in each side to faciltate handling. This was found unnecessary and a depression 1 in. deep is now made in each block about 5 in. below the top. The blocks are lifted by grab hooks which fit into these depressions, the grab hooks being slung from chains and lifted by the derrick. About 1,600 of these blocks have been made of which 750 have already been placed in the dam with practically no breakage. The porous blocks are placed in the bottom of the cutoff trench for its full length, and also in vertical tiers. The latter are 50 ft. apart below stream bed level, and 12 ft. apart from stream-bed to top of the dam. As set in place on the structure about two sections are kept above the level of fresh concrete and the central opening is protected by a wood cover to prevent débris from falling down the well.

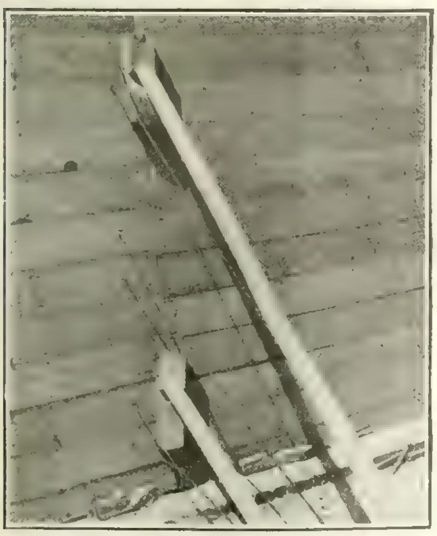


POROUS CONCRETE BLOCKS FOR DRAINAGE WELLS

These blocks are in place on the dam. The top is covered to keep out debris. Note depression near top for grab hooks.

Two 8-hour shifts are worked at the dam. The first shift is on from 6 a.m. to 3 p.m. with a lunch hour from 11 to 12. The second shift works from 4 p.m. to 1 a.m. Except for carpenters who do not work during the second shift, the crews on the dam are the same in both shifts.

Lighting for the second shift is provided by 1,000-watt lamps in dome-type reflectors strung about 150 ft. above the surface of the concrete. It would be desirable to have these nearer the work but it has not been con-



PIPE STRUTS USED TO BRACE CONCRETE FORMS

CASTING YARD WITH MATERIALS PLANT IN BACKGROUND

venient to place them below the derrick guys and other lines, so the overhead lamps, of which six are usually used, are supplemented by three or four additional lamps attached to the tower or convenient points lower down.

In an endeavor to profit by experience on other large dams where the large needle valve castings have been forced out of shape by the concrete in process of setting, special precautions are taken in pouring the concrete around the 5-ft. needle valves which are now being placed. The main valve castings are not embedded in the concrete which is poured with the main body of the dam. Instead a 3-ft. space is maintained by supplementary form work entirely around the valve setting. When ready for finally embedding the valve in concrete, the casting is held rigidly in the exact position desired by short pieces of railroad iron wedged against both inside and outside of the casting. Concrete is then carefully poured around the casting, the bracing outside being embedded by the concrete and left permanently in place.

All seams in the foundation were excavated to solid rock before concreting began, but in the upper portions of the canyon wall, as small seams are encountered, 1½-in. pipes are inserted in them and carried up about 20 ft. When this amount of concrete has been poured above the seam, grout is forced in through the pipe. Due to the considerable height of the structure the side walls were not readily accessible before construction began. Now that they can be easily reached they are again being gone over and all loose material barred down. Water-worn surfaces are either sand-blasted or drilled and shot.

No coal or fuel oil is used on the job. About 22,000 cords of wood, cut in the process of clearing the reservoir and floated down to the dam, is used under the boilers of dinkies, derricks and wherever power other than electricity is required.

Contract for the construction of the dam is held by the Utah Construction Co., for whom H. J. Lawler is superintendent and A. E. Paddock is construction engineer. M. M. O'Shaughnessy is city engineer of San Francisco and is represented by C. R. Rankin, as resident engineer at the dam.

Special Trussed Falsework for Concrete Arch

Design Made in Attempt to Do Away with Support to River Bed Subsequently Provided with Supporting Tower

By Merrill Butler
Bridge Engineer, Arizona Highway Dept., Phoenix, Arizona

FALSEWORK of rather extraordinary detail was designed for the Cienega Creek Bridge recently built by the Arizona Highway Department, but the design after erection appeared to be somewhat unsafe and was therefore supported by a tower through the river bed. Its original detailing and subsequent strengthening seem to be worth description.

The bridge, located about 30 miles southeast of Tucson, Ariz., carries the Benson Bail highway over the Southern Pacific Railroad and the creek which gives it its name. Its central span is a reinforced-concrete arch of 146 ft. span with no particular novelty except that which lies in the fact that the arch rib and the floor are integral for some distance each side of the crown as described in *Engineering News-Record*, August 10, p. 235. At this point the creek is a mere trickle most of the time, but sudden and violent floods are often experienced during the summer and winter months. The bed of the stream is composed of sand and gravel which erodes to a considerable depth during high water and which, therefore, is not particularly well suited for service as falsework foundation. These conditions caused the contractor to select the system of centering shown in the drawing.

In the construction, as indicated in view, Fig. 2, the main trusses were swung out from above and were erected entirely without support from the bed of the creek, which is 70 ft. below the roadway grade. Necessary framing was then built above the trusses and part of the arch ribs beginning at the springline poured as shown in Fig. 2. The falsework for the rib section at the right of the view is supported directly on the natural ground which forms the shore at this point before dipping abruptly to the bed of the stream.

There was no appreciable distortion of the false-

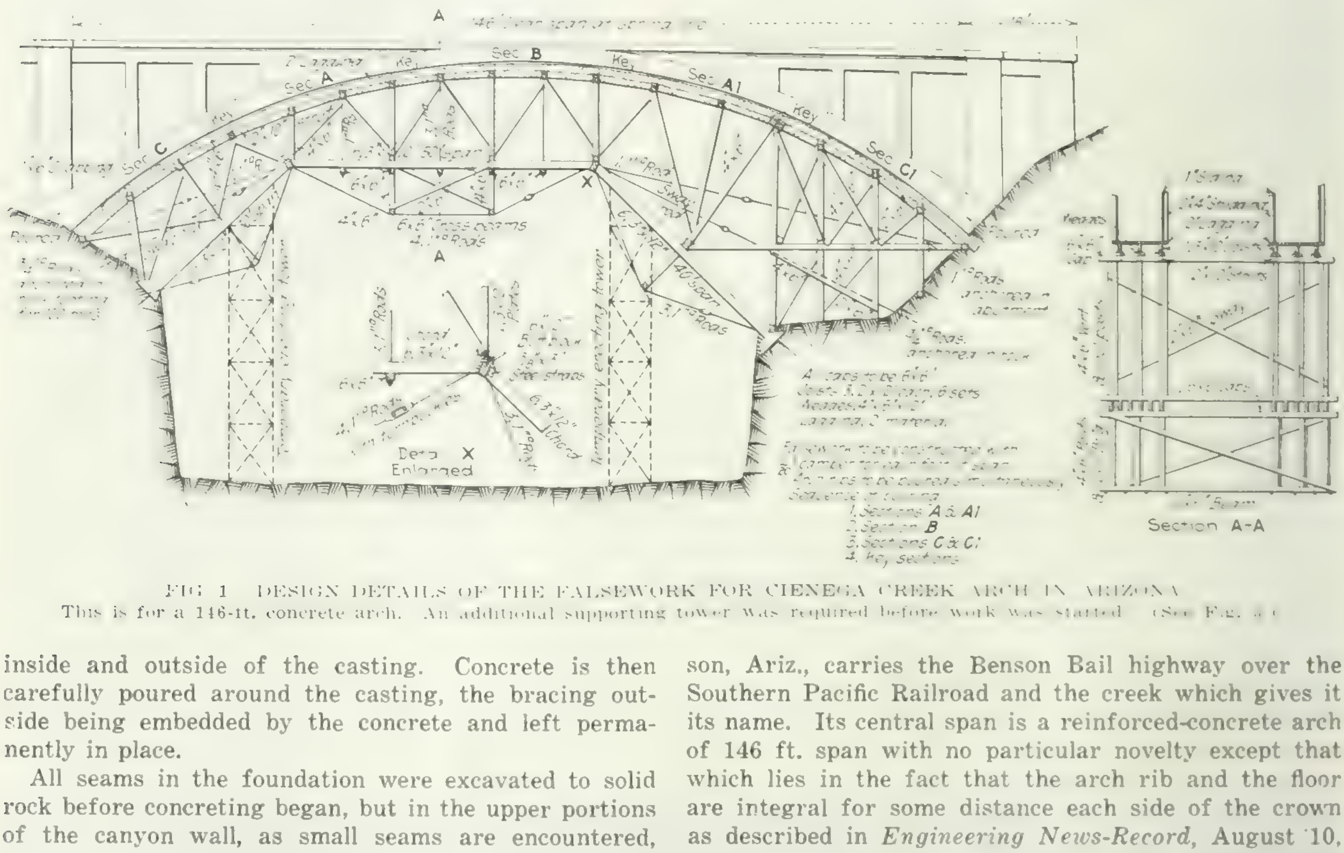


FIG. 1—DESIGN DETAILS OF THE FALSEWORK FOR CIENEGA CREEK ARCH IN ARIZONA
This is for a 146-ft. concrete arch. An additional supporting tower was required before work was started. (See Fig. 2.)

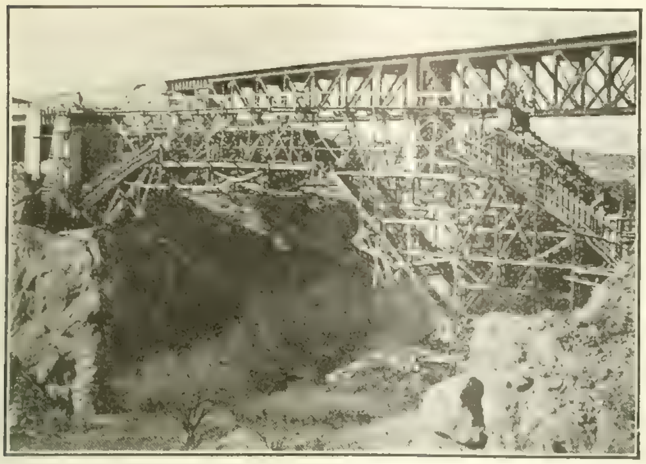


FIG. 2. FALSEWORK AS FIRST ERECTED

work, such as humping up at the crown and pushing endwise during or after these preliminary operations, but the engineers had reluctantly accepted the contractor's design for the falsework as indicated in the drawing and had agreed to its acceptance only on a strict adherence to the drawings and excellent construction details. After the falsework was up it was felt that the work was not as good as it should have been and that there was a considerable variation in the principal dimensions with the result that the falsework neither looked safe nor checked when the stresses were investigated.

The engineer, therefore, insisted that when the arch rings came to be poured across the creek that additional support was required and forced the contractor to put in a tower as shown in Fig. 3. Concrete foundations were prepared to give the necessary bearing for the footings of the tower. The wooden framing was carried up to the trusses and part of the load from them transferred by wedges. The tension rods in the horizontal trusses were then altered to suit the changed location of the support. The crown section, consisting of the monolithic roadway slab and arch ribs, was then poured and followed by the remaining rib section.

No floods in the Cienega Creek occurred during the time the tower was in place and the work was carried to a successful conclusion. The centering was dropped into the river after the tower had been dismantled.

The bridge was designed and built under the direction of Thomas Maddock, state engineer, with the writer as bridge engineer, A. W. Jenkins, resident engineer, and G. B. Little, inspector. English & Pierce of Phoenix, Ariz., were the general contractors.

FIG. 3. SUPPORTING TOWER IN PLACE

Water Power Development in Scotland

By R. Johnstone-Taylor
Underdale, Shrewsbury, England

Supplementing the note on water-power possibilities in Ireland in *Engineering News-Record*, May 25, 1922, p. 878, attention is called to a government report just issued on the water-powers of Scotland.

Altogether there are nine schemes, proposed, estimated to give 183,000 continuous kw. at an average cost of £38 5s., which is about double the present cost of modern steam stations in England. Some leading engineers are now interested in these proposals and have made preliminary surveys of two of the most promising schemes, known as the Lochaber and Grampian proposals. These have recently received Government sanction, and are likely to be proceeded with. Scotland, by reason of its topographical character and its abnormal rainfall is peculiarly suited to water-power developments, although, of course on a comparatively small scale compared to American enterprises.

The first British water-power scheme of any size was put down in Scotland for aluminum refining in 1909 at Kinlochleven, the 3,000 hp. Pelton wheels there exciting considerable interest at the time. The Lochaber scheme is in the same district and may be considered as aiming at utilizing the water power of the West Midlands of Scotland flowing towards the Atlantic. A normal head of 680 ft. will be available, with 880 ft. as a maximum. The drainage area is 303 square miles. It has an average rainfall of 73 in. per year, giving an estimated run-off of 876 million gallons per day. Natural lakes will be utilized as reservoirs, dams 36 ft. high being contemplated to give additional storage. Two of these lakes will be connected by a tunnel 3½ miles long, but the final supply tunnel is proposed to be 15 miles long and 15 ft. in diameter, the lower portion running under pressure. There will be one power station and the power will be utilized for aluminum production. The estimated available power on the Lochaber development is 72,000 hp.

The other proposal is known as the Grampians scheme, the power from which it is proposed to distribute over a wide area for general purposes. In the main it aims at utilizing the water power of the East Midlands gravitating towards the North Sea via the River Tay. The catchment area is 417 square miles divided into two sections and having four power stations. The total available power is estimated at 56,000 kw. The scheme is considered financially favorable. As in the Lochaber proposal natural lakes will be used as reservoirs and dammed 35 to 50 ft. to give additional storage, the total storage capacity being estimated at 100,450 million gallons, while pressure tunnels cut in the solid rock will be a feature of it. The available head at the uppermost of the four power stations will be 450 ft. and 16,000 kw. will be developed, while the lower power station on the same section is intended to give 14,000 kw. on a fall of 150 ft., but with an overload of 100 per cent in wet seasons.

The other section is much smaller, having a gathering area of 32 square miles but natural lakes used as reservoirs and pressure tunnels are also a feature of this section. The two power stations are estimated to develop 4,200 kw. and 7,500 kw. under respective heads of 650 and 870 ft.

Engineers in Many Fields Discuss Licensing

Extracts from Letters Commenting on the Editorial Discussion of the Subject Published in Engineering News-Record of July 6

Since the publication in the issue of July 6, of an editorial discussion on "A Rational Approach to the Licensing Problem," Engineering News-Record *has invited comment as to the viewpoint therein presented from a number of representative engineers. Some of these were known to favor the licensing principle, some disapproved and others either were neutral or had never expressed any opinions. The replies that have been received indicate a widespread approval of the principles advanced in our discussion, but few of the writers can find valid reasons for the licensing laws that have been enacted and are now contemplated. The following extracts are from some of these replies. Others appeared in the issue of Aug.* 31.—EDITOR.

J. B. Lippincott

Consulting Engineer, Los Angeles, Calif.

I am thoroughly in favor of a license law for engineers. At present we can hardly assume the dignity of a profession because of the very numerous irresponsible and incompetent men who are engaged in this pursuit without any restraint and without adequate qualification.

I cannot agree with your idealistic assumption that in discussing these laws, we must consider only the public welfare and not the selfish interests of the engineer. I think that we, distinctly, as a class, have a right to contend for our rights and for our advancement, specifically for ourselves and more or less as distinct from the question of public welfare. I am sure this has been done by many other professional men where the public interest is not vitally involved. For instance, I find that my dog doctor cannot practise without a license of the State of California. I think that we certainly have the right to receive the same amount of consideration that veterinary surgeons do.

The San Francisco and Los Angeles Chapters of the American Association of Engineers are both working on a law for presentation at the next session of the legislature.

J. V. Davies

Consulting Engineer, New York.

I think that you are on the right line with respect to the licensing question. This matter is not new, for somewhere or other I have found that in 1830 the question of licensing and regulating the engineering profession was advocated in England by the profession itself "for the purpose of securing greater efficiency in the profession and to promote safety." At that time engineering as a profession was new and there was no sub-division into specialties as now.

The question seems to have lain dormant for many years, but during the last ten or twelve years the legislatures of many states have passed licensing laws more or less simultaneously. Certainly, there has never been a demand either from the public or from the press for the protection (whether of the public or of the profession) that might be expected from such legislation. On the other hand, there seem to have been no enactments requiring that qualified engineers should pass upon and certify the safety of structures and equipment any failure of which may involve the security of the public. This, it seems to me, is completely ignored.

Take, for the purpose of illustration, our own New York law, as I presume most state laws will follow the same general lines. The first section states: "In order to safeguard life, health, and property, any person practising or offering to practise professional engineering * * * shall hereafter be required to submit evidence that he or she is qualified so to practise * * *." No one in whatever humble capacity is permitted to practise professional engineering until he has been duly licensed, but he may be licensed when he is twenty-one years of age, and before he is licensed he must have practised engineering for four years. The certificate issued as the result of this very special investigation as to qualifications states that the party "having given satisfactory evidence that he has the qualifications required by the law is hereby licensed to practise professional engineering." On such a basis as this, what possible protection can the public have that their lives, health, and property are safeguarded? The many branches into which the profession has been split up make the question of qualification to practise engineering on broad lines an absurd and superfluous anachronism. A man who has been trained and is expert in one line of engineering may not be in the slightest degree capable or competent to practise the profession in another line. The law is valueless and of no effect in so far as the protection of the lives, health, and property of the public are concerned.

In the passage of these laws there is no intimation (and the point is carefully avoided) that in them there is any purpose to benefit the profession itself. Reading between the lines, however, it rather appeals to one that they originated in a selfish motive to make a closed corporation of the profession.

Personally, I have no objection to the licensing of civil engineers, but that a civil engineer qualified, competent, and expert in his line in one state should be precluded from practising in another is absurd on the face of it, particularly as a single engineering undertaking often extends beyond the limits of a single state. If out of this chaotic mess of amateurish law making a proper federal requirement could be set up that would not only prescribe the qualifications necessary to practise within the United States but also provide that all public works wherein may be involved the safeguarding of the life, health, and property of the public shall be certified by a responsible and qualified licensed professional engineer, there would be some sense in the application of the licensing principle.

One result of the enactment of licensing laws is the legal establishment of engineering as a profession. It is the official, legal recognition that engineering in its various professional branches necessitates training and skill. As the profession has been built up by the engineering societies here and in Europe, it seems to me that those societies each in its own field are far better qualified to pass upon engineering attainments than would be individuals empowered by each separate state, sometimes politicians with no knowledge of engineering, or by others equally unfitted. It would seem that the qualifications required to become a member of any one of our great engineering societies would constitute a far better criterion for the professional engineer than the present chaos of loosely drawn and perhaps ignorantly conceived laws. When we can get these essential qualifications and proper examination of candidates by a central engineering body with licenses issued by a central authority we shall have arrived at a rational solution of the problem which would be acceptable to the profession itself and which would be worth while as a safeguard for the life, health and property of the public.

I venture to suggest that the Institution of Civil Engi-

neers of Great Britain has presented to us a lesson worthy of consideration. It is seeking to protect the term "civil engineer" by means of a bill to be passed in Parliament setting up a tribunal which shall pass on the qualifications of any one who desires to be termed a "civil engineer." This tribunal would be made up of men named by the president of the Institution. It appears to me that if such a tribunal could be set up in this country consisting of representatives of our engineering societies it would go far toward clearing up the situation.

Whether the state legislatures would be willing to see their licensing powers taken from them by such a nation-wide body is, however, extremely doubtful. I feel, therefore, that this discussion is more or less academic. If the state licensing laws are ill-drawn or unwise, the time to have stopped them was before they were passed, not after. The duty now remaining is to watch carefully and closelv their operation with a view to later amendment or consolidation.

I see in your issue of July 27, 1922, that the state engineering examiners have promulgated a plan by which there may be a recognition of licenses in other than the issuing states. Naturally I am entirely in accord with such a movement and for my part think that if an engineer receives a license in one state it should *ipso facto* give him authority to practice in any state.

* * *

R. D. Coombs

Engineer and Contractor, New York.

Lest he fail to convey his real opinion the writer desires first to record himself as opposed to the general licensing of engineers, either as at present practiced or under any other plan. The present plans cannot accomplish any great public benefit and the writer does not believe that any effective general plan can be evolved. It is believed that such support as the project has thus far received is based on three desires: 1. To "close" the profession and restrict the number of engineers; 2. To provide political place, patronage, and fees; 3. To prevent or decrease accidents, particularly in the building trades.

The present licensing plans will certainly not accomplish the first intention, whether or not that intention is itself desirable and in the public interest. The third desire can more surely be accomplished by enlarging, improving and if necessary licensing the building and related departments of our cities. The head of an engineering or architectural firm might be a competent engineer and the proud possessor of a license but those facts are no guarantee that the final structure will be a safe structure if passed by an incompetent or pliable building department, inspected by absent treatment, and built by a practical and sometimes reckless contractor.

May the writer amend your third principle by omitting the word "ultimate"? The actual designer is the one who should be competent, as his licensed competent and busy superior may never see the details of design. The real protection to the public is the reputation of the concern and the care taken by it to acquire the confidence of its clients.

It would be of interest to know the relative numbers of teachers and consulting engineers as compared with contracting engineers, railroad engineers, etc., who favor the plan of general licensing. The writer is under the impression that the former group furnishes most of the support for the movement and that the latter group does not admit either its practicability or necessity.

Even though it were possible to make any exercise of engineering judgment a misdemeanor if performed by the unlicensed, the enforcement of the law would be impracticable, and how otherwise can the purely engineering group expect to avoid encroachment by those who both design and construct or who *only* construct.

It would seem that the general licensing of engineers is merely another of the many efforts of recent years to make us all better by law and by establishing another federal or municipal agency which, on appointment, becomes miraculously endowed with superior vision and wisdom.

Chas. W. Gustavus

Peninsular Engineering Co., Detroit, Mich.

It was with a great deal of interest and chagrin that I read the statement that the New York Section of the American Institute of Mining Engineers and two engineering societies in Pennsylvania move for repeal of licensing laws. I have also noted from time to time editorials and comment on the question of licensing and would like to express my opinion on the subject.

The fundamental principles for creating an engineers license law are two, namely: the protection of the public and the protection of the engineer. No doubt the ardent advocate of professional ethics would eliminate the protection of the profession, but we must remember that facts as well as theory must be considered. Protection of the profession would itself protect the public. Speaking of protecting the public is a joke. The "poor" public apparently does not give a tinkers dam about the matter until some catastrophe takes place, and within two weeks they have forgotten it entirely. That this is true is being evidenced every day by the employment of contractors with the word "Architect" after their name, or the engagement of an electrical contractor who will furnish a free design.

Suppose we do enact license laws that protect the engineer. Our ethical brethren cry out that such laws constitute class legislation. The architects apparently are not worrying about the class legislation which is in force for their benefit. Nor are the lawyers and doctors. Before going farther, let us straighten out this matter of the public, lawyer and doctor, which some critics insist does not enter into the question. It has been stated that the doctor and lawyer deal with the individual; every man, woman and child being a prospective client. However poor, illiterate or ignorant, the plain citizen has the right to feel that his lawyer or doctor has been vouched for by the state. There is no other way to protect him. The state cannot examine and approve the prescriptions of the doctor, nor the briefs of the attorney, nor has the citizen, in general, the time, the ability, or the resources to investigate the qualifications of this individual into whose hands he is about to entrust his liberty, perhaps his very life.

It has been stated by advocates against licensing that these conditions do not apply in the case of the engineer or architect, that those who seek their services possess capital or command capital, and are in general responsible and of substance. They may be assumed to have intelligence, resources and time to determine the fitness of an engineer or architect. The standards of these investigators will probably be higher, and will certainly be more specialized than any that might be prescribed by the state in a reasonable license law. All this is sheer bosh, bunk and insidious propaganda. The very persons just mentioned are the ones who put up theatres, halls, grandstands and utilities. Who uses them, and whose life is endangered? The "poor" public, of course. So long as the engineers stand by and see these very persons hire plumbers and steamfitters as "expert heating engineers" and wiremen as "electrical engineers" and those other monstrosities that "Civil Engineers Wives" write about, just so long will the public be in danger and the engineers ranking in fourth place instead of the high and esteemed position our ethical brethren are wishing to have them occupy.

Licensing of the engineers, even if it could be termed class legislation and protection, would eliminate this riff-raff, and automatically furnish protection to the public, who are the ones requiring it, not the one engaging the services of the engineer or architect.

But, the critics will say, later work and experience will raise professional ability and trust in the engineers work, and not a license in the hands of the young graduate. It is an easy matter to require a certain amount of actual experience before a license would be granted, thus inspiring those to strive for it who are at least duly qualified, and build up the ranks so that the profession could occupy a dignified position. It is not necessary for the license to specify the business ability and horse sense of the holder of it, as one engineer seems to think. Doctors and lawyers

certificates do not require it. Competition takes care of that phase of the matter.

Further criticism may state that the license committee of the American Society of Civil Engineers, which has been sitting for a year, has not yet arrived at any conclusion justifying a report. This certainly is no reflection on the question under discussion when one considers the time they had deciding matters relative to their constitution, and as Gardner Williams remarked after their heroic efforts, "a careful reading will discover few sections that improve upon the old ones." American Engineering Council also adopted a report on registration. Talk about your milk and water editorials. The committee states it should be beneath the dignity of engineers to fence themselves against qualified competition by the artificial barrier of statute. Licensing provides competition among qualified persons, if anything, which is a reasonable step in a sane direction. Its the unqualified element that disrupts competition.

Other critics would unquestionably ditch registration and protect the public with the building code as it is being formulated at Albany by Commissioner Sayer's labor leaders, actors, health officers and other hot sketches. Sure, let the engineers educate these fellows and start a campaign of public information. That is what engineers are educated for, presumably, and not for engineering work.

Until "some" engineers realize that we must stick together and work together, as that which benefits one benefits all, we will have to listen to the "twaddle" about educating the public and raising professional standards until the cows come home. Registration for protection of the profession protects the public, and cannot be misconstrued as unethical or being class legislation. Here is hoping the mining engineers come up to the surface of the ground and see the light. Pennsylvania has enough poor laws on her books, so for goodness sake leave a few of the good ones on that were fortunate enough to get on.

Edward Flad,

Consulting Engineer, St. Louis, Mo.

Ought the state to pass upon the qualifications of one who desires to practice engineering and decide whether or not he may represent himself to the general public as an "engineer," issuing licenses to those only who are qualified?

The reasons for requiring licensing may properly be set forth as follows: 1. The protection of the general public against the charlatan or unqualified engineer, so that any one desiring to employ an engineer may know that the state has passed upon his qualifications. 2. The protection of the general public, as far as may be, against damage to life or property from accidents due to faulty design. 3. The protection of the engineer against the competition of the uneducated or inexperienced practitioner, thereby eliminating those who are unqualified and improving the standing of the profession.

Let us consider these reasons in the order above cited.—1. There does not seem to be any demand by the general public for protection against the unqualified engineer.

One who requires the services of an engineer may safely be assumed to be a person of some means, to have the ability required for making the necessary investigation and to have ample opportunity to become fully informed as to the qualifications of the particular individual before engaging him as his engineer. In this respect the engineering profession differs from that of the doctor or the lawyer. It is submitted that licensing would not materially assist the general public in the selection of engineers. The uninformed, the poor, the indigent, need no protection for they do not employ the services of engineers.

2. The protection of the general public against damage from accidents due to faulty design will not be properly accomplished by licensing unless the issuing of licenses is restricted so as to cover specifically each line of work.

An engineer may be qualified by education, training and experience to undertake important work of design and construction and yet not be an expert in all the various branches of engineering involved in the design. His ability to prosecute successfully a particular piece of work depends in large measure upon his ability to select assistants and specialists to supplement the general information which he himself possesses. Let us assume one of our leading engineers should undertake the design and construction of a system of waterworks. This would involve civil engineering, hydraulic engineering, electrical engineering, mechanical engineering and chemical engineering. I doubt if any considerable percentage of our leading waterworks engineers would be fully competent in the details of each of these branches, or able to qualify for licenses which eliminate those not fully qualified in the particular branch of engineering specified in the license. Any form of license which would offer material protection in this respect would undoubtedly eliminate 50 per cent or more of our most prominent engineers and, unless the license when issued did offer such protection, it would be a useless and unreasonable restriction and of no avail, so far as the interest of the general public is concerned.

It is submitted that the public is best protected against damage due to failure of structures by building laws enforced by public officials whose duties require them to check over and pass upon the plans and specifications before permits for their construction are issued, supplemented by such supervisory control as may be necessary during construction.

3. Such benefits as may accrue to the profession from licensing will depend upon the standard of qualifications set up.

If the standard is broad enough to admit all of those who should properly be admitted, licensing will eliminate very few, let us say perhaps 1 per cent of those now practicing. We all know that there are a few in each community who set themselves up as engineers and who are not qualified either by training or experience to practice, but those who should properly be eliminated are so few that they do not offer any serious menace to the standing of the profession. Any narrow restrictions in the licensing requirements, based upon examination as to technical knowledge in each particular branch of engineering for which licenses may be issued, would deprive the public of the services of a large majority of our competent engineers, and so may properly be considered to be against public policy.

Permit me to suggest, therefore, that even if licensing is provided for, the right to practice should not depend upon the possession of a license. Let him practice engineering who will, either with or without a license, and if it is thought that the interest of the profession so requires, license those that desire a certificate of qualification. Such procedure will preserve the right on the part of the public to employ either licensed or unlicensed engineers and the licensed engineer will derive whatever benefit may attach to his certificate of qualifications.

Summing up my views, I am opposed to licensing as a general proposition, holding; that the public interest does not demand licensing of engineers; that any form of license which eliminates only the manifestly unfit will be of so little benefit to the general public as not to warrant the inconvenience and expense to the engineer involved in licensing; that any form of license which would restrict the practice of the profession to those who are technically competent along each of the lines of work undertaken would eliminate 50 per cent or more of our capable engineers and hence would work against the public interest and offer a serious restriction to the practice of the profession; that a form of licensing which will insure qualification in the particular branch of engineering specified, if made optional with the engineer and not a prerequisite to practice, might be of some trifling benefit to both the general public and the profession—but I doubt it!

Architects on Cincinnati Terminal

The architects for the new Dixie Terminal at Cincinnati are Garber & Woodward, and not Barber & Woodward as given in *Engineering News-Record*, Aug. 10. p. 218.

Notes from the Inter-Mountain Country

By W. W. DeBerard
Western Editor, *Engineering News-Record*

Southern Idaho, an Engineers' Creation

SOUTHERN IDAHO is traversed by the Snake River in the form of a widely extended letter U. Much of the area adjacent is fairly level lava country of little use, dry but capable of becoming a paradise if irrigated. Irrigation engineers in consequence look upon the oases now existing as objects of their creation. Perhaps nowhere else has the operation of large works remained so largely in the engineers' hands. From water regulation down the river, comparable to train operation, to the detailed management of the projects, engineers retain supervision. Only partially developed as it is, Idaho is and has been for years the scene of more irrigation promotions than almost any other state. The last and largest of them all, the American Falls project, looks to the construction of a two-mile 90-ft. dam which will safeguard the crops on 900,000 acres now in cultivation and a complete water supply for half as much new land. A chance to look over the site of this coming largest of reservoirs with its 3,000,000-acre-ft. storage certainly seemed worth while.

American Falls as a town will have to move when the dam is built through its center. A new town site has been laid out on high ground to which there will be an exodus when the citizens imbibe the faith of the engineers in the certainty of the dam's construction. Meanwhile, the government is buying property and leasing it back to the owners. If construction is delayed another two years few condemnations will be necessary. I visited the new town site and drove down the main street which is marked now only with surveyor's stakes. It will be a pleasant place to live with zoning predetermined and other civic features carefully placed by a professional city planner which the Reclamation Service employed to put it on paper after a detailed study on the ground. Water will have to come up hill, sewage be led down again and the other utilities all fitted in as in the days of cantonment construction, though let us hope without the feverish haste and expense.

Interesting as is contemplation of the wonderful possibilities of making an ideal city the study on the ground of the site of this dam to hold back the largest of artificial bodies of water was more fascinating. Here if anywhere the geologist fixed the center line of the structure. In fact nature fixed it, for the geologists agree that only one line is feasible, and that shortly above the present falls substantially as shown in the photograph on p. 474, taken from the south side standing on the line. Without recourse to geological terms or an attempt to interpret the geologists' report, which more than one engineer already has misinterpreted, the areas both downstream and upstream get into unstable, undesirable or expensive formation difficulties of sandy clay or tufa layers which drillings indicate will be largely avoided at the site selected. The north bank of the river is good rock rising with the country slope and the south side is well compacted non-porous clay into which a core wall will be carried for several hundred feet. The site is a geologist's paradise. The outcrops and nearly perpendicular canyon walls lay bare the faults, successive lava flows, tufa and obsidian with spheroids and other geological phenomena.

AMERICAN FALLS DAM SITE WHERE WILL BE CREATED THE WORLD'S LARGEST RESERVOIR
At the far side of the river rock outcrops at the water edge and dips under the river. The near bank is of clay with occasional strata of fine sand. The irregular U-shaped spillway follows the end of a rock cap

A trip over a portion of the future 75,000-acre reservoir floor disclosed a wide flood plane covered largely with willows. At the lower end the ranchers eke out a fair living, though hay only could be grown because of the water-logged condition of the ground when any moisture at all is available. However, a large item in the estimated $13,000,000 cost of the project is for overflowed lands.

To see a sample of what the consummation of the work would produce it is only necessary to visit the present projects and this was done by a 150-mile drive down the river from American Falls in company with Barry Dibble, project manager, who knows everyone and everything which could possibly interest an engineer. On the way down the valley two main river structures claim one's attention, the dam for the Minidoka project of the Reclamation Service creating Lake Walcott and Milner Dam built in 1905 by the Kuhns for the two Twin Falls private projects. Three years ago when I was here last, attendants at both dams were bent on saving every last second-foot of water; this year they were wasting water prodigally. I recall

HANSON SUSPENSION BRIDGE 350 FT. ABOVE THE SNAKE RIVER

The first cables were shot across the canyon with a small cannon.

vividly Mr. Dibble's account of reducing to 12 sec.-ft. a 200-sec.-ft. waste through the mile length of stop planks of the Minidoka spillway by $500 worth of 6-oz. canvas tacked over the water face with the flop at the bottom covered with sand. My old notebook further records the fact that canvas was not to be had in Salt Lake but luckily it was found in Denver and shipped on hurriedly by express. At Milner Mr. McConnell put canvas strips between each flash board to make better joints and elaborate plans were made to grout a few small "boils" indicating direct seepage holes through to the rock below the dam. No such worries this year were in evidence, for Jackson Lake, the headwater supply, filled full last winter.

Burley, the largest town on the Minidoka project was not quite so prosperous looking as in 1919. The hotel was run by a receiver, and the dining room was closed. It had a day-after-the-night-before appearance. Houses and stores were for rent and the new school house built on the outskirts of the town a block beyond the last house on the street looked lonesome and probably will remain so for many years. Stories of city real estate orgies come to an end in the court house were rife. Several banks in Idaho quit last year. The potato flour factory which was ready in 1919 to save to the farmer freight costs and put out a product for eastern consumption and to send abroad for starving Europeans never started. The alfalfa meal mill was a success, however. Idaho shared in the expansion after the war and in the depression of 1921 but scarcely anyone spoke of it. Optimism is the Westerner's best asset. Burley has good schools, paved streets and a sanitary, though extremely hard well water supply. Despite these appearances the 1921 crop yielded on the 110,000 acres irrigated $3,400,000 worth of products shipped out in 4,500 cars and purchased wholesale manufactured goods to the extent of $3,430,000. The railway records always indicate that about the same amount of freight comes in as is shipped out. Eighty additional miles of roads were graded at a cost of $1,350,000. The project boasts of 260 miles of graveled roads.

Oakley Dam, about 25 miles south of Burley, is an excellent piece of engineering and example of an earth dam 145 ft. high with a concrete core wall, faced both upstream and downstream with hand placed rock riprap. (See *Engineering News*, p. 516, March 13, 1913.) Up to last year it had never been filled; the water shed is too small. However, last year water ran over the elaborate 600-ft. spillway of 2,000-sec.-ft. capacity for a short time. This year was also unusually wet but no water was wasted though the dam was nearly full. It is the last of the Pittsburgh financier's ventures and somewhere there is a slip in calculating the available runoff. The article noted above states that the duty was fixed at 1½ acre-ft. per acre and the runoff was based on an *average* precipitation from 15 years' record of 9.1 in. The promotion was on a 50,000-acre basis when one-half or less acreage, experience has shown, is all the development is good for. For the sake of making a compact project and to save the losses entailed in long ditches the state has been importuned several times, unsuccessfully, to segregate all of the settlers on 18,000 or 20,000 acres at the upper end of the project compensating those who have put in improvements outside of this area. In 1919 the settlers only had 10½ in. of water the whole season. Trees died. Knowing beforehand of the shortage many farmers put their quota on one-half or less acreage.

But my visit to the Oakley Dam was on a more serious question. At half a dozen points near the downstream toe there were depressions in the riprap. One large "crater" was located about half way up the slope. At two of the depressions quite a stream of leakage could be heard falling some distance. One of the largest sink holes was oval in shape, about 15 ft. long and 12 ft. wide. Last year much more water carrying a heavy turbidity came through when the reservoir was full. The people in the valley below grew quite alarmed though prominent engineers assured them that the leakage meant little. The core wall they claimed was surely intact and the water probably came around the ends of the dam. Nevertheless the operators of this project would do well in the humble opinion of the writer to throw off the riprap and lay bare the earth so as to learn what could then be seen. When 1½ sec.-ft. of water comes through an earth dam even though it is clear a bit more attention would seem advisable.

Twin Falls is an old town and the center of southern Idaho irrigation. Here Perrine, one of the earliest promotors, down in the narrow flat at the foot of the

GEOLOGICAL STRATA AT OLD POWER TUNNEL OUTLET

Soft tufa at bottom, hard lava flow [illegible] near top of tunnel

Snake River canyon walls planted the first irrigated crops in the vicinity. The yields were the lure that built the present development. Perrine's land was protected down in this slot of the earth where semi-tropical conditions prevailed. Fortunately for the promotors the soil and climate on the level stretches above the canyon floor proved equally good when irrigated. Perrine is dead but his good wife still runs the Blue Lakes ranch as it is called and maintains a toll bridge over the river.

Recently Twin Falls acquired a modern rapid filter to treat the ditch water which formerly it used after a short settling period. Bacterial and chemical tests are made daily, said Captain McRoberts, the mayor, who kindly escorted us to the plant and answered most intelligently all of our detailed questions as to difficulties with "mud balls," delayed floculation and short runs. In the winter two serious difficulties arise: The ditch may not carry any water and the temperature is so low that floculation may occur in the filters causing a deposit of aluminum hydrate. Bacteria are reduced from 8,000 to from 20 to 60. Chlorine is used. A turbidity of 80 comes down to zero. Alkalinity ranges from 120 to 15, indicating probably a hydrogen-ion concentration a long ways from the optimum point of coagulaton. It occurred to me that it would be most interesting to sit down with the mayor and his analyst and thresh out for a week if necessary all of the vexatious difficulties which his little 6-m.g.d. plant is as much heir to as are the larger plants at St. Louis or Cleveland. Some day some consulting engineer will make a good living selling his services to these small plants to keep them tuned up. Life in Twin Falls is worth as much as it is in St. Louis.

SINK HOLE DUE TO SEWAGE EITHER THROUGH OR AROUND OAKLEY DAM

Rock riprap on downstream face dropped into hole formed by seepage water carrying away earth below. Hole is 15 ft. across and falling water could be heard. Six such sinks exist, one is half way up slope.

Prospects of the American Falls Project—The farmers in the vicinity of Twin Falls were the last to sign up for the proposed American Falls District which will contain 500,000 acres located in eight counties. Late advices indicate that 1,388 persons owning 142,000 acres (20,000 more than required) did sign, validating the petition. On July 24 the board of county commissioners heard the petitioners in preliminary review. Four weeks later a hearing was to take place and after another interval of four weeks an election on the organization of the district. A bond issue election requires another four weeks' advertising. It is planned to vote $3,000,000 in this district which will need water only in dry seasons. Then obtain $3,000,000 from a district of new land and $3,000,000 from the Reclamation Service. The amount will develop 1,500,000 acre-feet of storage, one-half the ultimate capacity. Acreage at Twin Falls will pay $5 per acre while the new land will pay five or six times as much.

Such is the red tape of big developments. The engineer in Idaho is at the bottom pushing, talking, coaxing and earnestly pleading for a chance to help the other fellow help himself. What he gets out of it is a chance to build something monumental for the betterment of his country and fellow man and incidentally a meager stipend for the brief space of time he is employed. But he is eager to be at the job and get it finished though its very completion means the end of his services.

At the dedication of the Elephant Butte Dam, after congratulating and eulogizing all the dignitaries assembled on the completion of the structure, President Roosevelt turned to the engineers who had in some way places on the speakers' platform. "As for you engineers, you will probably be investigated." Rarely, however, have I heard expression of pessimistic views by the man on the job. He is too busy and truly interested in his job to think of them.

Report Progress in Investigation of Marine Borers

New York Committee Studies Conditions Under Which Borers Thrive—Will Publish Data on Protective Measures

THE local committee organized in New York to co-operate with the National Research Council in its campaign against marine borers (*Engineering News-Record*, Feb. 23, 1922, p. 335) has been studying conditions along the coast between Atlantic City, N. J., and New London, Conn. The committee now consists of about forty members with representation from the engineer and quartermaster corps of the army, the Bureau of Yards and Docks of the navy, and the lighthouse service. Several of the New York City departments are represented and the commissioner of docks is an honorary member. New Jersey is represented by the director of the Board of Commerce and Navigation. The committee includes also representatives of the engineering departments of the railroads and several of the engineers, biologists, and chemists of the city.

On Aug. 22 the committee reported on its work to date and outlined its plans for the future. Eleven hundred copies of a questionnaire have been sent to the owners of waterfront properties within the territory. These were designed to elicit information as to earlier and current attacks of marine borers, as well as data regarding methods of protection that have been used and the measure of success attained. Replies have been received covering about 330 structures. These give valuable information and indicate desirable locations for a more intensive study of the problem.

Inspections and Studies—In order to determine the present locations of the various species of borers, 81 test pieces were fastened to structures in the New York territory. Most of these have been inspected in place by biologists and 60 of them have been replaced by test boards each of which carries 24 blocks. One of these blocks is removed every two weeks and sent in to the headquarters of the investigation. As each block is removed it is replaced by a new one. This plan enables a determination not only of the presence of the

borers but also of the rate at which they work under various conditons. A biological survey also has been undertaken and piles removed from structures have been inspected. As the ravages of the teredo are not readily visible on the surface, it is necessary to cut up the piles in order to make the necessary inspection.

The biological study has shown the presence of limnoria this summer at several locations in Long Island Sound and Jamaica Bay. Live teredo have been found on the New Jersey coast in several places, in Great South Bay, and in New York Harbor proper at Sandy Hook, Perth Amboy, Elizabethport, Fort Hamilton, Clifton and St. George, Staten Island, and Bayonne. Evidence of earlier attacks, some of them dating back many years, was reported from many structures in and around New York harbor.

In order to determine the conditions under which the various borers work, the Board of Estimate and Apportionment of New York City has made at 61 locations, 208 determinations of the temperature, salinity, and dissolved oxygen content of the water, and recently has been making determinations of hydrogen-ion concentration. The committee has recently established six permanent stations at different points in the harbor where these determinations can be made more frequently. A sub-committee of the New York committee in conjunction with the national committee has been collecting and studying records of, and will soon report on, methods of protection for old and new structures.

Future Plans—The plans of the committee for future work provide for a continuance of the biological survey of the harbor to locate additional foci of possible infection and to watch the spread of borers from present locations. The chemical and biological study of the water will be continued and adjusted to the biological findings. It should then be possible to give warning to owners of structures which seem to be in danger from borers. To carry on this work the members of the committee have done much gratuitous work, the railroads have contributed funds, material, and labor. The city of New York and the States of New York and New Jersey through various departments have contributed labor, materials, and boat service. Similar assistance has been furnished also by the army, navy, lighthouse service, and coast guard. The American Museum of Natural History and the New York Aquarium have furnished working space and scientific assistance.

These studies carried on by the New York committee are supplemented by similar work being done at other points on the Atlantic coast, as well as in government and university laboratories. Much assistance is received from city departments as well as from the scientific departments of the federal government and the railroads. The chairman of the New York committee is E. P. Goodrich, and the secretary is C. L. Gamsby, Room 951, 466 Lexington Ave. The director of the national committee is Col. Wm. G. Atwood, Engineering Societies' Building, 29 West 39th St., New York City.

Handling Customers' Water Bills in Toledo

The 45,000 water customers' accounts in Toledo, Ohio, cost in 1921 slightly less than $2 each. This is too much for bookkeeping, billing and collecting, according to the latest annual report of the water department, and steps are being taken to reduce it. Accounting, meter reading and administration cost $9.28 p. m. g. as against $8.52 in 1920.

Constructing Modern Office Buildings in Japan

American Firm Uses American Methods, Personnel, Equipment and Materials in Oriental Construction Work

DURING 1919 the Japanese government sent a group of representative men to the United States and Europe to study building methods with a view to inaugurating in Japan a building-construction program embodying the best methods. The commission, after considerable study, decided that business buildings as erected in the United States were superior to others and in consequence invited the George A. Fuller Co., New York City, to organize a construction company exclusively for oriental work which would have as its first job the erection of modern office buildings in Japan. The construction company known as the George A. Fuller Co. of the Orient, Ltd., was organized therefore

FIG. 1—MARUNOUCHI BUILDING IN TOKYO

This building was erected for renting and investment purposes and is the largest of the four buildings herein described, having a rentable floor area of 632,000 sq. ft.

upon the invitation of such men as the late Baron Rempei Kondo, president of the Nippon Yusen Kaisha, and Baron Shibusawa, a member of the recent Peace Commission.

Buildings in Tokyo—The construction company sent an organization to Tokyo in January, 1920, to start a campaign of modernizing building industry in the far East. It was the desire of the Japanese that this organization not merely act as builders, but as teachers to train Japanese architects, engineers and mechanics in modern American construction methods. The company is now constructing four buildings in Japan, three of which are being built in Tokyo and one in Kobe. There is also under consideration an extensive construction program for Dairen, Manchuria (North China). The largest of the Japanese operations is the Marunouchi Building owned by the Mitsubishi Goshi Kaisha, which is an office building to be used entirely for renting and investment purposes. The cost of the structure when complete will be approximately $5,000,000. The ground area is 335 x 275 ft., and the building is 100 ft. high, or the equivalent of eight stories. Rentable floor area amounts to 632,000 sq.ft. The street facade has a

FIG. 2—JAPAN MAIL STEAMSHIP BUILDING

Japanese granite base course with cast stone to the second story sill line, above which the building is faced with local Japanese facing tile up to and including the seventh story. The eighth story is faced with cast stone and stucco. This building is of skeleton steel frame construction with reinforced-concrete floor arches, and is equipped with ten passenger elevators and one freight elevator. It will be completed by November of this year.

The second building is the Nippon Yusen Kaisha building, which is an office structure built principally to house the head offices of the Japan Mail Steamship Co. This building is approximately 290 x 160 ft. in ground plan and is seven stories in height, or approximately 100 ft. The building has a Japanese granite base course on the street façades and ornamental terra cotta for the balance of the street elevations. It is also of skeleton steel frame construction with reinforced-concrete floor arches, containing seven passenger and one service elevator, and will cost approximately $3,000,000. It covers 312,000 sq.ft. of floor space and also will be ready for occupancy by November of this year.

The Japan Oil Co. Building, which is being erected for the Japan Oil Co., Ltd., is the third building constructed in Tokyo and is about 165 x 160 ft. in area and seven stories in height. No buildings may be erected higher than 100 ft., according to the Tokyo building laws. This building also has a Japanese granite base, the first two stories are of Japanese cut stone, while the upper portions on the street fronts are faced with architectural terra cotta. This building is also of steel frame construction with reinforced-concrete floor arches. The cost will be about $2,000,000. It is now ready for occupancy.

In Kobe is being erected the Crescent Building for Messrs. Brunner, Mond & Co., (Japan) Ltd. The George A. Fuller Co., of the Orient, Ltd., acted in the combined capacity of engineers, architects and contractors for this building. It covers a plot 90 ft. square, and is six stories in height. Unlike the Tokyo buildings, it is constructed of reinforced concrete with long-span floor tile arches. The street façade is faced with Japanese granite base course, above which architectural terra cotta facing is used. The floor space in this building amounts to 43,000 sq.ft. When complete the building will cost approximately $325,000. This will be an office building used largely for housing the forces of the Brunner, Mond Co.

American Machinery and Materials Used—All buildings under construction are built in accordance with modern American construction practice, and American machinery is used practically throughout. Electrically-driven equipment, such as hoists, concrete mixers, engines, cranes and other power tools and plant had to be imported into Japan from the United States. Materials used in the construction in these buildings were also imported from the United States. The total value of imported materials is about $3,500,000, and that of construction machinery $250,000. In the list of materials shipped from the United States, are the following: fabricated structural steel, Oregon pine piles, architectural terra cotta, all materials for mechanical trades, such as heating, plumbing fixtures and pipe, radiators, boilers, fittings, etc., and electrical material; copper and iron doors, jambs and trim, polished plate and wire glass, mail chutes, sash chain and fixtures, wire-cloth reinforcing material, kitchen equipment, vault doors, finished hardware, linoleum, etc.

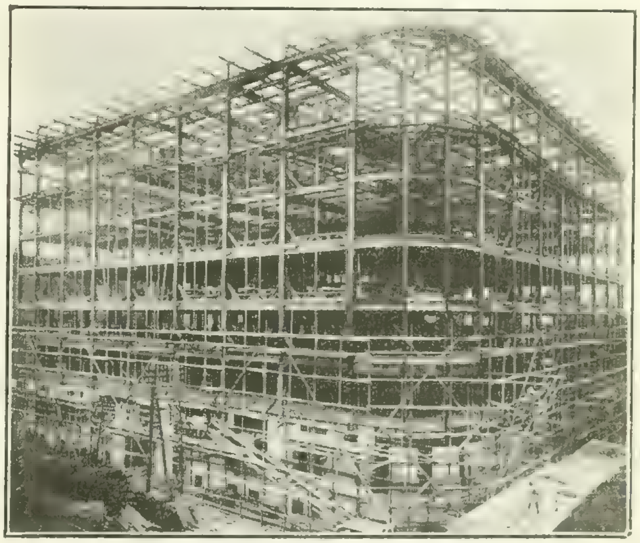


FIG. 3—JAPAN OIL BUILDING

Note heavy wind or earthquake bracing and round timber staging.

About 13,000 Oregon pine piles were sent from the Pacific Coast, together with 11,000 tons of structural steel, fabricated complete, 1,300 tons of ornamental terra cotta, 82 miles of plumbing, heating and electric piping; 75 miles of electric cable and wire and 25 elevators. Aside from these large items, a great quantity of imported miscellaneous specialties were required. In order to handle this large quantity of imported materials the construction company established a storage yard with docking facilities at Shibaura, Tokyo Bay, as a concentration point and all materials were distributed from that point to the various Tokyo buildings.

Local materials which were used were sand, cement, stone, lime, plaster and other materials which conformed as nearly as possible, if not entirely, with specifications for like products manufactured in the United States.

Japanese Eager to Learn—One of the features of the work was the readiness and in fact, eagerness with which Japanese construction workmen followed instructions from American superintendents. In the main, the

skeleton staff of mechanics in the several trades was sent from the United States and the engineering staff with various superintedents and foremen also were Americans. Japanese labor was utilized almost exclusively, instruction being given through interpreters.

Though the construction of these buildings lacked spectacular features, two main difficulties were encountered which were peculiar to the Japanese buildings. By reason of the very poor soil encountered at the sites of the three Tokyo buildings, it was necessary to use long pine piles under foundation footings. Then by reason of the limited facilities for disposing of excavated materials, the use of steam shovels was not practicable. Also the roads in the neighborhood of Tokyo are not substantial enough to withstand loads imposed by motor trucks in service for hauling structural steel and other material. These objectionable points were overcome by applying the native methods of transportation supplemented by American methods.

The New York manager of the George A. Fuller Co., of the Orient, Ltd., is William Oehrle.

"Inverted Penetration" Macadam Roads in Texas

By A. D. Stivers

Engineer, The Texas Co., Houston, Tex.

A TYPE of wearing surface for highways, which has been giving good service in Texas for more than four years, is known locally as inverted penetration. It is successfully laid, with a thickness of 1½ in. on macadam, gravel, and shell bases. As in the case with any type of highway surfacing, inverted penetration is no better than the base on which it is laid.

While it is difficult to set a minimum thickness of base, it is the opinion that 6 in. of macadam, 8 in. of gravel, or 10 in. of shell, compacted thickness, is the least that will justify the expense of a high-class inverted penetration surface. Where the traffic is heavy or the subsoil is poor, this thickness should be increased. An old road which has been in use for several years makes an excellent base if it is not worn into holes or worn so thin that it does not have adequate strength.

Inverted penetration differs from ordinary penetration macadam in the respect that the penetration of the asphalt into the voids of the stone is largely from below toward the surface. The surface is applied in two or three courses on a base thoroughly broomed to remove all dust immediately before the application of the asphalt. Some contractors lightly sprinkle the base prior to the application of asphalt in order to remove the dust film from the surface.

The first application is made directly on the base, with a pressure distributor, at the rate of from 0.3 to 0.6 gal. per square yard depending on the thickness of surface to be constructed. This is immediately followed by crushed stone spread by hand from piles already placed alongside the road. The stone in this first coat should be, in its maximum dimension, at least as great as the thickness of mat desired and in quantity sufficient more than to take up the amount of asphalt applied to the subgrade. This stone is then rolled and receives another application of from 0.25 to 0.4 gal. of asphalt per square yard. The second application of asphalt is usually covered with stone from ¾ to ⅜ in. in size and the surface is again rolled. It is then given another light application of asphalt of from 0.25 to 0.3 gal. per square yard, covered with screenings, again rolled and opened to traffic.

The total amount of asphalt used, the amount of stone, and the size of stone are of course dependent on the thickness of asphaltic mat desired. A typical example would be as follows:

LAYING ROCK BASE FOR PENETRATION MACADAM ROAD

First application: 0.6 gal. of asphalt covered with 1½ in. to ¾ in. stone, 1 cu.yd. to 27 sq.yd.

Second application: 0.4 gal. of asphalt covered with ¾ in. to ⅜ in. stone, 1 cu.yd. to 60 sq.yd.

Third application: 0.25 gal. of asphalt covered with screenings, dust removed, 1 cu.yd. to 100 sq.yd. These amounts of material will build up a mat approximately 1½ in. thick.

The asphalt used on most jobs so far constructed in Texas has been Texaco No. 250. This is a very soft asphalt having a penetration of from 250 to 300 at 77 deg. F. Of late the tendency among engineers has been toward the use of a harder asphalt, between 110 and 140 penetration.

Various kinds of stone have been used. Good results have been obtained with trap rock, and hard limestone for the coarser material and with hard limestone, Joplin chat and pea gravel for the screenings. It is of course important that whatever stone is used shall be perfectly clean and dry and be spread evenly over the surface by trained men.

The cost of this type of construction is much less than that of ordinary penetration macadam and where the work is carefully done the wearing surface is smooth, pleasant to the eye, of low traffic resistance, and stands up well under heavy traffic. Roads of this type have been constructed or contracted for in Tarrant, Greeg, Parker, Denton, Hill, Kaufman, Tom Green, Hunt, Harris, Atascosa and Debb Counties. Most of these are Federal Aid Projects.

Data on Coal-Bin Design

By a misprint in R. Fleming's article "Some Data on the Design of Steel Coal Bins," pp. 346-350, Aug. 31, the Panama Canal coal bunkers at Cristobal and Balboa were described as 500-ton bunkers, whereas the correct figure is 1,500. In Table III of the same article, p. 349, first column, the fifth heading "Water 25 lb. per cu.ft." should have the figure changed to 62.5. Finally, in the next column of the same page, line 5, the maximum load-intensity for triangular loading on a beam should be read as $2W/l$ instead of W/l; the calculation following applies to the correct figure.

Water-Works Problems and Practice

Abstracts of Papers and Discussions Before New England Water Works Association

Making and Testing Valves for Boston Water Division

By Thomas E. Lally
Assistant Engineer, Water Division, Boston, Mass.

DURING the past fifteen years the Boston water-works has had many hundred gates built outside of its own shop. The city furnishes everything necessary to assemble the gates, in the rough: Iron castings, composition castings, flange bolts, gasket and packing. The contractor does all the machine work, assembles the machined parts, and tests and delivers the finished gates to our yard. The machine work is inspected before assembling and must conform to our standards for finish and size and type of threads, and all similar parts must be interchangeable. Test bars, 26 x 2 x 1 in., on supports 24 in. apart, must show a deflection of at least 0.3 in. under a load of 19,000 lb. before breaking. The castings are inspected at the foundry for size, thickness of walls, dirty or spongy iron, cold shuts or blow holes.

In testing the finished gates, the gate is closed on one bell by a cap or head. The closed bell and gate is then filled with water. The valve is slightly raised to allow the water to fill the bonnet, the air escaping through the gland which was loosened for that purpose. After the gate is full of water the valve is subjected to a pressure of 150 lb. per square inch. The other side is then tested. This process duplicates the conditions in the line as nearly as may be and has been found very satisfactory. It shows up defects and exposes spongy places in the castings. It is preferred to the method of tapping in a piece of pipe in the bonnet and subjecting the bonnet and the parts surrounding the valve to the pressure but getting no pressure on the bells. This latter method is cheaper for the manufacturer and consequently is in almost universal use in commercial gates. It is my opinion that the commercial method is of advantage in the type of gate having loose disks because it tends to force both disks into seat at the same time at one operation. With the solid wedge type of gate which we use I do not advocate it. Our method will detect the slightest difference in taper between the seat in the body and the valve rings. We require the beaten-in seats and valve rings to be pinned. The nut through which the stems in all gates over 10 in. operates to lift the valve, is also pinned in to prevent the stem from turning it out.

* * *

High-Pressure Fire Systems from the Underwriters' Viewpoint

By G. W. Booth
Chief Engineer, Committee on Fire Prevention and Engineering Standards, the National Board of Fire Underwriters, New York City

CONFLAGRATIONS spread either by the generation of a heat wave of such intensity that everything combustible in its path is involved, or by means of flying brands carried by the wind far in advance of the origin of the fire that set fire to combustible roofs or porches. The first type of conflagration is that of which we must think in considering the installation of high-pressure fire systems, since most of them occur in high-value congested districts and it is only in such districts that the expense of installing and maintaining a separate fire main system can be warranted.

Nine out of the 18 cities which have installed special pumping stations for separate fire main systems have a population in excess of 400,000; 4 of the other 9 are in excess of 200,000 and most of the others either present special fire protection problems or were able to take advantage of favorable conditions to minimize the cost of installation or of maintenance or both.

Use of New York High-Pressure System—Since July, 1908, when the high-pressure fire system was put in service in Manhattan, the most extensive use made of it was in January, 1909, when it was brought into service for five simultaneous fires, three of them of more than usual severity, and one particularly so. At the extreme, seven pumps were being operated, delivering 33,500 gal. per minute against an average preassure of 225 lb. at the pumps and 205 lb. at the hydrants. Forty engine companies were called, including more than 600 men, and all the water thrown on the fire was from the high-pressure system.

The system was also used on the occasion of the Equitable Building fire, and at a difficult fire in a general storage warehouse fire on Jane St. in July, 1922. Because of a disastrous explosion in the early stages of the Jane St. fire, it was not considered safe for firemen to remain in the building, and the fire was therefore drowned by streams from the outside; at one time 60 large streams, using a total of over 30,000 gal. per minute, were in service, at a pressure of about 200 lb. at the hydrant, and a total of 87,000,000 gal. of water is reported to have been used. Each of these streams would require, if fire engines were used, the services of one fire company, whereas each company can lay and handle at least two or three lines from a high-pressure hydrant to turret nozzles or water towers. It follows, therefore, that fewer companies will be required for fires calling for large quantities of water, and a much smaller part of the city will be stripped of its normal protection.

* * *

Boston High-Pressure Fire System

By F. A. McInnes
Division Engineer, Public Works Department, Water Division, Boston, Mass.

THE Boston high-pressure fire system, as now proposed, will protect about one square mile of territory covering practically the entire congested value district of the city. It will consist of eight pumping units in three separate stations with 19 miles of mains. It is designed to operate, if the necessity should arise, at a pressure of 300 lb. per square inch. Two stations with four pumping units, 11.75 miles of mains and 313 hydrants have been in service for the past eight months, furnishing approximately two-thirds the measure of protection which the completed system will afford.

Pumping Station No. 1 includes two 3-stage double-suction centrifugal Worthington pumps, each directly connected to a Westinghouse 750-hp. steam turbine operating at 1,165 r.p.m. with a steam pressure of 175 lb., atmospheric exhaust. Two 16-in. suction mains connect with the low-service distribution system (pressure 55 lb.); one of them also connects with the high-service distribution system (pressure 85 to 90 lb.). A 16-in. suction main connects with the intake conduit supplying salt water from the Harbor to the Boston Elevated power station for condensing purposes. A centrifugal vacuum pump, with 75-gal. priming tank, driven by a 10-hp. 220-volt d.c. motor is provided to prime the fire pumps when salt water is used. Two 16-in. discharge mains, each equipped with a venturi meter, extend from the station to the high-pressure fire distribution system. A vertical centrifugal single-stage sump pump, driven by a 220-volt d.c. motor, takes care of any leakage, etc., in the station.

The [station] water piping is of cast-iron, with flanged joints, each piece of pipe in the force main being separately tested at a pressure of 600 lb. per square inch before being assembled. A 4-in. by-pass, equipped with the necessary check valves and meter, is provided between the suction and discharge sides of the piping to insure the absence of air in the system and to provide means of measuring the water leakage.

The principle control valves on the piping system are electrically operated by Deane control. Ross regulating valves are installed between the suction and discharge of each pump by means of which the pressures at the pumps are controlled from the operating board, upon which the necessary gages and indicators are installed and from which the valves in the piping system, the vacuum pump and the sump pump are operated.

The turbines are started by hand throttle. Steam is supplied through an 8-in. loop pipe connecting to each end of the steam header in the boiler room of the Boston Elevated station, where 20 Babcock and Wilcox boilers with a total of 10,344 hp. are located; eight to ten of these boilers are always in service.

At a test recently made by the National Board of Fire Underwriters, Pump No. 1 discharged 3,100 gal. per min. at 301 lb. pressure and 4,676 gal. per min. at 201 lb. pressure. Pump No. 2 discharged 3,114 gal. per min. at 300 lb. pressure; 5,164 gal. per min. at 209 lb. pressure, and 7,400 gal. per min. at 100 lb. pressure. The two pumps operating together discharged 6,580 gal. per min. at 292 lb. pressure and 10,266 gal. per min. at 201 lb. pressure.

Pumping Station No. 2 has two 4-stage single-suction centrifugal Worthington pumps, each directly connected through semi-flexible couplings with a 750-hp. 235-volt d.c. shunt-wound commutating pole Westinghouse motor with a speed range of 860 to 1,050 revolutions per minute. Power for operating the pumps is furnished through cables extending to the pump room from the main switchboard in the generating room of the Edison Third station.

Distribution System—The system was designed to deliver 12,000 gal. per min. about any block, with a hydrant pressure of 250 lb. per square inch, and a pump pressure of 300 lb. per square inch. As a matter of fact, the efficiency of the system exceeds this requirement, as during construction the sizes of mains were increased in several instances to provide for different proposed locations of pumping stations. One hydrant is allowed for each 40,000 sq.ft. of area.

The system now consists of 20,140 lin.ft. of 20-in. pipe, 1.51 in. thick; 28,808 ft. of 16-in. pipe, 1.27 in. thick; 13,081 ft. of 12-in. pipe, 1.04 in. thick; and 313 hydrants supplied by 8-in. pipe 0.8 in. thick. The straight pipe and special castings are of cast-iron, except that for branches where the opening from the run is 12 in. or over semi-steel is used. Two lead grooves are cast in the bell end and in the spigot end of each pipe; and similar grooves are turned, on the job, in the ends of any cut pipe. The joint material used where unbalanced pressures exist, or might develop, is an alloy of 95 per cent lead and 5 per cent tin. Extensive preliminary tests showed that the admixture of tin increased the strength of the joint sufficiently to safely permit tie rods to be dispensed with, a conclusion that has been verified in practice. All joints are made as follows: A small pot is kept warm, floating in a larger kettle of hot lead. When the joint is to be made, sufficient lead is measured into the pouring pot and the necessary amount of block tin is added at the last minute. The calking is done with dog tools, using a two-handed 4-lb. hammer, a starting chisel and three sets of calking chisels. The joint is finished or polished off with hand tools.

The post hydrant was designed and patented by Joseph A. Rourke, now commissioner of public works of Boston. It is of rugged design, with 8½-in. barrel, 6¼-in. main valve opening against the pressure and four 2½-in. independently-controlled outlets. A notable feature of the design is an auxiliary valve formed by a three-way cock operated by a covered stem extending along the side of the barrel and terminating in an operating nut located at the head of the hydrant. One position of the three-way cock closes the waste and equalizes the pressure above and below the main valve in the hydrant barrel. The other position opens the waste and closes the connection with the hydrant barrel. The hydrant was designed for a normal delivery of 2,000 gal. per minute, the loss at this flow being less than eight pounds.

* * *

Leadite Joints and Machines for Pipe Laying at New Bedford

By Stephen H. Taylor
Superintendent of Water-Works, New Bedford, Mass.

IN 1920 the New Bedford Water Department had about 6,600 ft. of 36-in. cast-iron main to lay in addition to the ordinary extensions. As labor was scarce, it was decided to purchase a 14B Bucyrus steam shovel with an extended dipper arm for trenching, and in 1921 when the 48-in. cast-iron main was started a 14B Bucyrus clamshell and derrick machine with a 30-ft. boom was bought. These machines have proved great money savers on the large pipe work which has been done in the past three years. The latter machine is used for pipe laying, and in places where the ground is too soft to support the steam shovel over the trench, excavating is done with the clamshell outfit on the same machine. Under ordinary conditions the excavation is done by the steam shovel traveling on platforms over the trench with the derrick following close behind, laying the pipe. The shovel deposits the excavated material into trucks which haul it directly to the backfill close behind, or to the spoil bank.

With reasonably good conditions from 120 to 180 ft. of trenching, pipe laying and backfilling per day is accomplished with a crew of from 15 to 20 men, two or three trucks, and the steam shovel and derrick. The advantage of a small crew is particularly great in our present work, which is ten to twelve miles from the city, requiring that the men be boarded near or transported to and from the job.

Tests of Leadite and Lead Hydrotite Joints—Some ten years ago a few joints in our smaller-sized cast-iron pipe were made with leadite and lead hydrotite. No trouble has ever been experienced from either. In the spring of 1920 I decided to make more extensive experiments with these substitutes for poured lead joints.

At that time leadite was offered at 12c. per pound and lead hydrotite at 10c., while lead was selling for about 7½c. per pound. One pound of either substitute would fill as much joint space as 4 lb. of lead, so that it would take 30c. worth of lead to do the same work as 10c. worth of hydrotite or 12c. worth of leadite. There is also a further saving in the reduced labor cost, because no calking is necessary, and the size of bell holes is greatly reduced. The only chance of skepticism, then, was as to their efficiency. As the contemplated work involved a considerable amount of jointing material, the 2c. per pound difference in cost of leadite and hydrotite was worth saving if the two materials were equally efficient.

Tests with 6-In. Pipe—Six lengths of 6-in. pipe were put together on skids about 2 ft. high, with a plug and sleeve on one end made up with lead and a patented plug in the other. Three joints were made of leadite and three of hydrotite. Dry white jute was used in its different forms. One joint with each material was made with loose yarn, one with the same yarn twisted lightly, and a third with the same yarn braided.

The pipes were first filled at city pressure (84 lb.) and the joints were all reasonably tight, the greatest leak occurring at the joint made of leadite with loose yarn. There was also some leak at the joint made of hydrotite with twisted yarn. The pressure was then raised, first to 150 lb. and then to 200 lb., all joints remaining reasonably tight and becoming entirely so with the exception of the two above mentioned. The high pressure was then released and normal yard pressure (84 lb.) maintained during the remainder of the test.

The ends of the pipe were raised by means of a derrick at each end, the supports, which were under the pipe, being removed as the pipes were lifted from them until, for a short time the line was practically suspended by the ends, forming a curve with about 144 ft. radius and the ends of 5 ft. 9 in. higher than the center. Finally joint No. 5, hydrotite, broke, allowing the center of the line to drop to the ground. It should be said, in fairness, that the joint which failed was not made with a continuous pouring, because some of the material was lost through a defective dam and a second pouring was necessary. Only a few seconds elapsed between the first and second pouring, however, as the kettle was close to the joint and it was only necessary to dip out more material. The whole line was then lowered to the ground and remained tight except the two joints before mentioned (Nos. 2 and 5.) These were made tight by caulking with a little lead wool, and for several months the line remained in the yard absolutely in tight condition, in spite of the abuse to which it had been subjected.

Experiments with 36-In. Pipe—As the principal work of the year was to be 36-in. pipe, it was thought advisable to experiment with this larger size to see if it could be successfully poured. Two lengths of 36-in. pipe were joined, with a plug in one bell and a sleeve and plug on the spigot end. Accidentally a class B pipe, N.E.W.W. specifications, was placed into a class F bell. This made an unduly thick joint (about ⅞ in.). The class B bell was too small to receive the beaded end of the plug, so the plug was reversed. This made an abnormally thin joint with no bead, as the space was so small that it would have been impossible to caulk a lead joint. These joints were made with leadite. On the other end the sleeve and plug were normal ½-in. joints and were poured with lead hydrotite.

When the yard pressure was applied, in spite of the bracing at the ends, the joints between the two pipes slipped about ⅞ in. This was the abnormally thick joint. The 84 lb. yard pressure on the 36-in. plugs developed a total stress on each of them of about 42½ tons. The braces were then removed and the pressure applied with the intention of pulling the work apart. When this was done the two abnormal joints made with leadite held fast, and the one where the sleeve joined the pipe, which was a normal ½-in. joint made with hydrotite, pulled apart.

As a result of these tests, it was decided to adopt leadite for our work, and it has been used in practically all the joints made since that time with excellent results.

The story of this test would not be complete without further reference to the advantage of the braided jute packing, which we have also adopted for general use. We find that although it costs a little over twice as much per pound as the plain dry jute, the saving effected in labor and material more than offsets the extra cost, and that a better joint is obtained because there are no loose ends of the fiber to mix with the jointing material and reduce its efficiency.

Comparative Cost of 48-In. Lead and Leadite Joints—Recently a very favorable opportunity was presented for comparing the cost of 48-in. joints made of lead and leadite, as two joints were made of lead on the check valves of our 48-in. line, because of the extreme weight of the casting and uncertainty of the ground in which it was placed. Figuring the cost of jute packing, labor and lead, a 48-in. joint cost $18.06; whereas the same items on a leadite joint cost an average of $4.42. It took three men 1 hr. and 40 min. to pour and caulk a lead joint, whereas the same three men would average to pour from six to eight joints per hour with leadite.

Discussion: An extended discussion brought out much opinion favorable to leadite, and less extensive but favorable accounts of experience with lead, hydrotite and metallium as jointing materials. On the subject of relative costs of cast-iron and steel pipe, Mr. Taylor said that by doing its own work the city was getting the 48-in. cast-iron pipe in the ground for about what a steel pipe line would cost.

Shorter Abstracts with Discussion

Water Quality, Service Pipes, and Plumbing—With particular consideration to the water supplied in the Boston Metropolitan District, D. A. Heffernan, superintendent of the Water Department of Milton, Mass., read a paper on "The Quality of Water and Its Relation to the Life and Proper Operation of Service Pipes and Plumbing Appliances." He charged (1) the Massachusetts State Board of Health with "apparent indifference" as to the quality of water supplied in the Metropolitan District, and (2) "the great majority" of water-works superintendents with knowing "too little of the quality of their water" as regards its "action on pipe."

"In 1912," said Mr. Heffernan, "Milton began to use exclusively for its services genuine black wrought-iron pipe, carefully lined with Rosendale cement in our own shop." Lead-lined couplings and lead goosenecks were also adopted, but fittings other than the lead-lined couplings were of brass. About 1920, or eight years later, it was found that "violent galvanic action" was "eating away the pipe at the threads inside the brass fittings and almost completely filling up the latter." Present practice at Milton "is to line all fittings and stops with lead, so that no water comes in contact with any two metals other than lead and brass or lead and iron. The old brass fittings are being gradually replaced with lead-lined malleable iron."

The danger of corrosion of the relief and vacuum valves on direct-pressure kitchen boilers, with resultant sticking, due to corrosion by the kind of water commonly supplied, was urged by Mr. Heffernan, as also the evils of brass connections to galvanized steel boilers and brass couplings in ½-in. galvanized pipe connections to boilers, with resultant filling of the pipe with rust.

In conclusion, Mr. Heffernan urged (1) that something should be done to lessen the action of water on piping—either treatment or control of action caused by grounding electric wires on pipe, or both; and (2) the creation of State Board for the Regulation of Plumbing "which would forbid the use of some wasteful (and dangerous) devices and regulate the use of others," thus cutting down water consumption and postponing (notably in the Boston Metropolitan District) the necessity for new water supplies.

Discussion: The discussion on Mr. Heffernan's paper centered in a general and hearty condemnation of the use of relief and vacuum valves on domestic boilers and of check valves between the boilers and meters. George W. Fuller, speaking of the corrosion problem, said it is big and complex. Usually, water analyses do not take corrosive qualities into account. Lime, after filtration, may be used to prevent corrosion, as planned for Buffalo and Memphis, Tenn.

Co-operation—The benefits of co-operation between the water authorities and consumers on the one hand, and the authorities and employees on the other, were presented by Francis T. Kemble, secretary New Rochelle (N. Y.) Water Co. The labor side of this paper aroused considerable discussion. The pension system, all-the-year work, more flexibility in wage rates, more human touch, were suggested by various speakers as ways of meeting the difficulties commonly experienced in holding water-works employees. Both C. M. Saville of Hartford and S. H. Taylor of New Bedford said that their men were put at forest work to keep them on the payroll winters.

Old Steam Pumps at East Weymouth, Mass.—Two 1.5-m.g.d. duplex compound steam pumps—a Blake installed in 1885 and a Deane, two years later—were operated for 29 years, latterly under heavy overload, "and under better conditions for six years more, before serious trouble was experienced," stated Fred O. Stevens, engineer and superintendent of water-works at East Weymouth, Mass. Meters installed in 1915-16 relieved the strain and enabled one pump to handle the peak load, but in view of the low efficiency of the pumps it was not thought advisable to go to the expense of overhauling them. The war and subsequent high prices deferred letting a contract for new pumps and delay in delivery kept the old ones in service still longer.

In the spring of 1920 a high-pressure cylinder of the

Deane pump cracked. A previous re-boring of the cylinder had left "a scant ⅜-in. of metal." A new cylinder was obtained, some minor repairs made, the pump put in service, and a contract let for 1.5-m.g.d. motor-driven centrifugal pump. In August, before the new pump came, the "Blake pump, which was in better condition" than the Deane (although two years older) and was "our chief reliance," developed a crack in the suction chamber "just above the bed-plate flange." An electric welding company made a weld in place, although the drilling showed "that in places along the fracture there was only a scant ¼-in. metal." This strengthened the cylinder, but "it was neither water nor air tight." A form was built on the foundation, 4 in. from the suction chamber, and filled with hot asphalt to a line about 3 in. above the crack. In a few minutes the pump was started. About once a week it was necessary "to heat the casting and asphalt with a blow torch to get a new bond."

Shortly after this repair to the Blake pumps, a crack was found in the suction chamber of the Deane pump, in such a position as to necessitate tunneling up through the masonry foundation to get at it. Hot asphalt, applied to this crack with a brush, "helped matters considerably, but we were never able to get this pump running as smoothly as the other."

After having "crippled along" until December 1, the pumping engineer reported that the crack in the Blake suction chamber was "showing up on the other side." Hot asphalt was applied, and a temporary emergency pump located and installed. On taking the water end of the Deane pump from the foundation, a second and larger but previously concealed crack was found. The metal along the crack was planed down and tapped for numerous ¼-in. boiler-plate screws, after which a ⅜-in. steel plate, with rubber gasket, was attached. The repaired part was "absolutely tight under 100 lb. test pressure." The repairs cost less than $100. The pump was run during the following winter so as to use some coal left over after the new electric-driven pump was put in service.

Cross-Connections with Private Water Supplies—Under the title, "Use and Discard of Auxiliary Fire Protection from a Polluted Source," Caleb M. Saville, manager and chief engineer of water-works of Hartford, Conn., reviewed the use and final abolition of such connections in Hartford, even where double-check valves of the Factory Mutual type had been installed (see *Engineering News-Record* for 1921, July 7, p. 12, Sept. 8, pp. 390 and 409, Sept. 15, 464). Mr. Saville stated that Hartford, "so far as is known, was the first city to permit the installation of the double check-valve in lieu of complete severance of connections, and also, so far as is known, after a trial of 13 years, Hartford is the first city to order them out." Cross-connections, he stated, are now prohibited by Lowell and Springfield, Mass., Providence, R. I., Stamford, Conn., Philadelphia, Pa., Cleveland, Ohio, Terre Haute, Ind., and St. Paul, Minn., and by the state boards of health of Minnesota, entirely, and Illinois, on new installations.

Discussion: As usual at water-works conventions, this subject stirred up much discussion, and also, as usual, the water-works men were almost entirely and unqualifiedly against these cross-connections, while representatives of fire insurance interests raised the only voices in their support H. A. Burnham, engineer Factory Mutual Fire Insurance Companies, said that special double-check valves are required or approved by the New York and New Hampshire state, and the Ontario provincial boards, of health, and that few if any state health boards and not many cities have prohibited them; and that records show 600 installations of double check valves in 170 cities and towns in the United States. Mr. Saville, in closing, said that all the insurance interests except the Factory Mutual Companies are satisfied with some entirely independent source of water supply for fire protection, or a tank filled from the municipal system. The only advantage of the double check-valve controlled interconnection that he could see was that it costs less than an absolutely independent fire-protection supply, which is an alternative.

Other Topics—Pumping by electric power at Concord, Mass., with current bought at 1⅜c. per kw.-hr., is saving that city a considerable sum over the cost of steam power, according to a paper by P. R. Sanders, superintendent of water-works.

Arguments against merging water departments with other municipal departments, on the ground of resulting decreased efficiency through less efficient operation and sacrifice to other departments, were submitted in a paper by George A. King, superintendent of water-works, Taunton, Mass. (where apparently there is a proposal to put the water system under a board of public works). Most of those who discussed this paper supported Mr. King's arguments, but there was some expression of opinion that under a proper system of state utility or other state control water-works interests would be protected.

An entire session was devoted to papers on the "Water Supplies of Southeastern Massachusetts," by X. H. Goodenough, engineer, Massachusetts Department of Health, "The Water Supply of Fall River, Mass.," by H. K. Barrows, consulting engineer, Boston, and "The New Water Supply of Providence, R. I.," by Frank E. Winsor, chief engineer Providence Water Supply Board. The papers by Messrs. Goodenough and Barrows showed how closely related are the water problems of New Bedford, Fall River and Taunton, all of which draw from a group of natural bodies of water known as the Lakeville ponds. The construction of the core wall of the Wanaque dam was described by Major Arthur D. Pratt, chief engineer, North Jersey District Water Supply Commission.

A detailed review of "Court Decisions Incident to Purchase of the Braintree (Mass.) Water Supply Co.," in the eighties, was presented by Henry A. Symonds, engineer, Boston.

Under the title "Sanitary Dangers of Water Supplies," E. Sherman Chase, of Metcalf and Eddy, consulting engineers, Boston, outlined several instances of water pollution which, though relatively minor, point to the refinements in water protection and treatment beyond what seem to have been commonly regarded in New England as necessary.

A review of the use of copper sulphate to control algæ growths in the Hartford reservoirs was presented by J. E. Garratt, office engineer, with particular reference to the increase in the use of the slow sand filters put in operation a few months ago (described in *Engineering News-Record*, Sept. 7, p. 380).

An impromptu discussion at one of the sessions brought out the fact that the recent increase in the use of flushometers is leading to requests for larger supply pipes to water closets, particularly group installations, than has been the practice for closets flushed from tanks.

Ford Car Wrecks Steel Bridge

A rural mail carrier's Ford broke down a 75-ft. steel span over Beaver Creek, five miles northwest of Mulhall, Logan County, Okla., on Aug. 3. According to the available information, the wreck was not a floor failure but a truss failure. Ernest S. Alderman, state engineer, says that the bridge was an old structure, first erected eighteen or twenty years ago, and has been washed away several times. It was salvaged and repaired each time. When the accident occurred it had just been straightened in a blacksmith shop after a recent wash-out and had been re-erected.

A Logan County official in reporting on the accident stated that eighteen or twenty years ago the commissioners "bought a large number of very inferior bridges, and the Beaver Creek bridge is one of them. It was washed out several times, the last time about four months ago, and was rebuilt soon after that. Fortunately, there aren't any of the inferior bridges on our state roads."

Concrete Grain Elevator Rebuilt At Chicago

Extensive Repairs to Foundations and Bins of Structure Wrecked by Explosion—New Dust Removal Apparatus

REPAIRING reinforced-concrete grain bins damaged to varying extents by a grain-dust explosion was one of the difficult problems in the reconstruction of the 10,000,000-bushel Northwestern elevator at Chicago. This structure has a total of 277 bins 15 and 22 ft. in diameter and 97 and 104 ft. high. It represented a cost of about $5,000,000 including equipment and the damage was estimated at about $2,000,000. The elevator and the explosion were described in *Engineering News-Record* of March 31 and April 14, 1921, pp. 560 and 634; Nov. 3 and 24, pp. 719 and 847, and Feb. 22, 1922, p. 327.

Removal of the heaps of debris was the first task. Acetylene torches were used to cut apart the tangled wreckage of structural steel from the superstructure and the reinforcing bars of the damaged bins. Locomotive cranes then loaded the steel and the shattered masses of concrete onto railway cars. In Fig. 1 the new steel-frame car shed and drier house are completed and also the cupola on the bins of the working tower. These are of structural steel with tile walls. Some of the bin forms are shown in place. The new steel framing for the conveyor galleries over the bins is in place, as well as that for the marine tower or leg at the right. This tower is on the dock wall of the Calumet River.

Reconstruction Work—A special problem was to determine what parts of the structure could be utilized with safety and what parts would have to be demolished. Rectangular foundations or bases of plain or non-reinforced concrete built on the concrete base or mattress carry the cylindrical bins. About 50 per cent of these bin foundations were damaged more or less, as shown in Fig. 2. Many of them had been displaced bodily by the explosion and were jacked backed into position. These foundations were rebuilt according to the original plans.

Thorough inspections and tests of the bin walls were made to ascertain the relative strength of different portions, and in many cases it was found necessary to tear down standing walls on account of the evident damage done to the reinforcing. Cracks were examined carefully and enlarged where necessary in order to determine whether the reinforcing bars had been sheared. Sound tests were made on doubtful areas of wall by men lowered in rope slings and having heavy hammers.

Complete disintegration of the concrete of the bin walls was evident in a few cases where the grain had burned or smouldered in the bins for two or three weeks. This was due to the effect of the continued high temperature upon the concrete, which contained limestone aggregate. The walls heated to a high degree by these furnaces within the bins had been drenched with water by the fire engines, causing serious spalling. In such cases, the strength of both the steel and the concrete was under suspicion. In some of the bins of the river house where the lower part had been badly damaged or partly blown away (see Fig. 1) an interior shell or jacket of reinforced concrete slightly thinner than the original wall was built inside the bin, no allowance being made for any strength of the original wall.

Inspection showed that in most cases the damaged bins had been subjected to severe tensile stress, so that

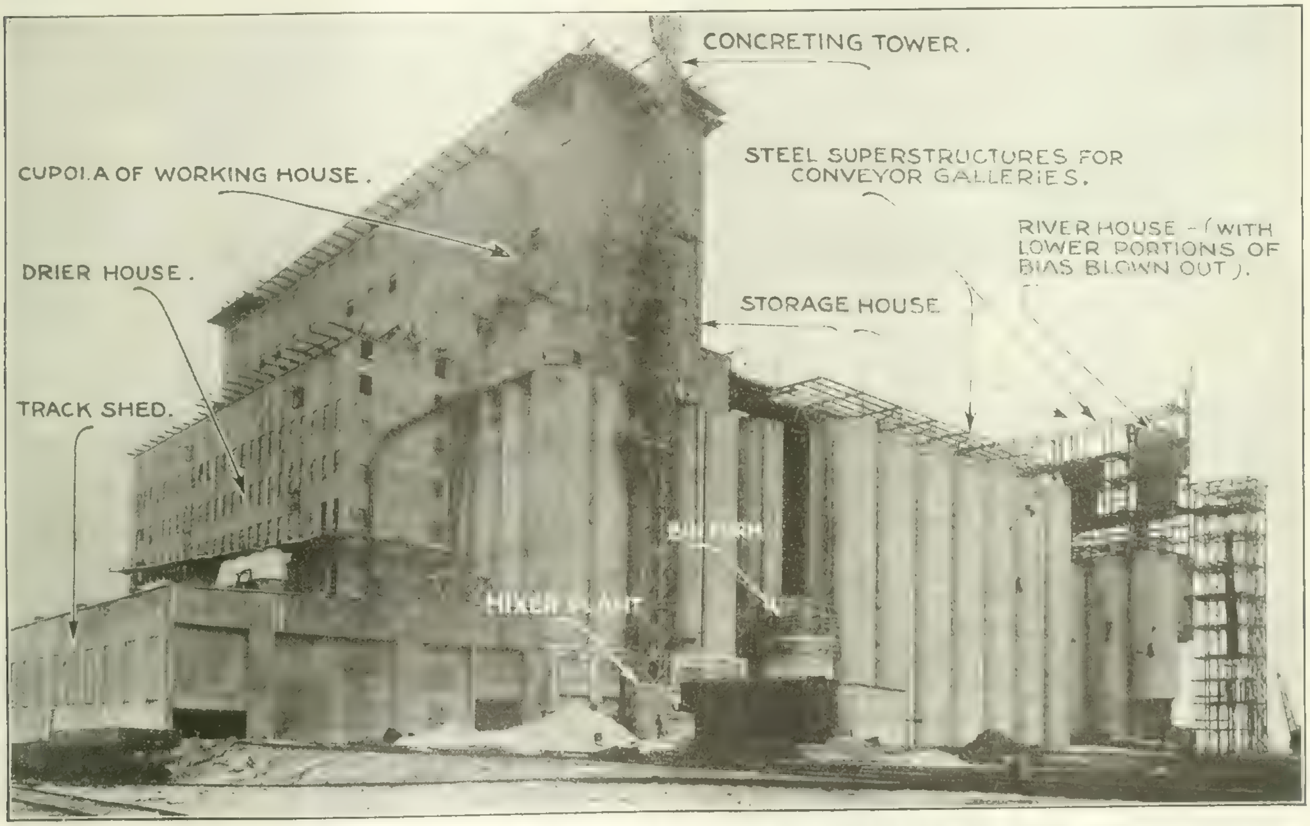


FIG. 1—RECONSTRUCTION OF NORTHWESTERN GRAIN ELEVATOR, CHICAGO

new reinforcing bars were required to supplement the original reinforcement. In cases where portions of the old reinforcement were utilized it was considered desirable to cut away enough of the concrete to expose the old bars for sufficient overlap with the new bars (see Fig. 2). Where the ends of old bars were left exposed and projecting by the removal of old concrete, laboratory tests were made on specimens to determine the quality of the steel.

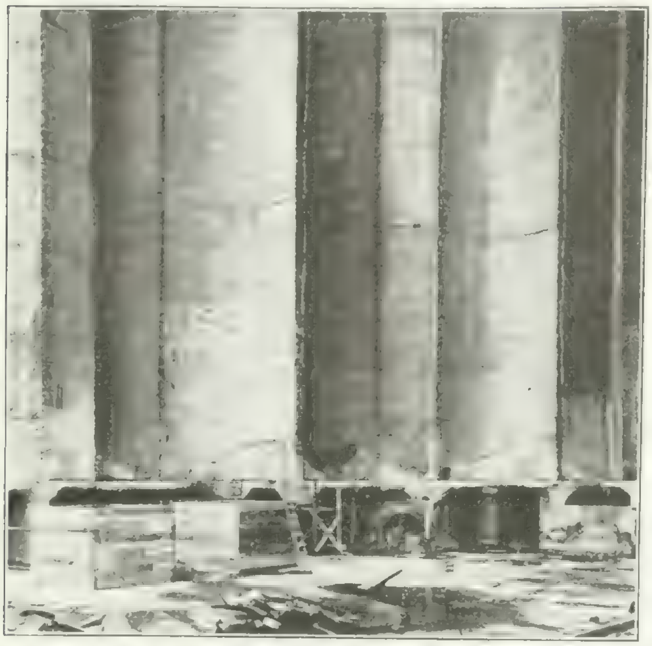


FIG. 2—SHATTERED BINS AND BASES CLEARED FOR RECONSTRUCTION

Concreting—For building up the new portions of the bin walls, steel forms were placed and concrete poured in the usual way. In some cases of small cracks caused by expansion of the reinforcement, it was necessary to widen the cracks by chisels to a width of several inches, so that the new concrete would bond properly with the old concrete and the steel bars. As tamping could not be applied in such cases the form was built up so as to give a head of concrete above the top of the opening, the excess concrete being afterwards cut off. No trouble was experienced in securing a good bond of the new concrete with the roughened surface of the old concrete.

For the heavier concreting, a large mixer was installed at the base of an elevator tower from which the concrete was spouted to the forms or to a hopper from which chutes or wheeled carts were loaded, as shown in Fig. 3. For patching the larger cracks several small portable mixers with gasoline engines were placed at the most convenient points and shifted as required. Concrete for the plain foundations was a 1:3:5 mix and that for the reinforced bins was 1:2½:4, the size of stone aggregate being 2½-in. and 1-in., respectively. Cement guns were used for closing the smaller cracks.

A thin coat of waterproof cement grout was applied to the interior and exterior surfaces in order to close minor cracks and to give a smooth finish and good appearance. Walls of 6-in. hollow tile were used for the cupola and track shed, which are of structural steel framing. These walls are coated with cement for the purpose of weatherproofing.

Dust Prevention—In the provision of new mechanical equipment special precautions are being taken to prevent a similar explosion in the future. One of the 11-ft. interstice bins in the middle of the storage section is converted into a ventilating shaft, through which fans will draw the dust-laden air from under the storage bins and force it out far above the roof. This shaft is shown in Fig. 3. Continual ventilation will be provided in the basement by placing the windows on tilting frames and by cutting large openings above the windows.

Since much dust ordinarily accumulates in the drier house a wide air shaft will separate the new drier house from the working house. With this arrangement both sides of the drier house can be opened and much of the dust blown out. Further, the house will be divided into twelve sections by partitions especially designed to isolate any explosion in one section. To eliminate the chances of heat due to friction from slipping belts, all drier fans will be driven by chains enclosed in dust-proof housings. A chamber between the east wall of the working house and the west wall of the storage bins,

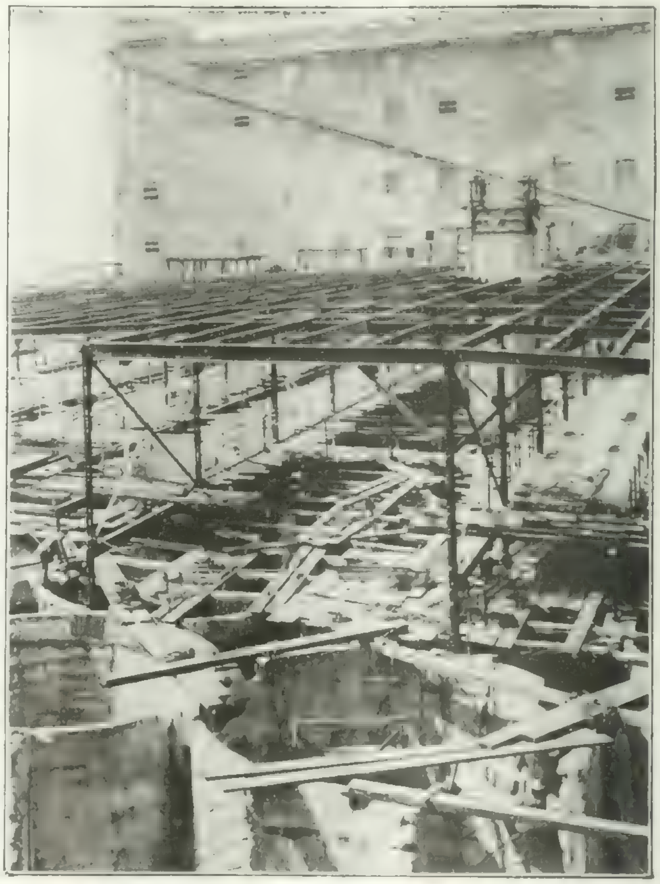


FIG. 3. REPAIR AND REBUILDING OF ELEVATOR

which was used formerly as a dust-settling chamber, will be converted into a ventilating shaft. It will have several large roof ventilators and will contain 20 of the cyclones of the dust-collecting system.

Two separate dust-collecting systems are being installed, each formed of separate units and each unit being operated independently. By one of the systems dust from all machinery and cleaning apparatus will be piped direct to twelve cyclone dust collectors on the roof of the track shed and twenty cyclones between the storage house and working house. Thence the dust will be carried to the collectors over dust houses outside the elevator. Fans will be connected to hoods which will be placed over all grain conveyor belts at the points of

delivery. Similar connections are made at the boots of all elevator legs. The other system will be a pneumatic dust-collecting system in two units to remove the dust from floors, walls and ceilings. This will have 408 inlet valves on 12,000 ft. of steel pipe varying from 2- to 6-in. in diameter and leading to four pneumatic collectors. Each of the two units will have two collectors. By this arrangement any grain picked up by the collecting hose will be salvaged by the first collector and the second collector will remove nearly all of the dust. This will allow clean air to pass through the vacuum producers.

To house the fans of the dust-collecting system, a specially designed fireproof building is to be provided outside the elevator. With the whole plant piped for compressed air, means will be at hand to blow dust out of motors and motor bearings. Every panel board throughout the plant is to be erected in a separate dust-tight room. All electric lights will be protected with double vapor globes and heavy wire guards.

The reconstruction of this elevator and the provision of additional dust-removal methods were designed by the John S. Metcalf Co., and the new concreting and installation of machinery was done by the Witherspoon-Englar Co., both of Chicago. These firms were respectively the engineers and contractors for the original structure.

To Improve Railway Terminals at Bombay, India

RAILWAY improvements planned and under way at Bombay, India, at an estimated cost of $35,000,000, include remodeling a large passenger terminal, building a new passenger terminal and a loop line, electrification of suburban lines and four-tracking of main lines. As shown in the accompanying map, two large railway systems enter the city and are connected with the railways and yards of the Bombay Port Trust, which is building new docks, grain elevators and other works. All tracks are on the Indian standard gage of 5 ft. 6 in.

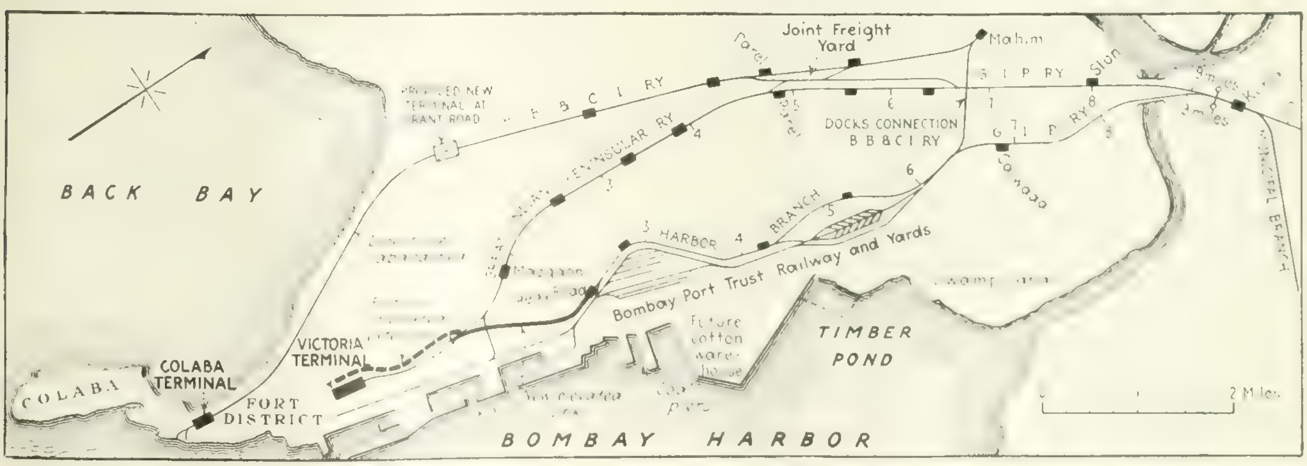
Loop Line and Elevated Terminal—Although the Great Indian Peninsula Ry. has four tracks for 32 miles the congestion due to increasing suburban traffic has led to the construction of a link connecting its harbor branch with the main line in order to complete a 9-mile loop or relief line. The old 6½-mile branch follows the east side of Bombay Island and terminates at Reay Road, where there is a connection with the dock railways. The new 2½-mile link extends from Reay Road across the city to the main line. Later, an elevated extension will continue this suburban line into the remodeled Victoria terminal station.

At present there are about 20 main line trains and 60 suburban trains in and out of this terminal daily, but with the opening of the loop line it is planned to operate a five-minute suburban service during the rush hours. Although the new line is intended mainly for electric suburban traffic its clearance limits provide for ordinary rolling stock and steam locomotives. Besides the suburban service, however, the line will give a direct route from the center of the city to the cotton warehouses and grain elevator now being built by the Bombay Port Trust in connection with the new docks.

Both the Victoria terminal and the Reay Road station are at street grade and as they are separated by the railway company's freight yards and dock branches it was necessary to build the new link at an elevation of 24 to 27 ft. Steep approach grades are required, 3 per cent for 812 ft. from the main line and 2.4 per cent for 1,150 ft. from Reay Road. The sharpest curve is 5½ deg. Most of the work is an earth fill between concrete retaining walls, with truss or plate girder bridges over the streets, but there are some rock cuts. Across the freight yards there will be 1,500 ft. of steel viaduct having 23 spans of 36 to 80 ft. The track will have 100-lb. bull-head rails in cast-iron chairs on wood ties.

Passenger Terminals—The Victoria station, a large and handsome structure, has ten tracks and seven high platforms, but in connection with the electrification it is planned to enlarge the station and provide seventeen tracks in two groups with a carriage driveway between them. The suburban group is to have eight tracks and the main-line group five, together with coach and freighthouse tracks. The seven-track approach will have two suburban and two through tracks for the main line, two for the harbor loop and a switching lead. The Bombay, Baroda & Central India Ry. now extends to an old terminal station on the water front at Colaba. Since this location is inconvenient it is proposed to build a new terminal station at Grant Road and to abandon the shore line or retain it only for local use.

Estimated costs of the several improvements are as follows: enlarging Victoria station, $2,350,000; new Grant Road passenger terminal, $800,000; electrification of all suburban lines, $18,800,000; shops for B., B. & C. I. Ry., $10,000,000; enlarging Mazgaon yard of G. I. P. Ry., $1,800,000; four-tracking main line of B., B. & C. I. Ry., $1,700,000.



BOMBAY RAILWAY IMPROVEMENTS

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Repaying Scientific Obligations

One reason why Sir Alexander Houston's latest annual report on "The Examinations of London Water" deserves the commendation given it in a notice elsewhere in these columns is that in presenting and interpreting data the author goes beyond London. He says:

> No hesitation has been felt in travelling beyond the range of purely Metropolitan Water Board affairs. As we borrow knowledge from others so ought we to try and repay our obligations. So far as the writer is concerned, his indebtedness to the work of other water authorities and other scientists is freely acknowledged. He ventures to think that in relation to questions of quality of water his board's views and policy in no way prevent him from exercising his individual judgment on all matters affecting the safety and purity of water supplies throughout the country, and adding what little he can to the sum of general knowledge of the subject.

This may be characterized as "repaying scientific obligations," a duty that might well be more generally recognized and fulfilled in public and other reports.

The Story of a Master Builder

E. H. HARRIMAN: A Biography in Two Volumes—By George Kennan. Boston: Houghton Mifflin Co. Cloth; 6 x 9 in.; pp. 842; illustrations. $7.50.

Unfortunately there are few worthy biographies of engineers. In large measure, therefore, the lay reader, who cannot be expected to seek out their stories in professional transactions and the technical press, must learn of their achievements by reading between the lines of conventional history or in the biographies of statesmen and business men. So we are grateful to Mr. Kennan for the generous credit he has accorded to the engineers associated with Mr. Harriman in his constructive work. Reading between his lines does not require a lens. Indeed, one need not seek between the lines, for he has set down the story so plainly that he who runs may read.

The readers of *Engineering News-Record* will be especially interested in three of Mr. Harriman's many works. These are the rehabilitation of the Union Pacific R.R., a similar service for the Southern Pacific, and the closing of the Colorado River break in 1907. In telling of these, the author tells of the work not only of the great railroad executive, but also of J. B. Berry, chief engineer of the Union Pacific, Horace G. Burt, president of that road and an engineer by profession, W. L. Park, superintendent of construction, Julius Kruttschnitt, general manager of the Southern Pacific, another engineer, William Hood, chief engineer of that road, and finally Epes Randolph, H. T. Cory, Thomas J. Hind, and C. K. Clarke, all of whom served in the struggle against the Colorado.

The story of the Union Pacific is the story of how a 1,000-mile streak of rust was converted in three years into a splendid transportation machine, helping to build an empire and paying dividends to its stockholders in the doing of it. It is the story of raising and spending in five years $45,000,000 for reconstruction and re-equipment, resulting in an increase in traffic density of nearly 60 per cent. It is the story of the Aspen tunnel, the 18-mile grade into Laramie, and of courageous and resourceful engineering of exceptional productive worth.

The rehabilitation of the Southern Pacific was similar in character but slighter in degree. As Western railroads went in those days, the road was in good shape when it was bought by the Union Pacific; but as the Central Pacific end of it from Ogden to San Francisco was required to complete the Harriman line to the coast he demanded that it be brought up to Union Pacific standards. This work required three years to complete and involved as one element the remarkable Lucin cutoff, carried for 27 miles directly across Great Salt Lake. Besides this, two other noteworthy cutoffs were built, the Bay Shore into San Francisco and the Montalvo in southern California. Altogether Harriman spent on the improvement of the Southern Pacific for extensions, betterments, new equipment, and other properties nearly $242,000,000. During his administration he spent on the two properties more than $400,000,000. And it paid.

The story of the Colorado flood is pitched in a different key. Meeting the flood was not a matter of thoughtfully planned engineering for business investment; it was rather a catch-as-catch-can, life or death struggle with a mad river bent on pouring a wave of desolation into a fertile valley, already the seat of a thriving community and smiling with promise of even greater wealth. The technical aspects of this engineering epic were presented in full before the American Society of Civil Engineers about nine years ago by H. T. Cory, one of the principals. Mr. Kennan has drawn freely on this and other sources and has succeeded in making the story of absorbing interest to the lay reader.

Other episodes that will interest the engineer as a live citizen concern Harriman's struggle with Morgan and Hill for control of the Burlington and with James R. Keene, who threatened his hold on the Southern Pacific. His beneficent relations with the Erie, his part in the Equitable Life Insurance squabble, his controversy with Stuyvesant Fish over the affairs of the Illinois Central, and his break with President Roosevelt all are recorded. But in controversial matters it must be remembered that Mr. Kennan is writing as a partisan, bent on the defense of Mr. Harriman's memory, and inclined to give him the benefit of every doubt. He has overdone this a little. No man so great as Harriman unquestionably was is likely to be so free from fault or error as this Boswell portrays his hero. But it would be ungracious to dwell on this since Mr. Kennan has been so generous when his pen has been untempered by the heat of controversy.

Within the space available it is impracticable to quote at length from this very stimulating book, but engineers will be interested in Harriman's counsel to J. B. Berry, chief engineer of the Union Pacific. "The only way to make a good property valuable," he said, "is to put it in the best possible condition to do business." To

which may be added the maxims that embrace to a considerable degree the Harriman gospel of railroad improvement: (1) "Develop railroads with cheap money." (2) "Never borrow from the substance of a road." The second maxim applies with peculiar force in these days of economies effected by deferring maintenance.

Masonry Structures and Foundations

REVIEWED BY A. BURTON COHEN
Consulting Engineer, New York City

THE DESIGN OF MASONRY STRUCTURES AND FOUNDATIONS—By Clement C. Williams, C.E., M.Am.Soc.C.E., Professor of Civil Engineering, University of Kansas; Consulting Engineer. New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 555, 265 illustrations. $5.

The use of concrete has made possible large engineering works of a permanent nature which would have been prohibited in stone masonry because of an excessive cost, and in other building materials because of a lack of permanence. It is found applicable and used more or less in every branch of civil engineering. Therefore it is of paramount importance that the student and the beginner should be properly directed in the practical and fundamental considerations included in this phase of engineering. That these considerations can be presented in a simple, instructive and convincing manner to the student much in advance and independent of his theoretical studies and that his training should include a knowledge of and familiarity with the reliable and most recent sources of investigations tending to improve the art, are the first impressions gained in reading Prof. Clement C. Williams' new treatise on "The Design of Masonry Structures and Foundations."

The opening chapter, on general principles, includes a discussion of well chosen factors affecting design and æsthetics. The engineering student and worker should be imbued with an æsthetic appreciation; should know full well the fundamentals of proportion and architectural orders. There is no denying the fact that in the development of our modern structures a most remarkable improvement is found in architectural treatment. Even the layman feels the sense of beauty and in public works the taxpayer accepts his assessments willingly if local improvements admirably executed reflect credit upon the community.

Ugly lines, as Professor Williams states, are the result of improper design and proportioning which add a burden of waste. A simple example is the design of an arch ring with proper crown depth but having an excessive depth at the haunch; there is the importance, as described under masonry arches, of the full determination of the arch ring from crown to haunch. Excessive depth at the haunch decreases the effective rise of the arch, causing a greater overturning tendency on the pier or abutment where an increase of quantities adds materially to the cost of the structure. It is apparent that Professor Williams' experience has carried him far beyond the average reach of design; he has dealt in the finer elements of the subject that have engaged the attention of those concerned in extensive application. He has found that pleasing results can be obtained by graceful lines inherent with economic stability.

The author states that masonry constitutes the most permanent type of construction when properly designed to provide for both physical and economic conditions and points out some of the practical necessities to a full development. Mention is made of the all-important problem of waterproofing structures exposed to the disintegrating action of water. The membrane system for bridges is recommended as the most durable solution of this problem, which agrees with best accepted practice. The proper treatment of expansion and construction joints and drainage in connection with the above considerations control largely the affirmation of the term permanency in concrete construction.

Other chapters cover the subjects of walls, dams, bins and chimneys, falsework and foundations, in a clearly determined manner. The distribution of loads is treated under various subjects; for example, the effect of a surcharge live-load in the analysis of abutment and retaining wall design is discussed and also the distribution or spread of live-load through an earth embankment. As a rule these considerations so extremely important are not found discussed in textbooks. Concerning the question of loads: The ratio in amount of live- to the dead-load in concrete structures as compared with the same ratio in steel design permits a greater increase of live-load in design of concrete structures at comparatively little increase in cost—an economic factor which may govern the permanence of the structure, due to heavier duties of future demand. The preponderance of dead-load over live-load is more noticeable in railway than in highway structures and accounts for many old masonry structures carrying the heavy rolling stock of today that has caused so many renewals in steel structures. These are pertinent considerations that can be given to the student at any time, lending interest to his work and supplying a satisfaction, even to his inexperienced mind, that a knowledge of the facts are of engineering value.

The personal touch of experience and the simple and logical sequence of exposition pervading the entire treatise give exceptional value to Professor Williams' work. There is a possibility of a fuller development of many of the good angles of thought mentioned, but there are limitations placed upon a single volume covering so wide a field. Prepared for the student and worker, some repetition of theoretical analysis was necessary. Much has been previously written on this subject but new developments are rapidly taking place, making obsolete some practice of comparatively recent years and tending toward a more scientific treatment. There is a well earned place at present in the class room and in the library for Professor Williams' work dealing with the best current practice.

How to Use the Gantt Chart

THE GANTT CHART. A Working Tool of Management—By Wallace Clark, M. Am. Soc. M. E., M. Taylor Society. With Appendices by Walter N. Polakov and Frank W. Trabold. New York: The Ronald Press Co. Cloth; 6 x 9 in., pp. 155. $2.50.

The keynote of this book is sounded on the first page where the author says: "The Gantt chart, because of its presentation of facts in their relation to time, is the most notable contribution to the art of management made in this generation." The book is overlauditory. As many readers know, the Gantt chart shows very simply by horizontal lines the relation of the schedule of work to time, the work done each day in relation both to time and schedule and, finally, the cumulative work done and its relation to time and the schedule. It is the object of the author to explain the application and use of the chart in various ways. This he does in chapters on machine records, man records, layout charts, load charts, progress charts and

charting the American merchant marine. The book is a clear presentation of a simple and useful method of charting many operations.

Sir Alexander Houston's Latest Report

CHEMICAL AND BACTERIOLOGICAL EXAMINATION OF THE LONDON WATERS. Report for Year Ended March 31, 1922—By Sir Alexander Houston, Director of Water Examinations, Metropolitan Water Board. London: P. S. King & Son, Ltd. Paper; 8 x 13 in.; pp. 65; diagrams. 10s.

The reports by Sir Alexander Houston on the water supply of London have no equals in the water-works or in the entire municipal field. This is due not alone to the size of the London water-works, the character of the water drawn from the Thames, other rivers and from wells and the methods of treatment employed, nor even to these and the notable research work which these reports always chronicle. It is besides, and of more importance, the faculty of reviewing a year's routine and experimental work, tying it with the work of earlier years, and at the same time making it of value to the whole sanitary engineering world, which is possessed by Sir Alexander and by so few other officials in charge of large operations.

The high spots in the present report are Sir Alexander's earlier accounts of the continued chlorination of large quantities of raw water as a substitute for storage before filtration, thus saving last year well toward $100,000 worth of coal that would have been required, under the old plan, to pump the water to storage; "Some General Notes on the Future Chlorination of Water"; notes on applying chlorine to water, particularly chloride of lime; a resumé of further parallel experiments on rapid and slow sand filtration (both without coagulation); and comments on the typhoid, meteorological chemical and bacterial tables in the report.

Significant to Americans, and we hope to Britons as well, are the eight pages filled with Prof. Melville C. Whipple's summary and appreciation of Sir Alexander's report of last year (surveying fifteen years' work on London waters), which appeared in the *Journal* of the American Water Works Association for March of this year. With modesty, Sir Alexander says of Professor Whipple's paper: "Judged in its true perspective, Whipple's review is an appreciation of the Metropolitan Water Board, the [its] Water Examination Committee, and the Water Examination Department in the order stated. Sir Alexander gracefully adds: . . . "no country during the present century has done more than the United States to foster scientific research in every branch of Preventive Medicine." He also mentions Prof. George C. Whipple's Microscopy of Drinking Water" approvingly.

A Book for Steel Plant Men

HUTTE Taschenbuch fur Eisenhuttenleute—Herausgegeben vom Akademischen Verein Hutte. E. V. Berlin. Zweite Auflage. Cloth; 6 x 8 in.; pp. 963; 511 line cuts. 738 marks.

Under date of June, 1922, appears a second edition of this comprehensive handbook of steel mill construction, first issued as a separate volume in 1910. There are over 100 pages of entirely new matter. A new section, Plant Layouts, presents some elementary principles of civil and mechanical engineering and notes many precautions to be observed looking to economical management and operation. Other new portions are devoted to physical measurements, thermal characteristics of metals and furnace materials, sheet finishing mills, wire drawing and the manufacture of wire products. Naturally the book confines itself almost exclusively to German practice, but it contains a collection of widely scattered information of interest to engineers concerned with the construction or operation of steel works.

The Metric System in Practical Form

METRIC SYSTEM FOR ENGINEERS—By Charles B. Clapham Lecturer in the Engineering Department, University of London Author of "Arithmetic for Engineers." [The Directly Useful Technical Series.] New York: E. P. Dutton & Co. Cloth; 6 x 9 in; pp. 181; diagrams. $6.

Those who may have to think simultaneously in terms of the English and the metric systems of measurement as a matter of daily occupation rather than of academic interest, will find this book useful and convenient. The relationship between the various English and metric units and combinations of units is shown by description, table and illustration. A distinctly practical feature is the use of every-day measuring tools in every-day operation to illustrate relative values in the two systems. Many practical examples are worked out completely. Bold face type has been used intelligently to emphasize the statements and units that have reference value. The several charts in the pocket at the end of the book enable direct conversion by inspection not only of the fundamental units of measurement, but also of many compound units commonly used in engineering work.

Tar and Its Uses

PREPARATION AND USE OF TAR AND ITS SIMPLE CRUDE DERIVATIVES—By W. W. Odell. [Prepared Under a Co-operative Agreement with the Illinois State Geological Survey and the Department of Mining Engineering of the University of Illinois.] Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 84; illustrated. Limited number free on application; 15c. from Superintendent of Documents, Washington, D. C.

It seems strange that a Technical Paper (No. 268) "published by the Bureau of Mines as a general treatise on the utilization of tar," and containing details as to its use for roads, metal, roof and other paints, wood preserving, and cement for various purposes should omit one of the oldest and what is still one of the most important uses of tar—the coating of cast-iron pipe. This use is not entered in the index. The nearest approach to its mention in the text seems to be in the following sentence (p. 30): "Hot water-free tar is also used for painting underground iron pipes and for coating castings, pipe fittings, and metal roofs that are exposed to the atmosphere." This omission is all the more notable because the pamphlet, very properly, devotes much space to the use of tar in highway construction.

Summaries of Climatological Data

Climatological data for the United States from the establishment of the various stations to and including 1920 are being summarized by the United States Weather Bureau for publication in two volumes. Meanwhile, "Reprints" or preprints, are being made in 9½x12-in. pamphlet form, each covering relatively small sections of the country—as the Potomac River Basin, Central Illinois, Western North Dakota, etc. Temperature, precipitation, wind, humidity and frost data are given, some by months and some by averages, maxima and minima. In some cases stream discharges are included. There is a map for each district and occa-

sionally diagrams are presented. The compilation is made by P. C. Day, climatologist and chief of Climatological Division. Charles P. Marvin is chief of the Weather Bureau.

A Notable Water Power Installation

The hydro-electric power plant on the Aar River, known as the Goesgen plant, was described in an extended article in the *Schweizerische Bauzeitung* last year. The article has been reprinted by the contracting company known as "Motor," of Baden, Switzerland, as a pamphlet of 54 pages, large size, illustrated with line drawings and many half tones. The development, one of the most important in Europe, involved a large variety of engineering construction and equipment, so that any one interested in hydro-electric development would be rewarded by studying the description of the work as an example of modern European practice.

Long-Time Gage Heights of River Po

Daily gage heights of the River Po, at Parma, Italy, from 1820 to 1870, with records for 14 years scattered from 1824 to 1844 inclusive, are presented in a large pamphlet report ("Ufficio Idrografico del Po," M. Giondotti, Parma, Italy, director), published by the Reale Commissione per lo Studio del Regime Idraulico del Po. A brief introduction by the director is followed by daily records, with maximum, average and medium figures by months and years and some analytical tables.

Swedish Testing Institute Reports

The Government Testing Institute of Sweden ("Statens Provningsanstalt," Stockholm, Sweden), has issued a report entitled "Fire Tests on Building Constructions in England and Other Foreign States" and another on "Some Foreign Methods for Testing Heat Transmission Through Building Materials," each with illustrations.

Standard Act Enabling Cities To Zone

A standard form of enabling act for state legislatures to pass authorizing municipalities to frame and adopt zoning ordinances has been prepared by the Division of Building and Housing, Department of Commerce, Washington, D. C., and may be obtained free of charge on application.

PUBLICATIONS RECEIVED

[When possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated. Many of the pamphlets can be obtained without cost, or by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain any publication listed should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

New Books and Revised Editions

AN INTRODUCTION TO THE STUDY OF LABOR PROBLEMS —By Gordon S. Watkins, Ph.D., Associate Professor of Economics, University of Illinois. [Crowell's Social Service Series.] New York: Thomas Y. Crowell Co. Cloth; 6 x 9 in.; pp. 664. $3 net; postage extra.

MACHINISTS' AND DRAFTSMEN'S HANDBOOK: Containing Tables, Rules and Formulas, with Numerous Examples Explaining the Principles of Mathematics and Mechanics as Applied to the Mechanical Trades. By Peder Lobben, Mechanical Engineer. New York: D. Van Nostrand Co. Flexible; 5 x 8 in.; pp. 487. $3.

MOSQUITO ERADICATION—By W. E. Hardenburg, Sanitary Engineer, Certified Member, American Association of Engineers. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 248. $3.

SMELL, TASTE, AND ALLIED SENSES IN THE VERTEBRATES—By G. H. Parker, Sc.D., Professor of Zoölogy, Harvard University. Philadelphia and London: J. B. Lippincott Co. Cloth; 5 x 8 in.; pp. 192; 37 illustrations. $2.50 net.

TECHNICAL EXPOSITION: A Textbook on the Application of Exposition to Technical Writing, Designed for Students in Scientific, Agricultural, and Engineering Colleges—By Karl Owen Thompson, A.M., Associate Professor of English at Case School of Applied Science, Cleveland, Ohio. New York and London: Harper & Brothers. Cloth; 5 x 8 in.; pp. 227. $1.75.

TEXT-BOOK OF THE MATERIALS OF ENGINEERING—By Herbert F. Moore, Research Professor of Engineering Materials, Engineering Experiment Station, University of Illinois, Member American Society for Testing Materials, with a Chapter on Concrete by Harrison F. Gonnerman, Formerly Research Assistant Professor in Theoretical and Applied Mechanics, Engineering Experiment Station, University of Illinois, Member American Society for Testing Materials, Member American Concrete Institute. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 315. $3.

A TREATISE ON PROBABILITY—By John Maynard Keynes. London: Macmillan & Co. Cloth; 6 x 9 in.; pp. 466. 18s. net. $6.

VECTOR CALCULUS WITH APPLICATIONS TO PHYSICS—By James Byrne Shaw, Professor of Mathematics in the University of Illinois. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 314; illustrated. $3.50 net.

Reports and Pamphlets in Various Fields

ECONOMICS OF HIGHWAY TRANSPORT: Proceedings of a Conference Called by the Highway and Highway Transport Education Committee, Held at the University of Maryland, College Park, July 27, 1921. Edited by C. J. Tilden. Washington, D. C.: Highway and Highway Transport Education Committee, Willard Building. Paper; 6 x 9 in.; pp. 51.

ELECTRICAL MACHINERY APPARATUS AND SUPPLIES—Fourteenth Census of the United States, Manufactures: 1919. Prepared under the Supervision of Eugene F. Hartley, Chief Statistician for Manufactures. Washington, D. C.: Department of Commerce.

FACTORS IN THE SPONTANEOUS COMBUSTION OF COAL—By O. P. Hood. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 9; 8 illustrations. Limited number of free copies; 5c from Superintendent of Documents, Washington, D. C.

FLEXURAL STRENGTH OF PLAIN CONCRETE—By Duff A. Abrams, Professor in Charge of Laboratory. (Authorized Reprint from the Copyrighted Proceedings of the American Concrete Institute, Vol. XVIII, 1922.) Chicago: Structural Materials Research Laboratory, Lewis Institute. Paper; 6 x 9 in.; pp. 25.

FOURTEENTH CENSUS OF THE UNITED STATES, 1920: Composition and Characteristics of the Population by States. Washington, D. C.: Bureau of the Census. Cloth; 10 x 12 in.; pp. 1253.

INDIAN STANDARD LOCOMOTIVES: 5 ft. 6 in. Gauge—By H. L. Cole, O.B.E., M.I. Mech. E., Locomotive Department, Indian State Railways, and Secretary, Railway Board. Calcutta, India. Paper; 9 x 13 in.; pp. 53; 63 charts. Rs. 5.

HAND BOOK OF THE ELECTRIC POWER CLUB—St. Louis, Mo., 1017 Olive St. Paper; 4 x 7 in.; pp. 286; line cuts.
Standardization results accomplished by association of manufacturers.

THE LOADING OF FILTER PLANTS—Reprint from Public Health Reports, March 31, 1922. By H. W. Streeter, Associate Sanitary Engineer, United States Public Health Service. Washington, D. C.: United States Public Health Service. Paper; 6 x 9 in.; pp. 13.

THE PROSPECTS FOR BUILDING CONSTRUCTION IN AMERICAN CITIES—By Leonard P. Ayres, Vice-President, The Cleveland (Ohio) Trust Co. Paper; 6 x 9 in.; pp. 35; illustrated.

RECENT PROGRESS IN THE THAWING OF FROZEN GRAVEL IN PLACER MINING—By Charles Janin. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 34; illustrated. One copy free; 10c. from Superintendent of Documents.

USES OF DESCHUTES RIVER IN OREGON—Report to the Federal Power Commission by Board of Engineers: D. C. Henny, Consulting Engineer, U. S. Reclamation Service; J. B. Cavanaugh, Colonel, Corps of Engineers, U. S. Army; F. F. Henshaw, District Engineer, U. S. Geological Survey. Washington, D. C.: Federal Power Commission. Paper; 6 x 9 in.; pp. 90; illustrated.
An advance abstract of this report appeared in *Engineering News-Record*, Sept. 22, 1922; p. 503. Irrigation as well as water power is discussed.

WAGES IN FOREIGN COUNTRIES: Research Report, National Industrial Conference Board. New York: The Century Co. Paper; 6 x 9 in.; pp. 131. $1.50.
Among other occupations, covers building trades; mining; metal manufacturing; sand, glass and clay products; woodworking.

WOOD PRESERVING TERMS—By Ernest F. Hartman and E. F. Paddock. New York: Protexol Corporation, 34 Barclay St. Paper; 6 x 9 in.; pp. 85. $1.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Special Rod for Setting Slope Stakes

Sir—I have read with interest the article by Paul McCombs in the issue of *Engineering News-Record* for Aug. 24, 1922, p. 303, describing "Method of Setting Slope Stakes With Rod, Hand Level and Tape." I have set slope stakes by a similar method using a specially-graduated rod, which could be used in connection with the tape and wire extension described by Mr. McCombs.

The rod that I use has the naught marked at the height of the observer's eye and is graduated to read up and down from that point. The advantage of a rod so marked is that it simplifies the computations. Wherever the depth of the cut or fill, as the case may be, is less at the stake than at the center, the tape reading plus the rod reading will equal the cut or fill at the center. When cut or fill is greater at the stake than at the center, find the point on the slope where the tape reading equals cut or fill at the center plus rod reading.

G. F. Webb.

Atlanta, Ga., Sept. 8.

Rivet-Hole Deduction and Tests

Sir—The statement of Edward Godfrey in your issue of Aug. 31, p. 366, to the effect that tension tests on riveted joints have no bearing on the capacity of riveted tension members is somewhat puzzling in view of the fact that the critical section of a tension member is usually through the first rivets of an end connection. Whatever may be indicated by experimental investigation as the true net section through a tension splice should at the same time be the net section of a tension member with end connections similar to the splices tested, unless by chance the body details are unusually exacting. Mr. Godfrey himself, in Chapter IX of his book "Steel Designing," has indicated, indirectly at least, that end details ordinarily control the situation. Reference has already been made by Dr. Steinman and others to tests of tension details that should satisfy the designer of the essential correctness of the theory discussed in the bulletin to which reference was made in your issue of June 1.

Mr. Godfrey's tests (*Engineering News*, May 3, 1906, p. 488) appear to afford as much support for the theory which he criticises as for his own view.

Out of the first series of nine specimens tested, failure occured on diagonal lines in seven cases, indicating that the provision of a zigzag area equal to the right sectional area is not sufficient. The sectional area as calculated by Mr. Godfrey appears to be too great along diagonal lines. There is something wrong in the method of figuring deductions when drilled specimens of material with a strength of from 58,980 to 60,430 lb. per sq.in. give an ultimate strength of only 53,780 on the net section. Adopting the deduction rule criticised by Mr. Godfrey, this latter would for the drilled specimens of tests 1 to 9 be 58,000 lb.

Test specimens 10 to 18 do not properly represent structural members, in that $\frac{13}{16}$-in. holes in $\frac{5}{8}$-in. material (in some cases punched holes) are located with their centers $\frac{1}{2}$ in. from the edge of the specimens. The closeness of the holes to the edges would tend to bring about early failure of the narrow strip of metal along the edge at each of the outer rivets and thus produce a high eccentricity on the whole specimen. Mr. Godfrey states that a hole on one side of a bar weakens it much more than one on the center, and it is reasonable to suppose that the greater this eccentricity, the greater the weakening effect would be. The fact that there was only one diagonal failure out of nine in tests 10 to 18 suggests some peculiarity of this series, since there appears to be no reason, if such peculiarity did not exist, why as large a percentage of diagonal failures should not have taken place in this series as in tests 1 to 9. The marked smallness of the ultimate stress compared with that realized in tests 1 to 9 leads one to the conclusion that the nearness of the holes to the edge is a special weakening factor.

Comparison of the low stresses reported by Mr. Godfrey for tests 28 to 36 with the known value of the material suggests that the deduction has not been correctly made. If it be made on the basis of the theory outlined in the writer's pamphlet, the stresses would then be increased 14 per cent as compared with Mr. Godfrey's. These stresses would then correspond very closely to those realized in tests 19 to 27, with the exception of the specimens with punched holes, which necessarily produce highly irregular results. The correspondence for the drilled and reamed specimens is very close, as should be the case since there is no eccentricity involved in specimens 28 to 36.

C. R. Young,
Associate Professor of
Structural Engineering,
University of Toronto.

Toronto, Sept. 7.

Herodotean Hydrology

Sir:—Some of your readers may enjoy the following article on a hydrological subject written about twenty-three and one-half centuries ago. Herodotus, the Greek traveler and historian, was the author.

"Perhaps, after censuring all the opinions that have been put forward on this obscure subject, [The Inundation of the Nile] one ought to prove some theory of one's own. I will therefore proceed to explain what I think to be the reason of the Nile swelling in the summer-time. During the winter the sun is driven out of his usual course by the storms, and removes to the upper parts of Libya. This is the whole secret in the fewest possible words; for it stands to reason that the country which the Sun-god approaches the nearest, and which he passes most directly over, will be scantiest of water, and that there the streams which feed the river will shrink the most.

"To explain, however, more at length, the case is this: The sun, in his passage across the upper parts of Libya, affects them in the following way: As the air in those regions is constantly clear, and the country warm through the absence of cold winds, the sun in his passage across them acts upon them exactly as he is wont to act elsewhere in summer, when his path is in the middle of heaven—that is, he attracts the water. After attracting it, he again repels it into the upper regions, where the winds lay hold of it, scatter it, and reduce it to a vapor, whence it naturally enough comes to pass that winds that blow from this quarter—the south and southwest—are of all winds the most rainy. And my own opinion is that the sun does not get rid of all the water which he draws up year by year from the Nile, but retains some about him. When the winter begins to soften, the sun goes back again to his old place in the middle of the heaven, and proceeds to attract water equally from all countries. Till then the other rivers run big from the quantity of rain-water which they bring down from countries where so much moisture falls that all the land is cut in gullies; but in summer, when the showers fail, and the sun attracts their water, they become low. The Nile, on the contrary, not deriving any of its bulk from rains, and being in the winter subject to the attraction of the sun, naturally runs at that season, unlike all other streams, with less burden of water than in the summer time. For in summer it is exposed to attraction equally with all other rivers, but in winter it suffers alone.

"It is the sun, also, in my opinion, which, by heating the space through which it passes, makes the air of Egypt so dry. There is thus perpetual summer in the upper parts of Libya. Were the position of the heavenly bodies reversed, so that the place where now the north wind and the winter have their dwelling became the station of the south wind and noon-day, while on the other hand the station of the south wind became that of the north, the consequence would be that the sun, driven from mid-heaven by the winter and the northern gales, would betake himself to the upper parts of Europe, as he now does to those of Libya, and then I believe

this passage across Europe would affect the Ister exactly as the Nile is affected at the present day. And with respect to the fact that no breeze blows from the Nile, I am of the opinion that no wind is likely to arise in very hot countries, for breezes love to blow from some cold quarter."

Urbana, Ill., July 31. M. L. ENGER.

Determining Rail Wear

Sir—My attention was recently called to the article on "Determination of Rail Wear for Valuation Purposes," by J. P. Newell, which appeared in the issue of *Engineering News-Record* for August 24, 1922, p. 310.

While very interesting and constructive, the article starts out with a probably unintentional misstatement of fact, as follows: "The difficulty of accurately measuring the wear of rails in the track has hitherto made the inspection of rails in valuation work almost entirely a matter of the judgement of the inspector. In the Grand Trunk arbitration, with ten thousand miles of track to be examined for actual purchase, a more definite method of procedure was desirable. It was made possible by the invention of a rail pantograph by S. W. Fairweather, office engineer of the government staff."

Anyone not otherwise informed, on reading the above statement would naturally infer that the measuring of rail wear by mechanical means was a matter of only recent endeavor, when as a matter of fact, the method described in this article has been in use for the past 15 years or more to the undersigned's personal knowledge.

For years past, several of our larger engineering instrument manufacturers have manufactured and sold "railographs" that have been in practical use for this purpose since 1906 or 1907, and possibly earlier. These earlier railographs were designed for measuring T-rail sections and were not then adaptable for the wear of the girder grooved-rail of the street railway. Since then, however, railographs or pantographs, whatever they may be called, have been designed to measure this girder grooved and other special street-railway rail.

Baltimore, Md., Sept. 11. ROBT. B. RIFENBERICK.

Louisville Sewer Specifications

Sir:—The article in *Engineering News-Record*, Aug. 17, 1922, p. 268, concerning the Louisville sewer specification controversy, indicates the results that may be expected when the principles of the law of contracts are disregarded. Generally speaking, contractors are better informed concerning such laws than are the engineers who prepare the specifications and such other documents which go to make up the complete contract. Clauses which the law will not enforce, are worthless, and are better omitted from the specifications and contract. The following analysis will serve to show the general principles upon which most of the changes and revisions asked for can be supported:

1. The clause (in the issue above noted) headed "Engineer to Decide," is faulty and cannot be enforced; since it is the plain intent of the clause to deprive the courts of jurisdiction, and to also deprive the parties of their right to action. The courts will not delegate their authority and any agreement to waive the right to action will not operate to change the law in this respect, and either party is entitled to sue the other for damage at its option.

2. Any arbitration clause that it is possible to write which gives the power of *absolute* settlement of dispute to any other than the courts having jurisdiction is likewise void. The arbitration clause may, however, be so worded that arbitration may be a condition precedent to the right to action by either party and the law will sustain such a clause. However, after being unable to agree by arbitration either of the parties may enter suit against the other.

Nearly every contract is changed more or less during the execution of the work. This may or may not give rise to differences of opinion. In nearly every case the final settlement involves an adjustment of these differences that is satisfactory to both parties. Such an adjustment may be taken, then, as a modification of the original contract. A memorandum of such adjustment and balancing of claims should, however, be made a matter of record, so that any one, at any time, can determine just what was done, and why. Such action is purely arbitration, and only becomes binding and final upon being assented to by both parties. While this is the right of either party, the law generally favors a peaceful settlement, and would probably sustain the awards made by a properly conducted arbitration.

3. The condition of the part of the clause which makes the engineer, who is obviously the agent of the commission, the higher court relative to the interpretation of his own plans and specifications, acceptability of material and character of workmanship required, is good, since he is plainly the better qualified to pass upon these things than are others; and little difficulty will be encountered in the operation of such a clause, if the engineer will specify clearly and definitely what is wanted and the standards to which such material and workmanship shall conform to be acceptable.

4. At first sight it would seem strange that the contractor should object so strenuously to provisions which he knows very well cannot be enforced; but he also knows that should the commission believe that the conditions were enforceable and could be sustained, that there could be no contract, as the parties could not have assented to the provisions of the contract in the same sense.

5. The part of the clause, "his estimate and decision shall be final and conclusive to both parties to the contract," is likewise faulty, since it is clearly the right of either party to inquire into the accuracy of any estimate, final or otherwise, that he may have cause to question. This clause, relating specifically to amounts of work done, is generally used. Engineers are usually honest enough so that neither party would be harmed by the operation of such a clause; and such a clause could only be made void by proving that the engineer had acted fraudulently in the matter, or was morally deficient, which would be a rather hard case to prove, as a general thing. It is the plain duty of the engineer to correct any error of whatever nature which he may have made in the preparation of his estimates.

6. Relative to the "points at issue," as listed under that caption, most of them can be justified by two other conditions in the law of contracts, nemely: (*a*). The contractor is required to protect himself by contract from contingencies that may arise in the prosecution of the work, and will be held to do anything which may reasonably be done by any one, in the performance of the work, as distinguished from the contractor's individual ability to perform such work. (*b*). The remedy for damage is compensation. Hence, if after the plans and specifications, which may have been not in accord or ambiguous, have been interpreted by the engineer, the contractor finds that he has estimated on construction work materially cheaper than what he is now required to build he is entitled to extra compensation therefor, and the courts will award it. The reverse is also true.

The above is given in order to show clearly the necessity of a clear understanding of the law of contracts when writing documents for the work which go to make up the complete contract for that work.

Port Huron, Mich.

BENJ. L. PARKER,
Resident Engineer,
St. Clair County Road Commission.

Paraffin and Poisons for Wood Preservation

By impregnating paraffin with iodine of arsenic, iodine of copper or other poison and injecting the mixture into wood Dr. Paul Bartsh of the Smithsonian Institution claims that the wood will be preserved indefinitely against all kinds of destructive organisms. *The National Lumber Bulletin* reports that investigators at the Forest Products Laboratory have shown that the new treatment will not cost any more than the present treatments and that the paraffin penetrates wood more readily than do the preservations now being used.

NEWS OF THE WEEK

New York, September 21, 1922

Kansas Cement Companies Pay Large Fine

Enjoined Against Trade Restraint and Pay $25,000 in Judgment Following State Attorney's Action

Seven cement companies operating in the State of Kansas have paid a fine of $25,000 and have agreed to a judgment enjoining them against certain practices in restraint of trade charged by the Attorney General in an action begun July 14, 1919. The official statement of the case is as follows:

The case of the State of Kansas, on relation of Richard J. Hopkins, Attorney General, as plaintiff, against the Ash Grove Lime and Portland Cement Co., the Bonner Portland Cement Co., the Fredonia Portland Cement Co., the Great Western Portland Cement Co., the Lehigh Portland Cement Co., the Monarch Cement Co., and the Western States Portland Cement Co., defendants, was begun in the Supreme Court of Kansas, July 14, 1919. The petition charged that the defendants had formed, and were conducting an agreement in restraint of trade by fixing prices and terms for the sale of cement at wholesale in the state.

The defendants denied the allegation of the petition in regard to forming or performing an agreement in restraint of trade.

Testimony Before Commissioner

The state moved the court to appoint a commissioner to take testimony and make a report to the court of the facts found and his conclusions of law upon them. The defendants then moved the court that instead of appointing a commissioner, the state be required to file written interrogatories addressed to the defendants, and that the defendants be directed to answer them. The court deferred the appointment of a commissioner, and made an order requiring the filing of the interrogatories and answers. The state filed 189 written interrogatories to bring out information from the defendants on the questions involved, and the defendants filed answers, and on the insistence of the state that the answers were incomplete, the defendants filed supplemental answers.

The state next renewed its motion for the appointment of a commissioner and the court appointed Z. T. Hazen of Topeka. Much evidence was introduced before him by the state.

The defendants then indicated to the state a willingness to agree upon a judgment, and a stipulation was made between the parties for the entry of a judgment against the defendants. This judgment was entered, pursuant to stipulation of the parties, on Sept. 5, 1922. It provided, in brief, that the defendants should, within twenty days, pay into the state school fund $25,000; that they should pay the costs of the suit including the fee of the commissioner, and they were enjoined from

(Continued on p. 49?)

Settlement Terms of Rail Strike

With the exception of about half a dozen of the large railways—including the Pennsylvania, D., L. & W., Delaware & Hudson and C. R.R. of N. J.—the carriers have accepted the terms which the striking railway shopmen submitted last week as a basis for individual settlement. The chief points in the agreement are summarized below:

All men to return to work in positions of the class they originally held on June 30, 1922, and at the same point.

Relative standing, as between themselves, of men returning to work and men laid off to be restored as of June 30, 1922.

Disputes as to relative standing and other strike controversies to be decided by majority vote of a commission to consist of six representatives of the labor organizations and six representatives of the railroads.

All pending law suits resulting from the strike to be withdrawn.

To Stabilize Coal Industry

With the support of Secretary of Commerce Hoover the Chamber of Commerce of the United States has begun a campaign to stabilize the coal industry and prevent a recurrence of present conditions caused by the strike. The program contemplates methods of equalizing and expediting the distribution of coal and of preventing soaring prices. Regulatory legislation will not be urged on Congress.

Decayed Trestle Cap Wrecks Bridge and Kills Eighteen

A motor truck loaded with men going to a ball game broke through a bridge over the Satilla River, three miles from Axson, Ga., on Sept. 11. Eighteen of the 32 passengers were killed. Searcy B. Slack, bridge engineer of the State Highway Commission, gives the following statement of the circumstances:

"The bridge, located on a secondary county road, was a wood trestle 150 ft. long with a 30-ft. A-frame span over the channel. The roadway was 12 ft. wide. The structure was of hewn timber and the wood floor was quite irregular.

"A 2½-ton Indiana truck carrying 32 negro men drove on the bridge at a speed estimated at 25 miles per hour, and crashed through the 30-ft. channel span. The failure apparently was due to a rotten bent cap at the south end of the channel span. All timber of this span fell into the river.

"The bridge was posted at the ends with a sign reading 'Dangerous to Cross with Heavy Load.' The accident thus illustrates the ineffectiveness of the practice of posting bridges."

Hetch Hetchy Work Shows Uniform Progress

O'Shaughnessy Reports 2,100 Men at Work on San Francisco Water Supply Project

M. M. O'Shaughnessy, city engineer of San Francisco, returned Aug. 24 from an inspection trip over the Hetch Hetchy project and reported good progress all along the line with a total of about 2,100 men at work and every prospect for completing the mountain division and developing power within two years.

On the main dam 253,000 cu.yd. of concrete out of a total of 376,000 cu.yd. had been poured. Over 40,000 cu.yd. were to be poured during August, leaving 80,000 yd. to complete the structure. In the 18-mile tunnel 74,244 ft. were driven, leaving 22,710 ft. to go.

In the Priest earth dam which will serve as a forebay for Moccasin Creek power house and which is located at the lower end of the 18-mile tunnel, 6,700 cu.yd. of concrete had been placed in the core wall and earth was being delivered to the dam at the rate of 40,000 cu.yd. per month. The completion of the structure was expected within fifteen months.

Tunnel Advanced

In the 6,000-ft. tunnel from the forebay to the upper end of the Moccasin Creek penstock line an advance of 262 ft. had been made at the reservoir end and the other portal was soon to be started. Foundation for the three penstock pipes was being prepared by a crew of about 130 men. Contracts had been awarded for generators and water wheels in the Moccasin Creek power house and satisfactory bids had been received for the switchboards. All power house equipment is to be delivered and installed within a year.

The construction of the Don Pedro Dam just below the Moccasin Creek site will make necessary the relocation of the Six-Bit Gulch trestle on the Hetch Hetchy R.R. Contracts for a new steel crossing have been awarded, excavation is now being made for piers to be 55 ft. high, and the new structure will be completed in four months. Eight hundred feet of the main Hetch Hetchy aqueduct just below Moccasin Creek power house will also be submerged by the water impounded behind Don Pedro Dam and bids are to be received at an early date for completing this work before the Don Pedro reservoir is filled.

The 20-mile section of the aqueduct in the San Francisco Bay division which is now under construction to supplement the present Spring Valley source of supply, is also to be completed within two years. Work has been started at both portals of Pulgas tunnel, 8,600 ft. long, near Redwood City, for which a $700,000 contract was recently let, and final studies are being made on the submerged pipe line to be laid across San Francisco Bay near Dumbarton.

Thomas B. Bryson

Career of Prominent Contractor Marked by Large and Difficult Construction Projects

Thomas B. Bryson, vice-president of the Holbrook, Cabot & Rollins Corp., whose death in New York on Sept. 5, was noted in last week's issue of this journal, was born in Mechanicsburg, Pa. He was graduated from Cornell in 1894 with the degree of C. E. and was first employed by the Pencoyd Iron Co. of Philadelphia as draftsman.

He left this company after about a year to become associated with J. W. Hoffman, where he obtained his early experience in the contracting business, being employed on heavy railroad construction and harbor work. He came to New York about 1900 and specialized in foundation and pneumatic work with the John F. O'Rourke Co. He was in active charge of a number of difficult foundation jobs, amongst which was the foundation for the Stock Exchange Building in Wall Street. About 1905 he started in contracting on his own account, specializing in foundation and tunnel work. During this period he constructed one of the sections of the Fourth Ave. subway in Brooklyn, adopting some original methods with great success.

Drydock Construction Difficult

In connection with the Holbrook, Cabot & Rollins Corp. he took a contract for the completion of Dry Dock No. 4 at the Brooklyn Navy Yard, a particularly difficult piece of work which had been in process for six years or more. Mr. Bryson sank a series of caissons through rock around the entire limits of the dry dock and three lines of caissons under the floor. The contract was successfully completed well ahead of the specified date.

Another contract in connection with the Holbrook, Cabot & Rollins Corp. was the section of the Catskill Aqueduct Tunnel from Cooper Union, New York, under the East River to Brooklyn. This was a 16-ft. bore through solid rock, reaching a depth of 750 ft. below sea level. Other pieces of construction work that he took in connection with Holbrook, Cabot & Rollins Corp. were pneumatic foundations, Public Service R.R. terminal, Newark, N. J.; pneumatic shafts, New York side, New York, New Jersey vehicle tunnel; pneumatic foundations, New York Telephone Building, Fulton St. and Broadway, New York City; pneumatic foundation work, First National Bank Building, Jersey City, N. J.

At the time of his death he was constructing foundations for the piers and abutments of the new bridge from Philadelphia to Camden. This job involved the sinking of two of the largest caissons that have ever been built.

Mr. Bryson was an associate member of the American Society of Civil Engineers, and had been president of the General Contractors Association of New York. He was recognized as having preeminent ability in foundation work from a technical standpoint, and was distinguished also by his ability to organize and handle men. He obtained not only the hearty co-operation of his associates, but also a high degree of loyalty and friendship.

Maurice B. Greenough to Enter New Field Jan. 1

Maurice B. Greenough, who for the past five years has been with the National Paving Brick Manufacturers Association, three years of which he has served as its secretary, is to become associated on Jan. 1, 1923, with M. Lasley of Chattanooga, Tenn., who controls very extensive interests, including the manufacture of paving brick and a road and pavement contracting company. Mr. Greenough became associated with the National Paving Brick Manufacturers Association in 1917, when he was made chief engineer. The next year he was made assistant secretary and in 1919 elected secretary-manager.

Mr. Greenough was born in Groveland, Mass., and received his early education in that town, graduating from the High School in 1908. He was graduated from Tufts College with a degree of Bachelor of Science in Civil Engineering in 1912. The year of his graduation he became associated with Winston Co., contractors, in the construction of the Ashokan reservoir for the N. Y. water supply, being stationed at Brown Station, N. Y. The following year he was appointed an instructor in mechanical engineering at the Rhode Island State College at Kingston, but soon left to serve five years as instructor in civil and highway engineering in the Case School of Applied Science.

Mr. Greenough is widely known among technical men and manufacturers of construction materials. He is an associate member of the American Society of Civil Engineers and of the American Society for Municipal Improvements and a member of the American Ceramic Society, the American Trade Association Executives, The Cleveland Engineering Society, The Illinois Society of Engineers, The Ohio Engineering Society, and The Wisconsin Engineering Society.

Duff Is New Secretary of Paving Brick Association

Edward E. Duff, Jr., of Pittsburgh, was appointed Sept. 15 secretary of the National Paving Brick Manufacturers' Association to succeed Maurice B. Greenough, whose resignation effective Jan. 1 is noted elsewhere in these columns. Mr. Duff is a civil engineer graduate of Carnegie Institute of Technology, class of 1913. After two years' service in the engineering department of the Pennsylvania R.R., he served as borough engineer and building inspector at Sewickley, Pa., where he was in charge of extensive grade-crossing eliminations, paving and other municipal activities. As a lieutenant and a captain, Engineers, during the World War he served with the A.E.F. in France. In 1919 he joined the field organization of the Eastern Paving Brick Manufacturers' Association as district engineer for the Western Pennsylvania territory.

Bill to Block Coal Profiteering Goes to President

Washington Correspondence

With the approval of the conference report on the bill intended to prevent profiteering in coal and providing for the control of distribution, the measure was sent to the White House. The signature of the President probably will be affixed and the bill become a law this week. Only twelve votes were cast in the Senate against the conference report on this bill, despite the fact that it was vigorously opposed by such influential members as Minority Leader Underwood and Senator Sutherland, of West Virginia.

Senator Underwood contended that the government can not undertake to regulate the prices of commodities every time the price level exceeds that which commonly is regarded as fair. One of Senator Underwood's objections to the legislation is that it does not reach the profiteer but concentrates its penalties on the consumer.

Senator Sutherland, in the course of his remarks, said: "This situation will cure itself in a very short time insofar as soft coal is concerned. The entire difficulty would be solved more readily if the transportation companies and the shippers were authorized to proceed to get this coal to the market in the usual manner, according to methods that have been adopted after many years of trial and experiment."

Senator Reed, of Pennsylvania, among other things said, asserted that if the bill is approved "every time anything goes up in price, and some people wish to get it cheap, they will come rushing again to Congress to fix the prices."

Advocates of Ford Muscle Shoals Offer Seek Vote on It in House

Washington Correspondence

Proponents of the Ford offer for Muscle Shoals are awaiting an opportunity to have the Detroit manufacturer's proposition brought to a vote on the floor of the House. In view of the legislative situation, it will require a special rule to bring this issue up and such a rule admittedly will be difficult to obtain.

While the general plan of procedure of the Ford advocates has been placed in the hands of Representative Garrett of Tennessee, acting minority leader, the assistance of a number of Republican members who have displayed keen interest in this subject is available.

Representative Garrett has no definite plan thus far. In discussing the matter he stated that his tactics would consist of waiting for an opportunity to move on the floor for instructions to the rules committee and of seeking an opportunity to urge the subject upon the rules committee, of which he is the ranking minority member.

Chairman Campbell, of the rules commmittee, is understood to be opposed to the Ford offer and the majority of that committee do not appear to be favorable to it. Added to this disadvantage from the viewpoint of the Ford advocates in the fact that the steering committee, which has great influence with the rules committee in determining the precedence of legislation for the consideration of the House, has refused to exert pressure in behalf of the Muscle Shoals bills.

San Francisco Votes First Money on Transbay Bridge Project

The San Francisco Board of Supervisors on Sept. 5 voted a sum not to exceed $225,000 for surveys and rights-of-way on the San Francisco-San Mateo County highway to connect the city with the proposed highway bridge across the lower end of San Francisco Bay. On the same day San Mateo County supervisors voted their share of $20,000 toward the work. Sufficient funds for all the preliminary work are now available. The total cost of the new highway when completed is to be about $4,000,000.

Cement Companies Pay Fine

(Concluded from p. 492)

maintaining or carrying out the terms of an agreement with Hiram Norcross for the maintenance of a joint bureau and from making or carrying out any agreement for fixing prices and terms of the sale of cement at wholesale within the state.

A copy of the body of the judgment is set out as follows:

Text of Judgment

"It is ordered, adjudged and decreed that judgment be rendered enjoining said defendants from forming, continuing or maintaining a trust or combination of the capital, skill and acts of the defendants, or any of them, for the purpose of creating or carrying out restrictions in trade and commerce, including among other things, the sale of cement within the State of Kansas; from carrying out restrictions in the full and free pursuit of the business of selling cement at wholesale in the State of Kansas; from agreeing to maintain, fix or increase the price of cement within said state; from fixing among themselves a standard of figures whereby the price of cement sold to the public within said state shall be controlled or established; from making, entering into, executing or carrying out any contract, agreement or obligation by which the defendants have bound or shall bind themselves not to sell or deliver cement below a standard figure or to keep the price of cement at a fixed or graded figure; from establishing and settling the price of cement between themselves; from precluding or preventing a free and unrestricted competition among themselves and others in the sale of cement in said state; from agreeing to sell and deliver cement within said state at uniform or substantially uniform prices fixed by the above named defendants; from unlawfully suggesting, advising or stating to each other, directly or through their officers, agents, or employees, the prices at which cement shall be sold by any of the above named defendants within said state; from doing any acts or making any statements to preclude or prevent competition in the sale of cement and the prices on the sale of cement in said state; from making, carrying out, continuing, maintaining or doing any contract, agreement, obligation or act to accomplish any of said purposes or acts enjoined as aforesaid; and from carrying out, continuing or maintaining an agreement between the defendants, or any of the defendants, or between them, or any of them and any other person or persons, of the terms set forth in the attached form of agreement with Hiram Norcross under the name Norcross Audit and Statistical Bureau.

"And that the defendants above named, pay to the State Treasurer of the State of Kansas, for the benefit of the permanent school fund of said state, the sum of $25,000, within twenty days from this date, and that said defendants, according to said stipulation, shall also pay the costs of this action, including an allowance of $4,000 to Z. T. Hazen, commissioner, for his services and expenses and the services and expenses of his reporter."

The Engineer in Public Life

PAUL DOTY

Paul Doty, chairman of the Minnesota Board of Registration for Architects, Engineers and Land Surveyors, has accepted the Democratic nomination for member of Congress from the fourth district of Minnesota, which contains the city of St. Paul. He was graduated from Stevens Institute of Technology, Hoboken, N. J., in 1888, with the degree of mechanical engineer. For a number of years preceding the war he was vice-president and general manager of the St. Paul Gas & Light Co., which position he resigned after the United States entered the World War to accept a commission as major, Engineers, U. S. Army. He was placed in charge of the utilities department at Camp Grant, Ill. Later he was transferred to Washington and placed in charge of utilities for all posts and camps, with rank of lieutenant-colonel.

Col. Doty is a director of the Minnesota Federation of Architectural and Engineering Societies, and president of the St. Paul Association of Public and Business Affairs, the local Chamber of Commerce. He has practically worked out of straight engineering into executive, financial and public lines. He is a director of the St. Paul Trust and Savings Bank, in charge of investments, mortgages and appraisal work. As president of the St. Paul Association he has endeavored to secure for the city the use of the water power now going to waste at the "high dam" in the Mississippi and has helped to secure from Henry Ford the promise of opening a manufacturing plant in St. Paul if the water power can be obtained.

Col. Doty has spent considerable time in Washington looking after these and other matters affecting St. Paul, and it was thought by the business interests in general that it might be well to place him in Washington permanently. The opportunity came when the nominee of the regular Democratic convention, a former mayor of St. Paul, resigned on account of ill health. Party lines will probably be abolished in the forthcoming election, it is predicted, for Col. Doty has the support of all the daily newspapers.

New England Water-Works Men Hold Convention at New Bedford

Two-score technical papers on a variety of topics, an automobile trip and lunch tendered by the New Bedford Water Board, a boat ride and clam bake provided by the Water Works Manufacturers' Association, and an exhibit of appliances by the latter, combined to make the forty-first annual convention of the New England Water Works Association at New Bedford, Mass., last week a success. The Dexter Brackett Memorial Medal for the best paper published in the association's *Journal* last year was awarded to X. H. Goodnough, chief engineer, Massachusetts Department of Health, for his paper on "Rainfall in New England." This paper, stated Robert Spurr Weston, chairman of the committee on award, was the summing up of twenty years of studies by Mr. Goodnough.

The chief business transacted at the convention, aside from the report just mentioned, was the adoption of resolutions providing for the appointment of two committees of Massachusetts members to take up with the state authorities of Massachusetts (1) the subject of merging water departments with other municipal departments and (2) the financing of water-works. The Committee on Standard Meter Specifications made a "progress report."

Abstracts of the papers and discussions appear elsewhere in this issue.

Brings Suit Over Twin Lakes Dam

Suit has been filed in the United States District Court of Boise, Idaho, by the Western Construction Co., to obtain $126,440 alleged to be due and owing for construction work on the north and south dams at Twin Lakes reservoir.

Reject Plan for Free Ports

In the issue of Sept. 14, p. 453, *Engineering News-Record* announced that a provision for free ports had been taken by the joint House and Senate conference from the bonus bill. This was in error. The free ports plan was taken from the tariff bill by the conference committee having it in charge.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, San Francisco, Oct. [illegible]

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Convention, Cleveland, Oct. 16-19.

The Rochester Engineering Society opened its fall season with a smoker Sept. 8. Besides "smokes" and refreshments, an entertainment was provided consisting of vaudeville sketches, moving pictures, and boxing bouts.

Personal Notes

JOHN H. DUNLAP, secretary of the American Society of Civil Engineers, left New York Sept. 18 to attend the fall meeting of the society in San Francisco, Oct. 4 to 8. En route he will address a number of the organization's local sections as follows: Detroit and Ann Arbor, Mich., Sept. 19; Chicago, Sept. 20; St. Louis, Sept. 21; Kansas City, Sept. 22; Kansas City, Sept. 23; Omaha, Sept. 25; Denver, Sept. 26; Salt Lake City, Sept. 28; Portland, Ore., Oct. 11; Seattle, Oct. 12; Spokane, Oct. 13; Duluth, Oct. 16; and St. Paul, Oct. 17.

D. E. HENRY, senior highway engineer, U. S. Bureau of Public Roads, for the past two years in the offices of District 6 at Ft. Worth, Texas, has resigned to become office engineer of Division 4, California Highway Department, with headquarters at San Francisco.

DR. ELWOOD MEAD, professor of rural institutions, University of California, and founder of the Durham and Delhi irrigations colonies in California, has been made an honorary member of the American Society of Agricultural Engineers.

COL. FRANK B. PARKER is an applicant for the office of postmaster at Ft. Worth, Texas.. Col. Parker, who has been a prominent citizen of Ft. Worth for over 15 years, was an engineer officer during the war, being commander of the American railway engineer troops at Vladivostick, Russia. He is now Texas representative for the Oil Insurance Association.

W. C. MARKHAM of Baldwin, Kansas, formerly Secretary of the Kansas Highway Commission at Topeka, and legislative representative of the American Association of State Highway Officials, has been appointed to a position with the U. S. Bureau of Public Roads, at Washington, D. C. His work will be largely that of handling relations of the federal board with the various State Highway Commissions. Mr. Markham represented the state highway commissions during the recent session of Congress, prior to the passage of the Federal Highway Act.

PAUL P. GOODELL, director of public works of Stratford, Conn., has resigned his position effective Oct. 1, to enter private business. A successor has not yet been appointed by Rutherford H. Hunter, town manager.

EDWIN F. GREENE, of the firm of Lockwood, Greene & Co., Inc., engineers, Boston, recently returned to Boston after an extended European trip.

FRED PETZOLD, formerly connected with the Thompson-Starrett Co., building contractors of New York City, as field engineer, has joined the H. G. Christman Co., South Bend, Ind., contractors and engineers. His new position is that of construction engineer.

MAXWELL, LEFTWICH & SMITH, an engineering firm, has been organized in Tuscaloosa, Ala., for service in industrial appraisals, power-plant tests, surveys, material tests and reports, and design and construction of power plants.

MARTIN W. COWLES, senior assistant engineer, Illinois Department of Public Health, has recently become associated with Clarence W. Marsh, 101 Park Avenue, New York City, in developing the electrolytic production of chlorine at the point of consumption for use in waterworks, swimming pools and for other sanitary and industrial requirements.

J. S. RUBLE has been elected vice-president in charge of all construction of the H. K. Ferguson Co., engineers and builders, Cleveland, Ohio. Mr. Ruble resigned recently as vice-president of the Austin Co., which position he had held for the past nine years. After graduation in mechanical engineering from Pennsylvania State College in 1901 he was engaged for four years in dock, ore storage, and unloading equipment, design and construction with Hoover & Mason, contracting engineers. He served for eight years as an engineer with the U. S. Steel Corp. at Pittsburgh, Cleveland, and Birmingham. At the latter point he was construction engineer for the Tennessee Coal, Iron & Railroad Co., where he was engaged in the design and construction of heavy foundations for blast furnaces, steel mills and power plants. To Mr. Ruble's other experience with corporations there is added the developing and placing in operation of completely equipped coal mines, involving shaft sinking, tunneling and installation of equipment including the power plant and repair shops, together with camps, commissaries, streets and sanitary systems.

H. NECKER, chief engineer of the Department of Roads, Quebec, Can., has been awarded the Order of the British Empire by King George in recognition of services rendered the British Mission of the League of Nations as consulting engineer.

Obituary

GEORGE F. BEATTY, building contractor, Brooklyn, New York, died Sept. 9 after an illness of seven months.

ALLYN G. BRIDGE, treasurer of the Amos D. Bridge's Sons, Inc., road building contractors of Hazardville, Conn., died at his home in that town, Sept. 7. Mr. Bridge was born in Hazardville July 10, 1865. Most of his road and paving work was done in the New England states and New York.

FREDERICK R. MILLER, of the firm of Roger Miller & Sons, Toronto, Can., engineers and contractors, died Aug. 30, aged 44 years. Mr. Miller was prominent in public life, having rendered important services to the government during the war. In 1916 he had charge of the production of munitions in the Toronto district and was afterwards appointed by the Imperial Munitions Board as vice-president and general manager of British Forgings, Ltd. Recently he was appointed a member of the Ontario Hydro-Electric Commission and the Toronto Transportation Commission. During his professional career he had charge of many important engineering works, including several contracts in connection with the improvement of the Toronto harbor.

From the Manufacturer's Point of View

Wanted: Better Salesmanship for American Firms Abroad

BY JULIUS KLEIN

Director, Bureau of Foreign and Domestic Commerce, Washington, D. C.

One of the essentials to our success in foreign business today is the selection of efficient traveling representatives of American firms for service abroad.

Several instances have recently been brought to light where unwise appointments have proved extremely costly. In foreign countries the traveling representative of an American house is regarded as the spokesman of his country as well as of his company; he has the power to build up or damage the prestige of both. Every effort should be made, therefore, to secure capable Americans to perform the task, even at some temporary sacrifice in domestic trade.

A partially successful pill salesman, whose sole qualification for the position is knowledge of Spanish and of "the customs of the people," made an American automobile company ridiculous in the eyes of scores of shrewd Latin-American business executives who put the incident down as "just one more example of Yankee stupidity."

Precisely the same mistake was made by a leading revolver concern which sent out as its South American salesman an accomplished linguist, the son of a missionary, born and brought up abroad, who had spent two weeks in the factory in New England. On his first business call he took his samples apart and couldn't put them together again.

It is nothing less than absurd for a steel company to send to Europe a man who does not possess a fundamental knowledge of the steel business—whose only asset, probably, is a long tour in Europe in a non-commercial capacity or as a pleasure seeker. In this country a salesman or field office manager can get in touch with the home office by telephone if in trouble. Abroad, this is usually impossible unless he has long distance radio receiving and sending sets in his pocket.

Nationality

On the subject of nationality, many firms favor the selection of a real American, bearing the indubitable appearance of one in preference to a naturalized citizen who is selected solely because of his knowledge of the language and customs of his native land. Many foreign firms have a keen respect for American business methods and they will frequently do business with a bona fide "Yankee" who evidently lacks polish, as against a man of their own nationality who approaches them as the representative of an American house. His record, his character, his family connections in the country and many other factors may mitigate against his success in his home country in the robes of a "Yankee salesman."

In considering a prospective traveling agent, it is undesirable to give exclusive attention to any single element or phase of his equipment. He must be suited (a) to the territory

and the trade to be visited; (b) to the line of goods to be handled; and (c) to the commercial policies of his employer. He must be a trade builder in the wider sense and not a mere order-book filler. The agent should be a man of good education, thoroughly versed in the fundamental technical aspects of his field. He should possess a broad fund of information so that he can converse with foreign buyers about something besides his own line of goods. Superficial knowledge of the topics of the day frequently paves the way for profitable business, especially in Latin-America. He should be able to sell American manufacturing methods as effectively as a bill of merchandise or an individual unit of machinery.

Personality and stability of moral character are factors whose importance can scarcely be overestimated. The habitual gambler, the drunkard, or the fast liver is a distinct liability, no matter how brilliant he may be as a salesman. It should be made clear, however, that this warning does not imply any prejudice against the salesman who is a good mixer, who blends his social activities with restraint and proper standards of living.

Tact and good manners are also essentials. The hustler with his American line of bluff, good-fellowship frequently meets with disaster in South America. The Latin-American is accustomed to well-phrased compliments and a strict observance of certain conventions. He dislikes the appearance of doing business in a hurry, yet understanding of proper approach often results in actual orders almost as quickly as in the United States.

The "plugger" type is preferred to the temperamental "star" salesman, for it has been found that the latter often suffers severe failure abroad when his customary spectacular methods cannot be adjusted to foreign conditions.

Agencies

The salesman pioneering for his house and expected to select permanent agents must possess sound judgment. It is a common fault in this regard to assign agencies to dealers placing the largest orders, irrespective of the dealers' organization, stability, and capacity to render service. Equally dangerous is the selection of a house which is already handling so many more profitable classes of goods that the new line is certain to be slighted or ignored. When the agent selected happens to be a European, handling competing European goods, the error is all the more serious. The ability, therefore, to form a shrewd, just estimate of persons and situations is invaluable.

Sales instinct, the desirability of preliminary training in the home office, preliminary knowledge of foreign conditions, ability to speak the language of the country, accuracy and exactness, supervision over traveling representatives, the salary question, continuity in service, and legal aspects, are some of the other factors involving the solution of "The Salesman Problem."

Lumber Standardization Progressing

Following conferences initiated by the U. S. Department of Commerce and held at Washington, Chicago and Portland, Ore., it is announced that there is every prospect that a standardization of lumber trade practices will come about in a fairly short time. There is now working a central committee on lumber standards, comprising representatives of the lumber manufacturers, the retail lumber dealers, the lumber wholesalers, the architects and the engineers.

This committee will develop a program of lumber standardization along the following lines: First, lumber grades and grade names, second lumber sizes, third, guarantees for the protection of the public. It is working in co-operation with the Department of Commerce in the same manner as the paving brick manufacturers worked in producing their recent standards of sizes. The committee is made up of John W. Blodgett, of the Blodgett Co., Grand Rapids, Mich., chairman; John H. Kirby and Charles A. Goodman, representing manufacturers; Dwight Hinckley, representing the wholesalers; John E. Lloyd, representing retailers; W. E. Hawley, of the Duluth, Missabe & Northern Ry., representing railways and engineers, and E. S. Hall, representing the architects.

Business Notes

The Hotchkiss Steel Products Co., Binghamton, N. Y., has put into effect this month a new sales policy for its steel road forms which are now being sold through the Hotchkiss agent organization. Previously these forms had been distributed through an outside selling organization. Under the new arrangement all matters pertaining to the sale of the road forms will be directed by R. C. Weller, sales manager, 1411 Lumber Exchange Building, Chicago.

C. E. Reese, editor of the *Gas Engineering and Appliance Catalogue* and associate editor of the *Gas Age-Record*, has joined the stoker sales department of the Westinghouse Electric & Manufacturing Co., at South Philadelphia. He was previously cadet engineer and combustion engineer with Henry L. Doherty & Co., and assistant engineer of the Illinois Public Utilities Commission.

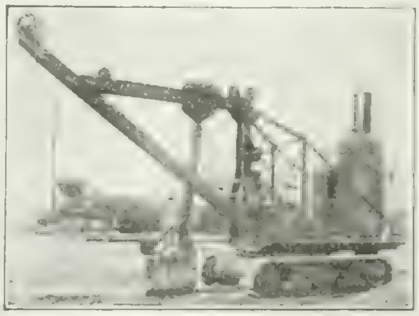
Equipment and Materials

Power Shovel with Horizontal Boom and Trolley

A new power shovel with ¾-yd. dipper designed for steam, electric or gasoline-engine operation is announced by the Fairbanks Steam Shovel Co., Marion, Ohio. The feature of the equipment is the horizontal digging boom and dipper handle shown in the accompanying illustration. The manufacturers point out that a much longer reach and dumping range can be obtained with this boom than with other types and that the highest trucks and wagons can be easily loaded. The shovel is particularly adapted to road and street construction and stripping.

Other features of the new shovel, designated as Model K, are its crawler traction, full revolving swing, submerged tube ASME boiler and Fairbanks reversing valve engines. If desired a standard boom and dipper handle can be substituted for the horizontal boom illustrated.

The dipper handle is hinged to the trolley and is operated back and forth



by cables fastened to a small drum on the trolley and a friction drum on the A-frame. An automatic stop device at each end of the travel insures against broken cables. The trolley may be held stationary at any point and the dipper handle may be adjusted for deep digging.

Many Special Features in Latest Type of Loader

A number of special features have been incorporated in the latest type of portable bucket loader, known as the Tanktred, manufactured by the Jeffrey Manufacturing Co., Columbus, Ohio. For the mounting a three-point suspension and crawler treads are employed. The buckets are of malleable iron with

steel cutting edges. The foot of the elevator is so constructed that the buckets are wider than any other part, allowing the machine to be advanced several feet into the pile with nothing but the cutting edge of the bucket in contact with the material.

A relatively large foot-wheel reduces centrifugal force and enables the bucket to pick up material, especially large lumps, without kicking them away. Flexibility of operation is secured by two speeds, a traveling speed for moving the machine from place to place and a feeding speed for driving the machine into the pile. Only one man is required to operate the loader.

A loading clearance of 9 ft. 6 in. allows the loader to serve the largest automobile trucks, a universal swivel

spout facilitating the spotting of the material to be loaded, without necessitating movement of the truck. Storage hoppers receive the discharge from the buckets, thus enabling the elevator to work while a full truck is being pulled away and an empty one spotted under the discharge spout.

Light-Weight Trench Excavator

A compact, light-weight trench excavating machine, with weight evenly distributed on crawler treads, has been developed by the A. J. Penote Co., of Cleveland for use in streets or on lawns for the installation of underground conduits, gas or water mains.

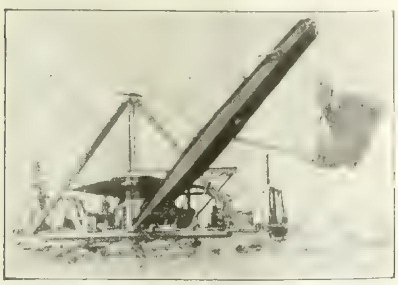
The equipment weighs 5 tons and is provided with a cutting ring 6 ft. in diameter, carrying a series of buckets as shown in the illustration. Power is furnished by a 20-hp. gasoline engine. The overall length is 16 ft. and the width 4½ ft.

The machine will excavate a trench 5 ft. deep with a minimum width of 10 in. and a maximum width of 20 in. The crawlers are equipped with rubber pads to protect lawns and sidewalks.

While the machine was built primarily for the Penote company's own use on a job in Detroit, so many inquiries have been received regarding it that plans are being made to manufacture and sell it.

A 1½-Yd. Dredge for Drainage Contractors' Use

A 1½-yd. dredge, designed particularly for handling material on drainage contracts has been placed upon the market by the Bay City Dredge Works,



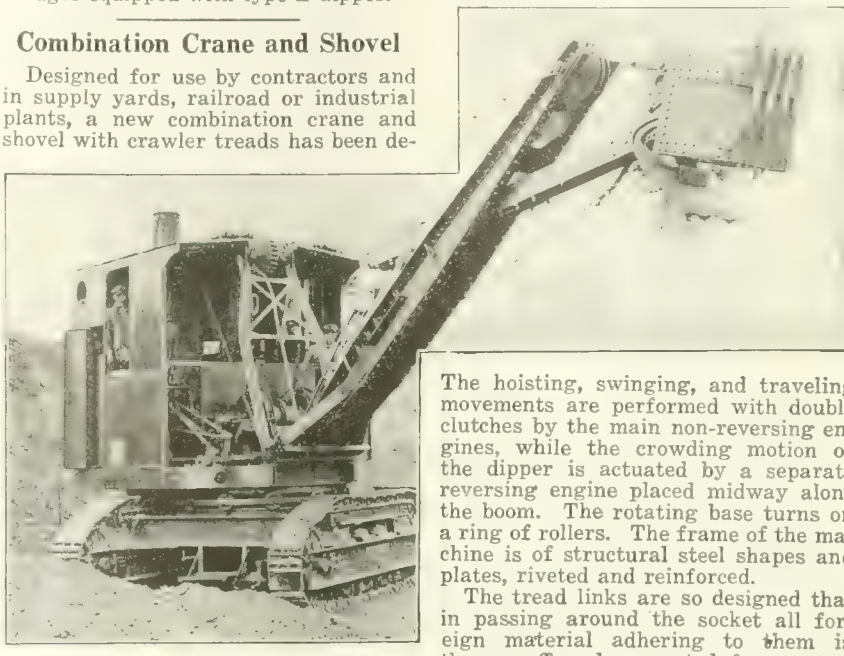
Bay City, Mich. Among the mechanical improvements incorporated in this dredge are a plate steel boom, type Z dipper, all-steel castings, band type clutches, heavy geared crowding device, and double cable on the boom guy. The machine is similar in design to the Bay City company's 1-yd. dredge, differing in its larger capacity and heavier construction throughout. It is claimed that the same operating crew can run the 1½-yd. dredge as is required for the 1-yd. dredge. The total shipping weight of the dredge is 100,000 lb.

The manufacturers state that M. J. Zabawa, working in Martin County, Minn., is handling 12,000 yd. per day in a single shift with one of the 1½-yd. dredges equipped with type Z dipper.

Combination Crane and Shovel

Designed for use by contractors and in supply yards, railroad or industrial plants, a new combination crane and shovel with crawler treads has been developed by the Orton & Steinbrenner Co., of Chicago, Ill. Two sizes of machine, ¾-yd. and 1-yd., are being manufactured. The design enables the crane boom to be removed and the shovel boom and dipper substituted. For work of tearing up pavements a separate boom with skimmer scoop can be connected to the crane independent of the main crane boom, in which case the hoist line is simply reeved over the scoop.

Motive power is supplied by only two engines, thus simplifying operation.



The hoisting, swinging, and traveling movements are performed with double clutches by the main non-reversing engines, while the crowding motion of the dipper is actuated by a separate reversing engine placed midway along the boom. The rotating base turns on a ring of rollers. The frame of the machine is of structural steel shapes and plates, riveted and reinforced.

The tread links are so designed that in passing around the socket all foreign material adhering to them is thrown off and prevented from entering the spaces between. A feature of the machine, its manufacturers claim, is the accessibility of its parts, especially those bearing the brunt of wear, so that field repairs, when needed, can be made with the minimum amount of lost time.

Out-of-the-Ordinary Trade Publications

Drag Scraper—THE LINK BELT Co., Chicago, features its "power hoe" or improved drag scraper in a 24-page illustrated booklet just issued. Among the applications of the power hoe are for storing coal and handling sand, gravel and crushed stone. Sketches indicate layouts for loading material from storage piles to box cars, for enlarging trestle storage, for delivery of coal from storage pile to power house, for loading from ground storage piles into trucks with the aid of an elevating conveyor, and for transferring bulk material from bottom-dump railroad cars to storage piles.

Road Oilers, Sweepers and Sprinklers—THE AUSTIN MANUFACTURING Co., Chicago, has just gotten out a 40-p. illustrated catalog describing its wide variety of equipment for the oiling, sweeping and sprinkling of roads. The foreword presents a picture of the development of road oiling since the first experiments in this country were undertaken in California in 1901. The Austin company built its first successful pressure road oiler about ten years ago and shortly afterward introduced its heater attachment; up to that time gravity type distributers were almost exclusively used. Pressure oilers are shown in the catalog with or without the heater attachment. The capacity of the horse-drawn type is 600 gal. and of motor-driven types from 600 to 1,000 gal. Detailed specifications are given for each type, as well as for a 750-gal. trailer oiler. In connection with its water sprinklers, details are given of the Austin vertical perforated spray head. Street sweepers with single and double-speed broom drives are illustrated and described.

Roof Leader and Vent Connections—THE BARRETT Co., New York, in a 28-page illustrated booklet explains the design features and uses of Holt roof connections with flat roof or saw-tooth construction. These connections may be employed at any place where vent pipes, leader lines, steam stacks, flag poles, or other fixtures passing through the roof require flashings. The booklet illustrates and describes eight types of Holt connections. A table shows the relationship between area of roof to be drained and size of leader pipe. There are included Barrett roof specifications.

Wall Colors and Illumination—THE EDISON LAMP WORKS of the General Electric Co., Harrison, N. J., has published a 16-p. illustrated booklet by A. L. Powell, discussing the effect of color of walls and ceilings on resultant illumination. It is pointed out that if the surroundings are not adapted to reflecting such light as strikes them, the lighting system, no matter how carefully designed, will be inefficient. The booklet takes up in detail the question of proper painting and papering of walls and ceilings. A table is given showing the percentages of light reflected on surfaces of various colors.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Salt Water in Oil Wells Affects Asphalt Prices

Mexican Crude Oil Production Falling Off Owing To Appearance of Brine—Road Oils and Asphalt Higher

Recent rises in the price of asphalt and road oils, as noted in *Engineering News-Record*, are explained by salt water encroachments in the light-oil fields of Mexico. According to the *Oil Trade Journal* reports from the South Fields of Mexico indicate that twenty of the thirty-one producing wells in the Toteco-Cerro Azul pool are showing salt water in amounts ranging from less than 1 per cent to as high as 15 per cent, with a recently completed well in the adjoining district of Chiconcilla showing 25 per cent.

The "stripping" process which has been put into use in these wells has been successful in keeping up a daily production of from 140,000 to 150,000 bbl. since the water appeared and three companies, agreeing upon joint regulation of production from this field, will each take out oil as desired, making the life of the pool a matter of speculation.

Imports of Mexican crude oil on July 15 had fallen off to a rate of fully 5,000,000 bbl. less per month than in the pervious months. Signs are numerous that the reduction in output will be even greater in the future, as there are at present not other pools of equal productive possibilities under development, or even in prospect, in Mexico. Six other wells also showed salt water in varying quantities.

The effect of the Mexican oil situation upon the construction materials market, has been to create a rising tendency in asphalt prices. In the New York market asphalt in bulk is now quoted at $14 as against $13, and $20 in packages as compared with $17.50 per ton, one month ago. Baltimore also quotes Mexican asphalt at $14 and Atlanta, $17.50 in bulk; both representing advances of $1 per ton over August. Detroit recently quoted a rise of $4.50 in bulk and $3.50 in packages; Philadelphia also announced an advance.

Anthracite Coal Output Increasing

The country's normal supply of anthracite coal fell short approximately 30,000,000 tons, as a result of the five months' suspension, according to the Coal Bureau of the Chamber of Commerce of the United States.

The report continues: "the normal yearly production of anthracite coal suitable for household purposes is about 72,000,000 tons. As it is possible to store anthracite safely for long periods, the industry is organized to run with fair uniformity throughout the year. It is the custom of producers, dealers and many domestic consumers to accumulate supplies in the summer and fall against winter needs. As the productive capacity of the anthracite mines

(Concluded on p. 500)

Finance Briefs

Stock market still rising. Steady buying of investment stocks due to easier money market last week. General public is buying for a continuation of the rise.

Bond market steady for all classes. Heavy demand for municipals, with many new issues. Railroad, industrial, public utility and Liberty bonds in active demand. Trading dull in foreign securities.

Foreign Exchange market lower on French, Belgian, Italian and other Continental rates, due to uncertain political situation. Abrupt drop in sterling to $4.41, lowest since July 3, to establish dollar credits for coming grain and cotton bills. Italian rate touches new low for the year, 4.18½.

Money market showing firmer tone in call rates, 4 per cent in early part of this week, due partly to Government withdrawal of $46,000,000.

Brick Prices Advance But Slightly Compared with Other Materials

Brick prices were already so high, in many instances, with demand decreasing, that even fuel shortage and poor transportation facilities have done little to boost prices still higher. According to the Common Brick Manufacturers' Association of America orders on the books of its members exceed by 66,000,000 the amount of burned and unburned brick on hand.

Advances in price occurred in five out of twenty-two cities reporting to *Engineering News-Record* during September; with declines in but two. Minneapolis quotes $18@$19, delivered, as against $17@$18 per M, last month; Kansas City, $16.50 as against $14.50; New Orleans, $13, up from $12.50; Atlanta $12, from $11 and Cleveland, $16 as compared with $14, one month ago. Dallas, however, quotes $10.90; down from $11.15 and New York, $15@$17, wholesale, alongside dock, or $18@$20.20 delivered; with $20 the prevailing price one month ago and $18 per M, wholesale, last week.

The situation in New York may be attributed to an actual increase in the supply as well as a shortage of second-hand brick. Scarcity of the used product helps keep up the demand for the present output of new brick, while increased production serves to deflate the price and also to dispel the recent fears of shortage. Brick, therefore, may be said to be the only one of the important building materials showing a downward price trend in the New York market at the present time.

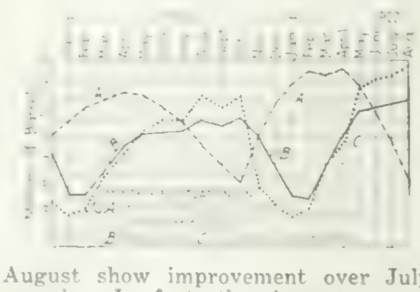
REPORT ON COMMON BRICK FROM 95 YARDS AS OF AUGUST 1, 1922

Dist. No.	Including States of	No. of firms reporting	Plants closed down	Burned brick on hand	Unburned brick on hand	Orders on books	Price per thousand at brickyard
1.	N. Y., New England	6	1	1,616,000	2,759,000	4,590,000	$14.00 to $19.00
2.	Pa., N. J., Md., D. C., Del.	9	0	10,043,000	6,834,000	35,034,000	12.50 to 17.00
3.	Va., N. C., S. C., Ga., Fla.	5	2	3,826,000	2,694,000	5,105,000	10.00 to 18.50
4.	Mich., Ohio, W. Va.	11	1	4,974,000	5,221,000	20,008,000	12.00 to 17.00
5.	Ill., Ind., Wis.	23	1	130,302,000	1,710,000	188,947,000	11.00 to 15.50
6.	Ky., Tenn., Miss., Ala., Ark., La.	13	1	18,753,000	5,743,000	13,453,000	9.10 to 16.00
7.	N. & S. Dak., Minn., Neb., Ia., Kan., Mo.	11	4	3,099,000	4,885,000	3,610,000	10.00 to 18.00
8.	Okla., Tex., N. M.	7	0	3,169,000	2,058,000	1,629,000	8.00 to 12.00
9.	Wash., Ore., Mont., Wyo., Ida., Utah, Colo.	7	0	4,507,000	624,000	4,503,000	12.00 to 19.25
10.	Calif., Ariz., Nev.	2	0	3,935,000	4,267,000	10,265,000	14.00 to 14.[illegible]0
		94	10	184,224,000	36,795,000	287,144,000	

August Cement Output and Shipments Heavier Than July

Production of portland cement in the United States during August, according to the Geological Survey, totaled 11,064,000 bbl., an increase of 107,000 bbl. over the preceding month. Shipments amounted to 14,361,000 bbl. or 511,000 bbl. heavier than July.

Despite the fuel and car shortage both production and shipments during



August show improvement over July records. In fact, the August output exceeds that of the corresponding period in 1921, by 1,420,000 bbl. Shipments in August, 1922, showed an increase of 2,021,000 bbl. over the same month last year. A rate of shipment in excess of production, left only 5,737,000 bbl. in reserve at the end of August, which was 2,696,000 bbl. under the stocks on hand, July 31.

June Exports of Construction Machinery Only $263,709

Exports of steam and other power shovels, cranes, hoists and derricks (except mining) from the United States during June, as reported by the Department of Commerce, numbered 329 units, worth but $219,131 as compared with 226 units, valued at $376,832 during May. Dredging machinery, weighing 256,869 lb. and worth $44,578, most of which went to France, Canada, Central and South America, would bring the total for this class of exports to $263,709.

Of the thirty-seven steam shovels, France took thirty-one; England, one; Japan, two and Canada, three.

Bond Sales for Last Eight Months Heaviest Since 1892

The amount of long-term municipal bonds sold during August was of relatively moderate proportions, for these times, totaling only $65,911,016 as against $92,958,989 for July and $94,638,755 during August, 1921, according to records kept by the *Commercial Financial Chronicle.*

Despite the abrupt drop in bond issues in August, a remarkably steady increase in new offerings has been in evidence during the last two weeks.

Bond sales from Jan. 1 to Sept. 1 totaled $810,183,774 as against $665,858,366 for the first eight months of 1921 and $448,830,120 for the corresponding period in 1919, the highest three periods during the last thirty years.

Among the more important issues were: North Carolina, $5,000,000 4s and $2,300,000 4½s and State of Oregon, $1,500,000 4½s at 102.31, a basis of about 4.29 per cent; Hudson County, N. J., $1,554,000 4½s, on a basis of 4.35@4.45 per cent; City of Minneapolis, Minn., $1,120,000 4½s at 102.271, a basis of about 4.30 per cent and Bay City, Mich., $1,000,000 5½s at 105.033, a basis of about 5.08 per cent.

Short-term securities issued during August totaled $23,321,000, including New York City temporary loan negotiations amounting to $11,600,000.

Of the fifty-six representative issues shown in the accompanying table, seven sold at par, forty-eight above and only one below par; the yields ranging from 4.20 to 5.97, with one at 6.25 per cent. The rates varied from 4 to 6 per cent, with one issue in Idaho at 7. All those drawing 6 per cent were in the Southern and Western states; the single 4¾ being in Maine and the one 4 per cent issue in Vermont.

Next week — Why 1913 is used as a base by the United States Bureau of Labor Statistics.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 147 to 159, are the following projects:

Sewers in various streets, Chicago, Ill., $2,000,000. C. D. Hill, ch. engr.

Five-story building including garage, Montreal, Que., $1,000,000.

Office and stores, 12 story, Philadelphia, Pa., $1,000,000.

REPRESENTATIVE PUBLIC BOND SALES DURING SEPTEMBER, 1922

State	Purpose	Amount	Maturity	Rate Per Cent	Basis	Sold For	Dated	Purchased By
Missouri	Road	$5,000,000	1926-27	4½	4.35	100.6443	Sept. 1, 1922	Liberty Central Trust Co. of St. Louis
County								
Bartholomew, Ind.	Highway	15,600	1923–32	4½	....	100	Aug. 28, 1922	Union Trust Co. of Columbus.
Beaver, Pa.	Courthouse	100,000	1923–32	4½	4.20	103.37	Sept. 1, 1922	Union Trust Co. of Pittsburgh.
	Road	150,000	1933–47	...	....	....	....	....
	Hospital	50,000	1948–52	...	....	....	....	....
Clearfield, Pa.	Road	325,000	1952	4½	....	102.52	Sept. 1, 1922	Harrison, Smith & Co., Philadelphia.
Dearborn, Ind	Highway	19,000	1923-37	5	4.73	101.88	Sept. 1, 1922	Peoples Nat. Bank of Lawrenceburg
		10,200	1923-37	5	4.73	101.889	Sept. 1, 1922	Dearborn Nat. Bank of Lawrenceburg
Floyd, Ind.	Highway	27,400	1942	4¾	....	100.53	May 15, 1922	Fletcher Savings & Trust Co. of Indianapolis.
Franklin, Ohio	Highway	59,000	1925-32	5	4.73	101.39	Aug. 1, 1922	Seasongood and Mayer, Cincinnati.
Guilford, N. C.	Hospital	100,000	1923–57	4¾	4.73	100.13	Sept. 1, 1922	Taylor, Ewart & Co., Chicago.
Kalamazoo, Mich.	Roads	38,600	....	5¼	....	100.04	....	Detroit Trust Co., Detroit.
Madison Co. Road Dist. No. 3, Miss.	Highway improvement	96,000	1923–47	5½	....	101.29	Sept. 5, 1922	Kauffman, Smith, Emert Co., Inc., of St. Louis
Monroe, Mich.	Road	77,000	....	5½	....	100.818	....	Prudden & Co., Toledo.
Monroe Co. Road Imp't. Dist. No. 3, Ark.	Road improvement	160,000	1942	6	....	102.50	Sept. 4, 1922	The First National Co. of St. Louis.
Ocean, N. J.	Road improvement	150,000	1926	5½	....	100.30	June 1, 1922	Security Trust Co., Camden.
Randolph, Ind.	Highway	23,000	1923–32	5	4.74	101.25	Aug. 15, 1922	Gavin L. Payne Co., Indianapolis.
Red River, Atchafalaya & Bayou Levee Dist., La.	Levee	400,000	....	...	....	100.56	....	L. E. French & Co., Alexandria and others
Redwood, Minn.	Ditch	165,000	1928–42	4½	4.49	100.19	Sept. 1, 1922	Capitol Trust & Savings Bank of St. Paul
	Highway	12,484	1932					
Tensas Basin Levee Dist., La	Levee	120,000	1932-61	5	..	100.91	Sept. 1, 1922	Marine Bank and Trust Co. of New Orleans
Tillamook, Ore.	Road	71,400	1937-39	5½	4.93	106.27	July 1, 1922	Lumbermens' Trust Co. of Portland.
Tipton, Ind.	Highway	2,000	1923–32	5	....	100	Aug. 25, 1922	Citizens Nat. Bank of Tipton.
Vanderburgh, Ind.	Roads	28,680	1923–32	4½	....	100	Sept. 2, 1922	Fridy & Maurer, Evansville.
Wells, Ind.	Highway	2,000	1923–32	4½	....	100	Aug. 15, 1922	Wells County Bank of Bluffton.
Township								
Harrison, Allegheny Co., Pa.	Sewer	50,000	1925–49	4½	4.37	101.4105	Sept. 1, 1922	Mellon Nat. Bank of Pittsburgh.
Hayden Lake, Irr. Dist. Kootenai Co., Idaho	Irrigation	100,000	1933–42	7	6.25	..	July 1, 1922	Ralph Schneeloch Co., Portland.
Linden, Union Co., N. J.	Street improvement	181,000	1923–42	4¾	4.32	101.534	Sept. 1, 1922	Nat. State Bank of Elizabeth.
Municipality								
Asheboro, N. C.	Street improvement	$135,000	1925–39	5¼	5.23	100.13	July 1, 1922	Taylor, Ewart & Co., Chicago.
Ashville, Pa.	Street improvement	11,000	1924–45	5	4.90	100.875	July 1, 1922	E. H. Rollins & Sons.
Belhaven, N. C.	Electric light system	30,000	1925–52	6	5.97	100.37	July 1, 1922	W. K. Terry & Co., Toledo.
Biddeford, Me	Sewer	50,000	1927–36	4¼	4.24	100.069	July 5, 1922	Merrill, Oldham & Co., Boston.
	Street	25,000	1927-31					
Boulder, Col.	Reservoir	100,000	1937	4½	....	100.061	Oct. 1, 1922	James H. Causey & Co., Denver. Benwell, Phillips & Co., Denver.
Cape May, N. J.	Paving	66,500	1923–42	5	....	100	Sept. 25, 1922	Merchants' National Bank of Cape May
Carlton, Minn.	Waterworks	15,000	....	5½	....	102.66	Sept. 1, 1922	Capitol Trust and Savings Bank of St. Paul
Cedar Rapids, Ia.	Waterworks	100,000	1923–42	4¾	4.30	103.60	June 15, 1922	Weil, Roth & Co., Cincinnati.
Chatham, Va.	Street repair	12,000	1952	6	....	100.41	Sept. 1, 1922	Chatham Savings Bank.
Dubuque, Ia.	Grading	75,000	Serially	5	...	102.20	July 1, 1922	Bonbright & Co., Chicago.
East Spencer, N. C.	Street improvement	15,000	1925–39	6	5.90	100.60	July 1, 1922	George & Fetner, Cherryville.
Fairview, N. J.	Disposal plant	33,000	1923–55	5½	5.47	100.378	Aug. 1, 1922	B. J. Van Ingen & Co., New York.
Genoa, Ohio	Street improvement	15,000	1923–31	5½	....	100.61	Aug. 1, 1922	Ryan, Bowman & Co., Toledo.
Greenburgh, N. Y.	Highway	31,800	1923–33	5	4.34	103.43	Sept. 1, 1922	Scarsdale Nat. Bank.
Greenfield, Ohio	Street improvement	8,000	1923–30	5½	5.11	101.55	Aug. 1, 1922	Davies-Bertram Co., Cincinnati.
Kent, Ohio	Waterworks	200,000	1923–47	5	4.71	102.57	Sept. 1, 1922	A. T. Bell & Co., Toledo.
Kinston, N. C.	Waterworks	50,000	1925–62	5	4.99	100.11	Aug. 1, 1922	Caldwell & Co., Nashville.
	Street improvement	50,000	1925–42	5	4.99	100.11	....	....
Madison, N. J.	Gen'l improvement	69,000	1923–48	4½	4.34	101.74	Sept. 1, 1922	J. G. White & Co., New York.
Montclair, N. J.	Permanent improvement	50,120	1923–42	4½	4.37	101.135	Oct. 2, 1922	J. S. Rippel & Co., Newark
Mt. Morris, N. Y.	Pavement	72,000	1923–48	4½	4.48	100.157	Sept. 1, 1922	Farson, Son & Co., New York.
Muskegon, Mich.	Improvement	105,000	1923–32	4½	...	100	Sept. 1, 1922	Kean, Higbie & Co., Detroit.
Norwood, N. Y.	Streets	3,000	1924–29	5	4.75	101	July 1, 1922	State Bank of Norwood.
Oakwood, Ohio	Sewer	32,000	1923–32	6	5.27	103.26	July 15, 1922	Seasongood & Mayer, Cincinnati.
Ogema, Minn.	Electric lights	13,000	1930–42	6	5.85	101.50	Aug. 1, 1922	Drake-Ballard Co., Minneapolis.
Plant City, Fla.	City improvement	150,000	....	6	....	104.04	Aug. 1, 1922	Hillsboro State Bank of Plant City and Caldwell & Co., of Nashville
St. Albans, Vt.	Street improvement	20,000	1933–36	4	4.19	98.17	Aug. 1, 1922	Harris, Forbes & Co., Boston
St. Joseph, Mo.	Sewer	795,000	1927-41	5	4.52	104.132	May 1, 1922	Harris Trust & Savings Bank of Chicago.
Sacramento, Cal.	River filtration	900,000	1923–61	5½	4.57	111.932	Jan. 1, 1922	Anglo-London-Paris Co. of San Francisco; Eldredge & Co. and Kissel, Kinnicutt & Co. of New York.
Thomasville, N. C.	Street	75,000	1925-39	5½		101.04	Aug. 1, 1922	Bolger, Mosser & Willaman of Chicago.
Topeka, Kan.	Genl. improvement	100,000	....	4¾	....	101.75	Aug. 29, 1922	Brown-Crummer Co., Wichita.
Watertown, Mass.	Sewer	9,000	1923-31	4½	4.31	100.826	Sept. 1, 1922	Arthur Perry & Co., Boston.
Windber, Pa.	Improvement	15,000	1946	4½	....	100	Nov. 1, 1916	Windber Trust Co.

Anthracite Coal Output

(Concluded from p. 498)

is sufficient to take care of this uniform demand only, it is apparent that any interruption in the regular production during the summer is bound to create a shortage which cannot be overcome.

"There are no accurate figures as to stocks of anthracite usually carried by producers, by dealers, or in the bins of household consumers. It is known, however, that broadly speaking, stocks of anthracite were exhausted. The strike has already caused a five months' interruption at normal production—a shortage amounting to 30,000,000 tons.

Except for a few thousand tons recovered by dredging the rivers, there was absolutely no production of anthracite coal from April 1 to Sept. 11, at which date the mines reopened with a production rate of approximately 17,500 tons for the first day, in three Pennsylvania districts.

On the first day of resumed mining activities the Lehigh Valley R.R. hauled thirty carloads of freshly mined anthracite coal, in domestic sizes, to the New York market alone. The second day, Sept. 12, witnessed the shipment of eighty-five carloads from the Shamokin, Pa., district as the result of a single day's production.

With rapid increases in output and facilitated deliveries of domestic hard coal, owing to rigid freight embargoes on all materials other than necessities, the anthracite shortage, while not completely overcome, will be greatly alleviated. The effects of a car shortage will be felt, however, principally by shippers of construction materials.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of September 7; the next, on October 5.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.04	$3.65	$4.20	$2.92½	$3.05	$3.80	$3.25	+$3.90	$3.75
Structural rivets, 100 lb.	3.85	4.35	4.00	3.35	3.52½	4.80	4.25	+4.00	6.50
Reinforcing bars, ⅝ in. up, 100 lb.	2.94	3.50	3.50	2.82½	2.95	3.97½	3.00	+3.75	+3.25
Steel pipe, black, 2½ to 6 in. lap, discount	57%	61.15%	45%	59½%	58.9-5%	43%	45.7@49.1%	+45%	30.00
Cast-iron pipe, 6 in. and over, ton	55.30	—49.00	51.50	46.86	52.00	60.00	51.00	—51.00	50.00
Concreting Material:									
Cement without bags, bbl.	2.85@3.00	2.50	2.25	2.20	2.39	2.85	2.71	2.90	2.78
Gravel, ¾ in., cu.yd.	1.75	1.85	2.25	2.00	1.75	1.75	2.25	1.00	1.50
Sand, cu.yd.	1.00	1.15	2.25	2.00	1.00	0.75	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	1.65	1.60	2.25	3.50	2.25	3.00	—1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+57.00	40.00	40.00	49.00	40.00	50.00	33.00	24.50	50.00
Lime, finishing, hydrated, ton	15.80@16.17	+23.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.14½	+1.80	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	—18.00@20.20	+12.00	10.90	11.00	18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	.09	.065	....	.11	.08
Hollow partition tile 4x12x12, per block	.1112	.0776	.115	.0808	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	.91	—.99	1.13	—.97	1.00	1.12	1.04	.86	1.12
Common Labor:									
Common labor, union, hour	.60	.35	....	.80	....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.44@.60	.30	.25	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered except sand, gravel and crushed stone alongside dock, common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars, tile "on trucks"; linseed oil and cast iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180 lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast iron pipe and crushed stone f.o.b. cars; other materials delivered.

San Francisco quotes on Heath tile 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.96 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Structural shapes and reinforcing bars, $2@$2.10 per 100 lb., f.o.b. Pittsburgh, on ordinary business; $2.15@$2.25 for prompt shipments. Standard rails quoted by leading interest at $43, as against $40 per ton, at mill. The new price, effective Oct. 1, represents the first rise in standard rails since October, 1921, when the price dropped from $47 to $40 per ton. Steel ingot production at Pittsburgh mills has jumped from an annual rate of 26,000,000 to 30,000,000 tons in the last three weeks, despite the continued scarcity of coke and pig iron. Car shortage, or still more strictly speaking locomotive shortage, may prevent further gains in output for some time to come. The closing of the Ford motor plant, however, will have a lessening effect upon demand to the extent of about 30,000 tons of iron and steel per month.

Seattle warehouses quote shapes at $3.90 as against $3.75; rivets at $4, up from $3.75, and reinforcing bars at $3.75, compared with $3.60 per 100 lb. last week. Montreal also reports advance in steel bars, now $3.25 as against $2.90 per 100 lb. Steel pipe discounts in Seattle warehouses reduced five points, following recent mill advance.

With lumber production at 5 per cent below normal for the week ending Sept. 9 as compared with a normal rate of output attained during the week of Aug. 26, and orders and shipments also rapidly falling below normal, lumber prices in New York advanced $2 per M ft. over the week end. Although no other large centers reported advances, lumber prices are firmer if not higher throughout the country.

Atlanta reports hydrated lime up 50c. per ton and common lump, 5c. per bbl.; also a rise of $1 per M on common brick. New York, however, quotes brick at $18@$20.20, as against $21.50 per M, delivered, one week ago.

Linseed oil up 4c. in New York and down 2c. per gal. (5 bbl. lots) in Chicago, since last week.

Reduction in prices of 40@60 per cent gelatin dynamite are announced, effective Sept. 18.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

Volume 89 NEW YORK, SEPTEMBER 28, 1922 Number 13

Cleveland's New Sewage-Works

NOT least among the municipal improvements that many of those attending the convention of the American Society of Municipal Improvements at Cleveland next week will desire to visit are the two sewage-works recently put in operation there. These works, the nature and extent of which are outlined elsewhere in this issue, go far towards completing one of the largest programs of sewage treatment ever yet adopted by an American city. Imhoff tanks were chosen following lengthy experiments with various processes and despite strenuous efforts by promoters to substitute fine screens although those in responsible charge of the experiments had concluded after a small working-scale test that they would not meet local requirements. All this, combined with severe criticisms of the Imhoff tank in some quarters for years past, and its disfavor after extensive use at Baltimore, should add to the interest of a visit to the Cleveland sewage-works.

An Explanation Wanted

AN OCCURRENCE like the Strand theater floor collapse last Friday places the community which permits it to happen in a decidedly unfavorable light. It is the business of the public authorities to prevent such accidents, to make impossible a piece of inexcusable construction like building decayed wood into a structure intended for public use. And it is the community's business to maintain a spirit that will induce its officials to carry out their obligations. Pittsburgh has some genuine explaining to do in the Strand theater case, the more so as only a few months ago the city had another theater accident which revealed equally bad conditions. Pittsburghers may claim that the occurrence of two accidents is mere coincidence, and that either accident, or both, might have happened elsewhere. True. But it is also true that when the practice of bad building gets a start in a particular city it easily becomes a habit. The habit appears to have taken hold in Pittsburgh. It may be general, or it may be confined to the moving picture "industry." If the latter proves to be the case it may be practicable to reduce the danger by requiring that every moving picture theater owner furnish heavy bonds against accident. There is no reason why moving picture theaters should continue to be less safe than other public buildings.

An Asphalt-Paving Experiment

CHANGES in asphalt-paving specifications have for a long time concerned themselves chiefly with the control of the mixture to reduce shoving and to carry the loads of modern motor trucks. In the light of this fact the new pavement being built in Philadelphia, as described elsewhere in this issue, is of radical design. The departures from previous practice are essentially structural. First, the bond between surface and base is made definitely rough and more pronouncedly rough than any raking or corrugating of the concrete, as in ordinary practice, is able to make it. Second, the surface has been made mechanically rigid by thickening the binder and using large size stone up to dimensions equaling the full depth of the binder. The coarse stone, it is thought, will interlock and make the binder course, considered as a column, more rigid against lateral forces, while the roughened base will prevent sliding on the bonding plane. It may be anticipated that both the necessity and the special efficiency of these structural precautions against shoving will be questioned. Several seasons of service will be required to disclose positive evidence. At the least estimate, however, the experiment is in the line of constructive thinking and offers enough possibilities to make careful observation of decided interest.

Zoning Progress

THE rapid progress of city zoning is not fully shown by the mere statement that in the past six years eighty cities have adopted the system. There must be taken into account the fact that at the outset the average city father did not even know what zoning was, much less understand its value. Then, too, in many if not most states legislation was necessary, and in practically all highly desirable, before their cities could legally adopt zoning; while in others constitutional amendments seemed imperative. The list compiled by Miss Voorhees, of the United States Department of Commerce, shows that at least seventy-eight cities, in sixteen states and the District of Columbia, have adopted zoning. That there is considerable lag in the use of the zoning powers thus far granted appears from the fact that although twenty-five states have authorized some degree of zoning, the power has been exercised as yet in but sixteen, and in some of these by only one or a very few cities. This is due partly to the newness of the enabling legislation, and partly to the restriction of zoning powers in a third of the twenty-five states to one or a few cities. In three states where the grant is of general application, forty-six cities, or more than half in the whole list, have adopted zoning: New Jersey, twenty-two; California, thirteen; New York, eleven. The zoning activity of the present year has been even more notable than appears from the cases thus far listed, because: (1) There remain several months for action in 1922; (2) probably not all adoptions this year have yet been reported; (3) there is much zoning work in progress that will not be consummated until 1923. Further impetus doubtless will be given to zoning by new enabling acts to be passed next year, when most of the state legislatures will be in session. Material aid to such legislation has been provided by the Department of Commerce, which has drafted a model zoning act. The same government agency has also made available to all concerned a Zoning Primer.

The Lima Sewage Deadlock

A FEATURE of the Am. Soc. M. I. program at Cleveland next week is a review of the present status of sewage treatment by George W. Fuller, which has been included in the advance copies of papers circulated by the society to promote discussion at the convention. It would be out of place to discuss Mr. Fuller's paper here, but the object of printing papers in advance may properly be promoted by calling attention to a somewhat extended statement by Mr. Fuller of what has been at least a temporary deadlock on the sewage-works of Lima, Ohio, where Mr. Fuller's plans for fine screens and sprinkling filters, after having been approved by the Ohio State Department of Health, and sent out to bidders were withdrawn by the city authorities in order to give a chance for the reception of alternate bids for the Landreth direct-oxidation process. That was late in March of this year. The proposed alternative bids were never invited, but plans for the Landreth process were submitted to the State Department of Health for approval. The department requested information as to the Landreth process and its efficiency and the Lima authorities engaged Col. George A. Johnson to supply it. His report was favorable to the process but at last accounts the department had not rendered its decision on the Lima application. Mr. Fuller's review of this situation, combined with a paper by the city engineer of Allentown, Pa., on the operation of the Landreth plant in that city, gives promise of lively discussion at the Cleveland convention.

New Work for City Engineers

MUNICIPAL engineering is commonly understood to include certain definite kinds of work in which there has been little change for a generation or more. The city engineer, up to the present, has had to deal with four main specialties: paving, water supply, sewerage and refuse disposal. It is possible that developments of the twentieth century may enlarge the scope of his duties. Ample evidence is on hand to indicate that the growth of motor traffic has given rise to new problems demanding a very large share of his attention. But what of traffic by air routes? It is not a rash prediction to say that before many years have passed every city or town of any importance will have to have its airplane landing and take-off fields. The article on this subject by Archibald Black (see p. 504) is apropos. In a few cities engineers have been called upon to design and lay out an airplane field, but for the most part this is a branch of engineering which, on account of the comparative newness of air travel, has received little attention. At almost any time a city engineer may be called upon for advice as to the proper type of runways for airplane landings, suitable schemes of field marking, arrangement of buildings, the most desirable size and shape of plots, and similar queries for which it is difficult to find answers in technical literature now available. The municipal engineer who would be up-to-date needs to know something about airplane landing fields. Mr. Black's article has some interesting information for him on this subject.

Sweeping-Machine Performance

RECORDS of performance of street-sweeping machines, particularly when comparisons are drawn between different types or makes of sweepers, must be carefully analyzed before general conclusions are asserted. On a street having a smooth pavement and a high crown, with a greatly predominating fast automobile traffic, the sweeping conditions are quite different from those on streets having the opposite characteristics. The volume of dirt moved may not differ greatly but its distribution is entirely dissimilar. On smooth pavements with high crowns the fast traveling cars sweep the dry dirt toward the gutters. Commonly in such a street the sweeping machines do not need to touch the middle of the roadway and a trip up one side and down the other cleans the pavement. Always in computing yardage, however, the full width of the street must be counted. When the whole street is covered the yardage is no greater, on the records, than when only the sides are covered, but the machines are required to make from 50 to 100 per cent more mileage. A comparison on a yardage basis favors the machine which makes the smaller mileage although it may not be a whit more effective or more efficiently operated than the other. When the sweepers are employed interchangeably, sometimes in one territory and sometimes in another, the average performances indicate comparative efficiency quite fairly but the fact may be altogether different where there is a territorial assignment of machines. These facts account for a great many of the apparent discrepancies in sweeper performance records from different cities or from different street cleaning districts of the same city.

Too Many Asphalt Grades

ARE highway engineers insisting upon too great refinement in their specifications for asphalt for road work? A review of the requirements of a number of state highway departments indicate wide variations in the most important test for asphalt quality, namely, penetration. It is true that for certain special conditions of traffic or climate special grades of asphalt may be necessary, but according to the views of asphalt producing interests, as expressed in the section, "From the Manufacturer's Point of View," of this issue, there is opportunity for constructive work in eliminating the number of asphalt varieties called for without lowering the quality of any of the types of construction in which asphalt is used.

It is maintained that, for all practical purposes, an upper limit of seven grades of material is ample, as against thirty or more which are now demanded in the specifications which highway engineers have issued in the various states. The plea for fewer grades of asphalt comes from the producer. Have highway engineers anything to say in defense of their position? *Engineering News-Record* will welcome discussion on this important subject.

There is no doubt that on account of the highly technical character of the chemistry of asphalt, many engineers have adopted specifications more or less blindly merely because they have been used by someone else. Still others, with adequate laboratory equipment and chemical personnel, lean the other way by putting into their specifications a great amount of individualism. Apparently few of them have given much thought to the troubles which demands for so many varieties of asphalt pile upon the shoulders of the producer.

The matter of reduction in varieties in construction materials is now new. Only this year the paving brick

industry took decisive action in reducing the varieties of paving brick from 66 to 11. Cement specifications have long since been standardized, and we do not find every engineer with a concrete dam or a factory to build putting into his specifications various and sundry special tests for cement. What has happened in the case of brick and cement indicates that some benefits may be derived from an impartial inquiry into present practices of specifying asphalt. There is no doubt that under the present system there is a great economic loss. With fewer and more uniform requirements—but with enough to insure a sound quality of material—the producer's problem would be vastly simplified and lower production costs made possible.

Consulting Advice by Questionnaire

EVERY city engineer, water-works superintendent or other technical official knows what a nuisance the average questionnaire has come to be. Often it is addressed to the mayor or other ranking official who passes it down the line little knowing the enormous amount of work it may entail. His word is law, and valuable time must be spent to satisfy the questionnaire fiend who more often than not asks for a lot of information, opinions and advice that would require several weeks of investigation by a consulting engineer.

A most flagrant case of this kind is the present attempt by some one who signs himself "F. Whitney" to get five or ten thousand dollars worth of advice on a water supply in Lake County, Illinois, presumably for Waukegan, by means of a set of questions sent to other Great Lakes communities. The survey, as he calls his questionnaire, contains more than 250 blank spaces to be filled out under sixteen heads. Every conceivable sort of question relating to a water supply from intake cost to chlorine application, from water rates to pumpage, from types of meters to pipe sizes, is asked on three single-spaced mimeographed sheets of foolscap size. The letter accompanying the request for information is naïve, to say the least. The last paragraph is a masterpiece of professional impudence or gross ignorance of the value of professional advice. It follows:

"In addition to the points raised by the survey questions and data, it would be a pleasure to get your mature practical views on what you deem ideal for Great Lakes communities and also what your experience has rubbed into you in regard to your pumps, boilers, steel vs. cast-iron pipe in Great Lakes' soils and waters, and especially on the relative merits of filtration and nonfiltration by going to sufficient distances and depths to get reasonably safe water in its raw condition. Have you any views on tunnel intakes and submerged cribs, anchor ice, etc.? What is your view on tunnels?"

At least one city official received special attention in a typewritten request for additional information on tunnels involving some seventy items. "Practical views" on filtration versus long tunnels with chemical treatment were requested as well as preferences for brick or concrete as a tunnel lining and why.

The questionnaire, a legitimate means of collecting information, is in a fair way of being discredited by abuse. Since the war its use has been multiplied beyond reason so that every one is now looked on with suspicion. There is a limit to the obligation to answer such inquiries and in the engineering field that limit is pretty definitely marked where professional opinion is asked. Queries as to facts, when properly validated and within reasonable bounds, should be answered as a matter of professional courtesy but attempts to obtain consulting advice by the circular method should be refused and denounced.

Detail Design

SO MUCH is said and written about the engineering of large-scale operations, and about what some people are pleased to call the broader aspects of professional activity, that the part played by detail design is often in serious danger of being forgotten. We say "danger" advisedly, for upon details the larger part of the modern engineering art is built up. But the field of details receives only slight recognition in society programs and in technical literature generally. This, we submit, is unfortunate, and ultimately to the disadvantage of the whole profession.

A fairly extended experience in dealing with technical literature leads to the conviction that much of this condition is due to the men who are engaged in detail designing—to their retiring disposition, perhaps, or to their feeling that the problems which they work upon do not interest the majority of their professional brethren. The latter feeling is certainly unwarranted. Let an enginer come before the public with a worth-while study of almost any detail in the whole field of engineering, and he is met in nearly every instance by a most active and interested spirit on the part of his hearers. If details are neglected in professional discussions, it would appear to be chargeable more to the retiring disposition of detail designers than to any extraneous cause.

Curiously enough, the inadequate representation of detail problems in our discussions has its most immediate reaction on the work of the detail designers themselves. Excellence in detailing, as most engineers will recognize, is not entirely within the control of the individual designer, but is much interwoven with current custom in the particular branch of the art concerned. When good practice develops in a particular field it is not always, or perhaps not often, the product of increased knowledge or designing skill, but is due rather to increased popularity of good construction—which means good detail construction. The consuming fields which includes many engineers, comes to demand good detail construction when a particular branch of the art is in a well developed stage, while in an earlier period it is apt to be impossible to secure acceptance for soundly designed details, because of competition based on the prevailing standards of practice. A constant educational process is needed to bring thorough detailing to the front and to keep it there. If the detail designer would have his product, namely good details, receive proper valuation, he must bring his work into professional discussions and take the lead in developing the demand for excellence.

In this effort, the editors of *Engineering News-Record* are at all times glad to help. More discussion of design details is published in the pages of this journal, perhaps, than in any other place of discussion of engineers, yet it represents only a small part of the vast field of design and construction details involved in the civil engigeer's work. The problem of bringing about a fuller representation of detail design in our current technical literature is one that concerns the whole profession.

How to Lay Out and Build an Airplane Landing Field

Notes on Shape and Size of Plot, Runway Details, Type and Arrangement of Buildings, Drainage of Field, Best Kind of Grass and Proper Marking to Aid Pilots

By Archibald Black
Consulting Aeronautical Engineer, Garden City, N. Y.

WITH various municipalities throughout the country considering the establishment of airplane landing fields, the arrangement of them becomes a problem which the city engineer is likely to be called upon to solve. Owing to the newness of the airplane industry little attention has been given to the systematic arrangement of such fields. While the Air Service has some very fully equipped fields, these were constructed under pressure of war conditions and at a time when the requirements of such fields were not fully understood. In addition to this, the army equipment is considerably more elaborate than is likely to become necessary at municipal fields for some time. Consequently, the city engineer charged with arranging a municipal field who attempts to copy the features of some army field, is likely to make as many errors as he avoids.

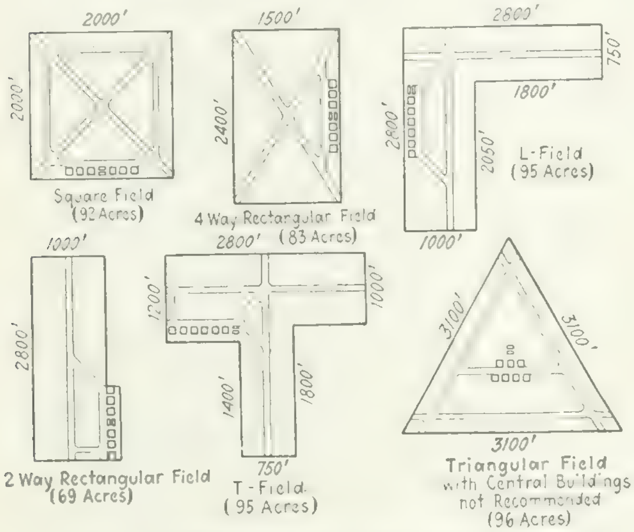


FIG. 1. TYPES OF LANDING FIELDS WITH 2,800-FT. RUNWAYS

Light lines indicate 2,800-ft. runways and most used connections.

Shape and Size of Plot—In general, a square plot is the most suitable shape for a landing site, because it permits airplanes to take off or land in any direction. As the airplane must always take off and land headed into the wind, the importance of wind direction, and its effect upon the field layout, will be immediately appreciated. Where the direction of prevailing winds, throughout the year, is subjected to considerable variation, the square field is essential. In cases where less variation of wind direction is recorded, the plot may be narrowed until it becomes a comparatively narrow rectangle where little variation is shown. Before the property is purchased, Weather Bureau records should be consulted and this information obtained. It is one of the most important points for consideration in the arrangement of the field. In comparing the direction of the winds, their importance may be assumed to vary with the square of their velocity and directly as their frequency. Rough sketches of possible arrangements can then be made and the purchase of the plot negotiated intelligently.

The size of the plot will depend upon the useful length of the runways which can be provided. For the general run of airplanes and for low altitudes, say below 1,000 ft., a clear runway length of 2,500 to 3,000 ft. should be provided. This should be liberally increased for higher altitudes but the requirements regarding length of runways at altitudes are so dependent upon the types of machines that no general rules can be laid down. Thus, if the field is to be square, a 2,000 x 2,000-ft. plot will be required. If conditions permit, this size should be slightly increased. It is very undesirable to use a smaller plot, although it is possible to use one of about 1,800 x 1,800 ft. with slightly increased risk of accident. If the plot is to be L-shaped, the legs of the L should not be less than about 1,000 ft. wide, in addition to providing runway length. Where the field is surrounded by, or runways obstructed by, tall buildings, power lines, etc., the size must be increased. A good general rule is to assume that such obstructions render useless the adjacent part of the field, or territory around it, for a distance of 8 to 10 times their height. Fig. 1 shows a variety of different shapes of fields drawn to the same scale and each providing 2,800-ft. runways.

General Arrangement—In the general arrangement of any landing field provision should be made for hangars, shops, garages, field office, gasoline and oil storage, runways, roads, field marking, water, telephone, electric-power lines and, where necessary, field drainage. While many of these facilities will not be provided for some time, it is good policy to consider them all from the start. The plans should be prepared showing future as well as immediate installations. Only in this way can the field be expected to provide a logical arrangement when fully developed. The additional cost of this forethought and consideration is negligible, while neglect might prove expensive later. Fig. 2 shows what may be regarded as an ideal field layout using the square plot. This arrangement cannot be copied for any location; it must be adapted to the local conditions. Great consideration should be given to future expansion. The field, if laid out as indicated in Fig. 2, is so elastic in arrangement as to be capable of expansion to the limit of its capacity without moving any of the original buildings or equipment.

Buildings should be liberally spaced in order to reduce the fire hazard, which is usually serious at these fields. So much ground is necessary for runway purposes that there is nothing to be gained by crowding the buildings close together. All buildings should be on the side nearest to the road so that it is not necessary for automobiles or persons to cross the field to reach any of them. The arrangement shown provides for the field office and the miscellaneous buildings in the center of one side, with the hangars on each side, roadways and

railroad spur behind. This is probably the most convenient all-round arrangement but it may have to be modified to suit local conditions. No matter what arrangement may be used, great care should be taken to keep all structures, roads, etc., away from the ends of the runways.

Buildings—The hangars should be arranged, preferably facing the field, so that airplanes may be conveniently taken in or out. Where other considerations permit, these buildings should face south as this protects them somewhat from the cold north winds and makes conditions less uncomfortable for the mechanics in winter. In the case of the floors being of cinders, it also allows the sun to shine inside and keep this floor dry when the large door is open. The hangar layout should be sufficiently elastic to permit erection of several types of buildings without destroying the

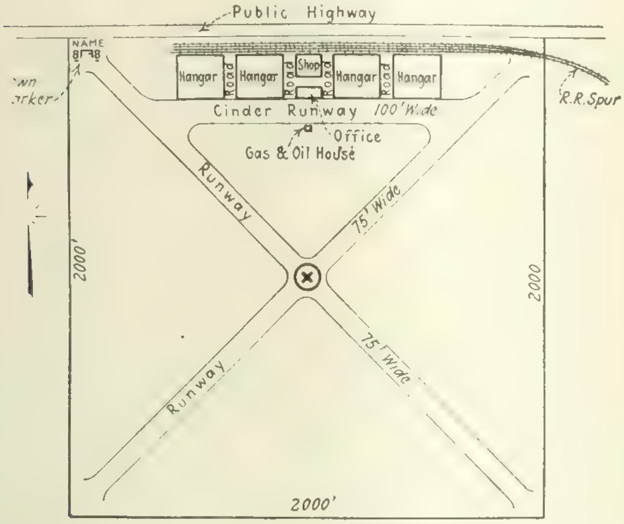


FIG. 2. IDEAL SQUARE FIELD FOR AIRPLANE LANDINGS

general arrangement. While the field may be provided with buildings of a certain size at the start, those added later may be very different in size and shape. If some effort is made to anticipate the possible variations in future buildings, much trouble may be avoided and the space utilized to better advantage as the side of the field becomes crowded with structures.

A study of all of the existing types and sizes of hangars on the American market showed that a 200 x 200-ft. plot appeared to accommodate itself better to the various arrangements than a smaller size. This plot also has the advantage of permitting the erection of an ultimate building of 200 x 200 ft. outside, should conditions ever warrant. As the largest airplane built to date has a span of only about 131 ft. this size of building should provide sufficiently for future machines. Fig. 3 shows some of the sizes and types of hangars which can be accommodated on the proposed "standard plot"; where space permits, its use is recommended. This same size of plot may be used for all of the other miscellaneous buildings as well as for hangars, unless local conditions necessitate otherwise. No rule can be formulated for the relation between hangar, garage and shop floor space as this will vary for each project. In most civil fields part of the hangars will probably be used for shop purposes at the start. The gasoline and oil house should be located well away from other buildings but convenient to both field and road so that either airplanes or automobiles may make use of its facilities. The field office building should be so placed that the field manager, pilots, or others who may have business there, can view the field, gasoline station, wind indicator, etc., from its windows. Such location will save considerable running around by these men when the field is in use.

Runways—In all cases the runways should be arranged with regard to both the direction of the higher prevailing winds and to the freedom from obstructions, either inside or outside of the field, at their ends. They should be as long as the size and shape of the field will permit, but arranged so that the pilot can take off directly into the wind as nearly as possible all of the time. They should also be arranged with some regard to the possibility of allowing space for a turn back into the field to effect a landing in case of engine failure while taking off. It will probably be found that the arrangement of two crossed runways comes nearest to providing this in most cases. Except where the soil drains very well, the part of each runway likely to be most used should be surfaced with cinders, slag or stone about 75 ft. wide for a distance of about 1,000 ft. The part of the runways likely to be most used will be that part on the end *towards* which the higher prevailing winds blow, excepting possibly 100 ft. at the extreme end. If funds limit the work, it might be well to consider that the surfacing of a strip less than 50 ft. wide and 750 ft. long is of very doubtful value. A track from the hangars to the surfaced part of the runways should also be surfaced. The width of this portion will vary according to conditions, but it would be well to provide a strip at least 25 ft. wide and located so that an airplane 100 to 150 ft. wide can be rolled along it without touching the buildings.

In the early days of aviation airplanes took off from and landed upon any convenient part of the field, using the grass-covered surface as a runway. Grass never was entirely satisfactory for this purpose. It held the soil together only when the traffic was infrequent and even then the ground softened up at certain periods of the year. As the business develops, the use of prepared runways is becoming accepted as necessary. Such runways must be constructed to carry the load of the airplane during its run over the surface before taking off and after landing. They must also resist damage to their surface when landings are effected thereon, this being probably the severest requirement. Table I gives some sizes of airplane tires with the loads which they may be normally expected to carry and impose upon the runway surface when at rest or moving slowly. The tendency in commercial and other machines today is towards lighter loadings of the tires. With good runways, this may revert back to the full loads of the table.

TABLE I—SOME AIRPLANE TIRE SIZES WITH THEIR NORMAL LOADS

Size of tire, in.	Normal load, lb.
26 x 3	325
26 x 4	750
26 x 5	1,000
32 x 6	1,650
36 x 8	3,100
44 x 10	6,000

The actual load at the moment of landing depends so much upon the machine and the pilot that it is impossible to give it any definite value. It may be less than the figures above, but is more likely to be greater. Landing gear stress calculations are usually based upon

an arbitrary weight of 4 to 6 times the weight of the airplane. It is very improbable, however, that loads even approaching this will be imposed upon the runway surface.

The types of surface most suitable for roads are not generally suitable for runways. The runway surface must not be so soft that the wheels sink into it or the take-off run will be seriously affected. On the other hand, it must not be too smooth and hard or the machines landing upon it will roll an excessive distance after landing. It has been found in practice that a good compromise surface can be obtained with cinders or slag, rolled just enough to remove the excessive looseness without solidly compacting the surface. Such a surface neither retards rolling too much nor too little, drains itself well and holds up under usage. As concrete has sometimes been proposed, and even used, for runways, it might be well to mention here that it is *not* suitable for this purpose unless separate runways

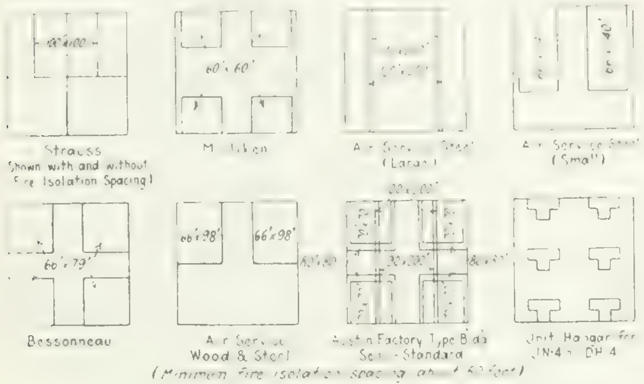


FIG. 3. SOME POSSIBLE HANGAR ARRANGEMENTS IN "STANDARD" 200 x 200-FT PLOT

are provided for taking-off and landing. It provides an excellent surface for taking-off from, but is entirely unsuited to landing on because of its smoothness. The cost of concrete construction also is so high as to make it prohibitive on most projects.

The runways should be crowned as little as possible. If they are to be drained to each side it is suggested that the crown be about ¼ in. to the foot of width. If drained by percolation, either with or without artificial drains, it may be possible to slightly decrease even this figure. *It is very important that no open ditches be located in the vicinity of the runways.* If ditches are necessary for drainage of runways, they should be filled to the level of the field with broken stone, gravel, or other available material. Very large stones should be used in filling the bottom of the ditches and the size should be gradually decreased to small sizes at the top. This will prevent the ditch from filling up with silt during rains. The sides of the runways must be free from shoulders or ridges, not even shallow gutters being permissible in connection with the drainage system. The preferable method of draining the runways is by percolation. Where the soil is porous (gravel, sand, etc.) this can be obtained by merely using a porous runway construction. Where the soil is not sufficiently porous to take care of drainage naturally, a system of drainage ditches, filled with broken stone or gravel, should be constructed below a porous runway and arranged to carry away precipitation.

If the extreme ends of the runways are graded to an appreciable rise, this will tend to decrease the danger of collision with the fence or running over the property line when an airplane takes off and is immediately forced to land through engine or other trouble. A rise in grade of this kind should not end precipitately, but should drop gradually to the fence line. Another method of decreasing danger of overrunning is to raise a dense growth of tall grass on the ends of the runway. Either of these methods or, what is probably still better, a combination of both, might be used to retard the progress of any airplane approaching the fence too closely. It is probable that the adoption of reversible propellers, in the near future, may render such precautions less necessary but it is always well to have them.

Grass—The infield itself should be well drained and, where natural drainage cannot be relied upon throughout the year, an artificial drainage system should be provided. On all parts of the field surface not covered by buildings, roads or runways a growth of tough, all-year grass should be raised to bind the surface. The type of grass required will vary according to the soil and it would be well to consult some reliable seedsmen familiar with its characteristics. Peter Henderson & Co., of New York, were consulted regarding the conditions to be met and made the following recommendations:

Use about even proportions of

Canada Blue Grass	*Hard fescue
Fancy Kentucky Blue grass	*Sheeps fescue
Fancy red top	*Red fescue
Meadow fescue	Pacey's perennial ryegrass

*For soil having more than the usual proportion of sand increase the amounts of these.

As a strong, thick turf is desirable on flying fields, the grass seed should be sown at the rate of from 150 to 200 lb. per acre according to the fertility of the soil.

Roadways and Railroad Tracks.—Roadways should be provided to connect each of the field buildings with the entrance and with each other. The arrangement should be as comprehensive as funds will permit so that drivers will use these roadways in preference to driving over the sod. It is advisable to regard most of the roads as double track and to surface them over a width of 16 ft. Where there is little possibility of vehicles passing each other, they could be constructed as single track, 8 ft. wide. As these roads may be expected to be neglected to quite some extent, they should be well drained and crowned. If a railroad spur is to be brought into the field it should be carried along back of the hangar, shop, garage and stockroom buildings. In the case illustrated, such a spur is provided and space is left for a future parallel track with crossovers so that cars may be left behind any one of the buildings.

Field Markings—Two types of markers for the guidance of pilots should be provided in the layout. These are the field marker and the international marker. The first serves the purpose of identifying the field and showing the direction of the runways. Assuming the adoption of the Air Service recommendations, it will consist of a white circle, as shown in Fig. 4, inside of which are lines indicating the direction of the runways. The international marker was created by the International Air Convention, to which the United States is a signatory, and is designed to enable pilots to identify the towns in which the field is located. This marker is intended to be placed on the right hand side of every railroad track where it enters the town. Only in some of these cases will one of these markers be adjacent to the field, but they should be constructed

during the construction of any municipal field where they do not already exist. The Air Service recommends placing one of these markers on the northwest corner of each landing field where not adjacent to the one by the railroad track. This should be good practice to follow.

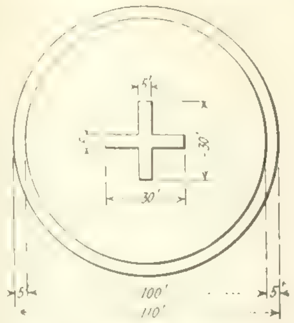


FIG. 1. FIELD MARKER

A marker of this type is shown in Fig. 5. The open-sided rectangle represents the lower or upper half of the quadrangle formed by the lines of latitude and longitude, while the dot represents the relative position of the town in this quadrangle. The numbers indicate the latitude and longitude of the south and west sides of the quadrangle. Either the name of the town or the telegraphic call of the field may be added as shown. The most convenient and practical method of constructing markers of either type is to remove the sod, fill in with broken stone, or other suitable material, and tamp or roll down. Only the large sizes of stone should be used. The thickness after rolling should be 4 to 6 in. and the stones should be whitewashed or painted to increase visibility of the marker.

Miscellaneous—If water pipes are available in the vicinity of the field, lines should be extended into it and to each shop, hangar, etc., building. If no water line is available, a well should be sunk as the water supply is of considerable importance. Where electric power and telephone lines are available anywhere in the vicinity, these should be extended into the field, the power lines being carried into each and every building, the telephone line into the field office at least. Every effort should be made to confine the line poles to the rear of the field buildings. In any case, where they pass the ends of the runways, even if outside the field, they should be lowered. If radio equipment is to be installed, the preferable arrangement is to provide a remote controlled station with the aerials at least ten times their height distant from the field. Where this cannot be done, they should be as low as possible and located directly in back of the buildings. No matter where they are located, they should be rendered as visible as possible both by day and night. This may be obtained by painting the towers or poles in alternate stripes of black and white and by mounting small electric lights on the extreme points of each. In most cases it is advisable to fence the field along the side of the public roadway. If the surroundings are quite undeveloped it will not be necessary to carry this fence around the entire field, but it will probably be sufficient to carry it back from the public highway about a couple of hundred feet to discourage entry by other than the regular gate. All buildings, fences, etc., on the field, and any dangerous obstacles outside of it, should be so painted as to be very plainly visible.

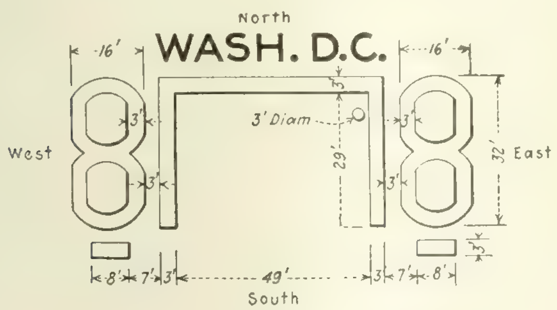


FIG. 5. INTERNATIONAL MARKER

Hydraulic Laboratories in the United States

A PAMPHLET on the hydraulic laboratories of the United States, compiled by the Engineering Foundation, New York City, from special reports gathered by it, lists 57 such laboratories and describes 49 of them. The descriptions are under 12 heads, on a uniform plan. As the pamphlet contains no summaries (beyond the statement that 49 laboratories are described) and in the hopes of securing additions to the list, if there are omissions (as the Foundation thinks likely) *Engineering News-Record* has made up the accompanying table and foot note summary:

HYDRAULIC LABORATORIES IN THE UNITED STATES
Table Made up from a Pamphlet Compiled by the Engineering Foundation.

Name of Laboratory	Year Established	Possibilities for Outside Work	No. on Regular Staff
Allis-Chalmers	1914	No	2 to 10
Armour Institute	1903 (about)	Yes	7 (part time) besides mech. and helpers
Assoc. Factory Mutual	1889	Yes	11
Brooklyn Polytechnic	1900	Yes	2 (besides mech. when needed).
Brown Univ.	1903	Yes	3 to 5
Bureau Standards	1915	Yes	Not given
Cal. Inst. Tech.	1911 (about)	Yes	About 3
Univ. California	1902	Yes	1
Carnegie Inst Tech.	1913	Yes	2
Case School	1892	Yes	4
Cochrane (Co.)	1914	Yes	4 (on and off)
Colo. College	1915	No	1 (in charge)
Colo. Expt. Sta.	1913	Yes	3
Columbia Univ.	1899	Yes	2 assigned; others available
Cornell Univ.	1898	Yes	2
Dartmouth Col.	....	Activities confined to class work	
Harvard Eng. School	1890	Yes	4 (usually)
Holyoke W. Power Co.	1882	Yes	As needed
Horton Hyd. Laby.	1915	Yes	3
Univ. of Ill.	1891	Not usually	4 or 5 (12 available)
State Univ. of Iowa	1920	Yes	2 research assts. on half time, one mech. full time
Johns Hopkins Univ.	1917	Yes	2 (part time)
Lafayette Col.	1898	Yes	1
Lehigh Univ.	1911	Yes	3
Leland Stanford Univ.	1913	Yes	1 in each of 2 labs. with studentassts. as needed
Lowell Locks & Can.	1792	Yes	Not stated
M.I.T.	1915	Yes	8 (about)
Univ. Mich.	1916	Yes	Not stated
Univ. Minn.	1911	Yes	3
Univ. N. C.	1921	Yes	2 (part time)
Ohio State Univ.	1885; probably earlier	Yes	4 prof. and research instructors as needed
Penn. State Col.	1895 (about)	Yes	3 instructors in lab.
Univ. Pa.	1906	Yes	3 of faculty usually, besides mech. and helper
Univ. of Pittsburgh	1918	Yes	Operated 2 weeks at end of spring term by staff of 3
Princeton Univ.	1905	No	0 05
Purdue Univ.	1911	Yes	2
R.P.I.	1908	Yes	10 (at least) competent to do work
Univ. Rochester	Not given		....
Rose P. I.	1878	No regular	1
S. Morgan Smith Co.	1921	No	3 or 4 when needed
Stevens I.T.	1875	Very little	6
Syracuse Univ.	Not given	Not given	Not given
Univ. Texas	1904	Yes	3
U. S. Naval Acad.	1903	Yes	60 and 95 mech. & laborers
Wash. Univ.	1909	Limited	2
Wis. Univ.	1905	Yes	5
Worcester P. I.	1895	Limited	2 or 3
Yale Univ. A	1892	Yes	1
Yale Univ. B	1911	Yes	3

Summary: Of 49 laboratories in above list, 41 are connected with 40 different engineering schools, including the U. S. Naval Academy; 5 are run by companies and 1 by a consulting engineer; 1 by the U. S. Bureau of Standards and one by the Associated Factory Mutual Companies. The distribution of the 49 laboratories by years established is as follows:

Year	No.	Year	No.	Year	No.	Year	No.	Year	No.
1792	1	1890	1	1900	1	1908	1	1916	1
1875	1	1891	1	1902	1	1909	1	1917	1
1878	1	1892	2	1903	3	1911	5	1918	1
1882	1	1895	2	1904	1	1913	3	1920	1
1885	1	1898	2	1905	2	1914	2	1921	2
1889	1	1899	1	1906	1	1915	4	....	3

From the more detailed information given in the pamphlet, it appears that in many cases not so indicated the "regular staff" is not engaged on a full-time basis, but is sometimes engaged in other work.

From Job and Office

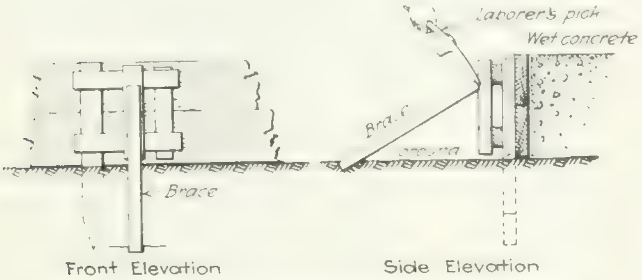
Hints That Cut Costs and Time *For the Contractor and the Engineer*

Bracing a Concrete Sidewalk Form

By D. H. Fleming

City Engineer, Owen Sound, Ontario, Cal.

RATHER an ingenious "stunt" was executed here recently on a concrete curb and sidewalk job. Forms sufficiently braced began to bulge. The form setter rigged up a brace as shown in the accompanying illustration and by means of an ordinary pick jacked



PICK USED AS PINCH BAR FOR JACKING FORM

the form and its contents back into place. I have often seen the same job done in a much more clumsy fashion, using a sledge instead of the improvised pinch bar, and incidentally a great number of words not found in print.

Amount of Water in Storage Is Determined by Graph

By George C. Love

Chief Engineer, Newport News Light & Water Company, Newport News, Va.

IN ORDER to determine the exact amount of water in a reservoir at any height of water surface, and the area of the submerged surface, the accompanying graph, which is greatly reduced in scale, was evolved. The large graph in use has proved very convenient, and the general method pursued in making it may interest other water-works engineers.

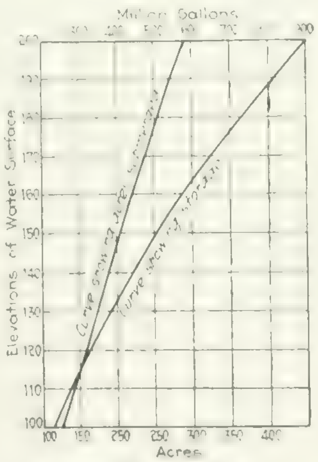


CHART GIVES WATER VOLUME AND SUBMERGED AREA

The data from which the curves were plotted were secured from elaborate surveys. The contours were plotted to large scale and the areas measured by planimeter. Elevations were secured by taking soundings from known water levels, each sounding position being located by stadia from stations in a closed traverse.

Pumpage from storage was measured by a venturi meter and platted daily on the graph, together with rainfall, temperature and water-surface elevation.

Shortcutting Earthworks Computations by Slide Rule

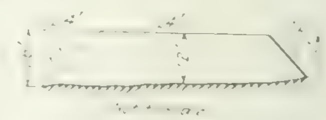
By Kenneth H. Gideon

Wyoming State Highway Department, Rock Springs, Wyo.

THE 10-IN. K and E polyphase slide rule may be graduated by an amateur in such a way that cubic yards may be obtained in earthwork computations direct for sections 50 ft. in length by one setting of the slide and runner.

Set the right hand index of scale *C* at 926 (0.926 = number cubic yards in a triangular prism with a base of 1 ft., an altitude of 1 ft. and a length of 50 ft.) on scale *D*. Set up the adjusting screws so the slide will be held firmly in this position. The only tools now needed will be a very small T-square and a needle.

Hold the T-square firmly against the upper edge of the rule and with the needle project scale *C* onto the space below scale *D* on the lower face of the rule. Include all graduations between (1) and (2) but omit the smallest graduations on the remainder of the rule. The same general scheme of numbering should be followed as on scale *C*. Ink graduations carefully and the scale is then ready to be used.



ROAD SECTION USED FOR SLIDE RULE COMPUTATION

Consider the section shown on the accompanying figure. Set the runner at 1.2 (the center fill) on the new scale. Run the slide to the left till 27.6 (the sum of the two outside distances) on the reciprocal scale *CI* coincides with the runner setting. The right hand index of scale *C* now reads 30.7 on scale *D*. This is the number of cubic yards in the prism just considered for a length of 50 ft. Now set the runner at 2.4 (the sum of the two outside heights) on the new scale and move the slide till 12 (one-half roadway width) on scale *CI* corresponds with the setting of the runner. The right hand index on scale *C* now reads 26.7 on scale *D*. The sum of 26.7 and 30.7 (57.4) is the number of cubic yards in that particular section taken for a distance of 50 ft.

Treat the adjoining section in a similar manner and the sum of the results will be the quantities between the two sections, if the distance is 100 ft. For a short station, multiply the result of the addition of the two quantities by the length of the station in terms of 100 ft.

Irregular sections are computed in the same general manner as is used in the end area method. At any point set the runner on the height given, on the new scale. The setting for scale *CI* will now be the difference between the distances out of the points on either side of the reading considered.

Follow this scheme across the section and add the results, not forgetting of course to subtract the last quantity obtained, if any intermediate reading occurs outside the roadway width.

Specially Designed Hoisting Equipment Is Part of Efficient Concrete Plant

An average of 468 cu.yd. of concrete was poured per 10-hr. day in the three weeks actual working time necessary to erect the first half of the terminal public market being constructed for the City of Newark, N. J., by the Clifford F. MacEvoy Co., of that city. Though 42 days were consumed in building the first portion, only three weeks actual working time were put upon it. With a simple and efficient concreting plant the above average was maintained and with an 80-ft. vertical haul a maximum of 768 cu.yd. of concrete were chuted to place in one day of 9 hr. 50 min.

The plant consists in a hoist tower 180 ft. in height, set in the approximate center of the building with chuting running in either direction; two timber tail towers about 100 ft. high supporting, together with the hoist tower, the chuting; a 1-yd. mixer and a specially designed hoist. Due to the efficient operation of this latter piece of equipment and the simplicity of the rest of the layout, the contractor has been able to maintain a high average in placing concrete. The hoist is a single 24-in. drum hoist located in the basement of the building and driven by a 75-hp. electric motor which also operates the mixer. The hoist is the friction type but with special wood blocking. Its principal features are a foot brake made of two circular bands of ½-in. steel circling the flanges of the drum, supported at the top by hangers running from the block upon which the hoist is mounted; and an automatic stop, which precludes the possibility of a load being lost even though the motor and brake both go wrong. The brake is lined with a fibrous material of ½-in. thickness into which has been inlaid fine strips of copper. The hoist engineer is able to control the bucket lowering entirely with the brake, never relying on the clutch. As many as 84 batches of concrete in one hour have been raised a distance of 100 ft. by this hoist. The hoist was built by the National Hoisting Engine Co., Harrison, N. J.

The terminal market is entirely of reinforced-concrete and will be of three stories with another story as a possible future installation. The upper floor is to be used for automobile storage.

What "Job and Office" Is

For some time the articles which make up the "Job and Office" section have been addressed in part to the "average engineer." There are those who object to this term, who say that you cannot average engineers and that the articles are aimed at "a high-grade man on his way up or a man of inferior ability who is stalled or on his way down."

There is something in this criticism. To be classed as "average" is not flattering to most men. Self-esteem calls for a higher rating. So we are going to withdraw the "average engineer" part of the sub-title.

But the subject matter of these "Job and Office" articles should not be misunderstood as they have been by the critics mentioned. "Average engineering," in its original intent, represented the body of engineering practice, the multitude of little things which, one by one, make up the great whole of a completed engineering project. They are the day's work of the engineer. To assume that such devices and solutions as are described in this section are beneath the notice of the engineer who has arrived is to misunderstand what engineering is, to ascribe too much significance to the occasional engineer who moves in higher circles intent only on the broad problems of industry, economics and natural forces and who delegates most of what the rest of the profession calls engineering to his subordinates. There are such engineers, but they are rare and engineering literature only in small part is addressed to them.

"From Job and Office" is for and from the engineer and contractor who are doing things in a new way, who have time in the pursuit of the general to concentrate on the specific, who realize that a successful engineering performance requires about twenty per cent visualization of the whole and about eighty per cent satisfactory execution of the details.

Floor Forms Protected in Stripping by Ropes Stretched Beneath Them

By E. F. Clasby
Field Superintendent, Aberthaw Construction Co., Boston

In a multi-story reinforced-concrete building where floor forms are used several times, each successive use leaves the ceiling surface a little rougher due to the poorer condition of the forms through having been damaged in stripping and handling.

In a building under construction for the Dennison Manufacturing Co. at Marlboro, Mass., special requirements of the owner made it necessary to pay particular attention to ceilings. Accordingly, the writer devised a scheme of rope supports for breaking the fall of the floor forms when they were stripped. These ropes were stretched crosswise of the building between columns and fastened as high up on the columns as the mushroom head would allow. Other ropes were run between these in pairs and spaced far enough apart so that they would catch the ends of the floor panels when the panels were removed. The result was that most of the panels were caught on the ropes, but in the case of those that did not, their fall was so broken that they were little damaged. When re-used these forms gave practically as good a surface as after the first use.

This method has resulted in ceiling surfaces in the upper stories being much better than is usually the case. In fact, the difference in smoothness between the underside of the roof slab and the first story slab is not noticeable. The labor cost of placing the ropes was practically offset by the saving in repairing forms.

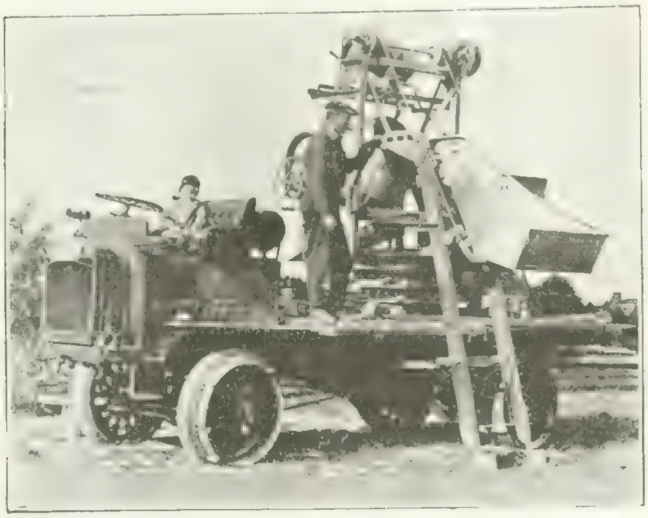
On Estimating Floor Slabs

In *Engineering News-Record* of Aug. 24, p. 305, information was asked for on the practice of estimating that portion of the floor slab which rests in the wall. The following is one of the replies, being from Charles F. Dingman of Palmer, Mass.:

"I have never heard that any standard practice had been adopted by other contractors, but it has always been my practice to consider it as a part of the slab."

Mixer Moved on Motor Truck Fitted With Steel-Flanged Wheels

DIFFICULTY in moving his concrete mixer led Stanley Carman, a masonry contractor of Woodmere, Long Island, N. Y., to fit up a motor truck so that the mixer could be taken anywhere with the greatest ease. He mounted the mixer on the truck and then put 10-in. steel flanges on the front wheels and 12-in. steel flanges on the rear wheels. Thus the time of moving the mixer from one job to the next was reduced to the minimum and the flanged wheels facilitated the placing of equipment in just the location where it could be used to the best advantage.

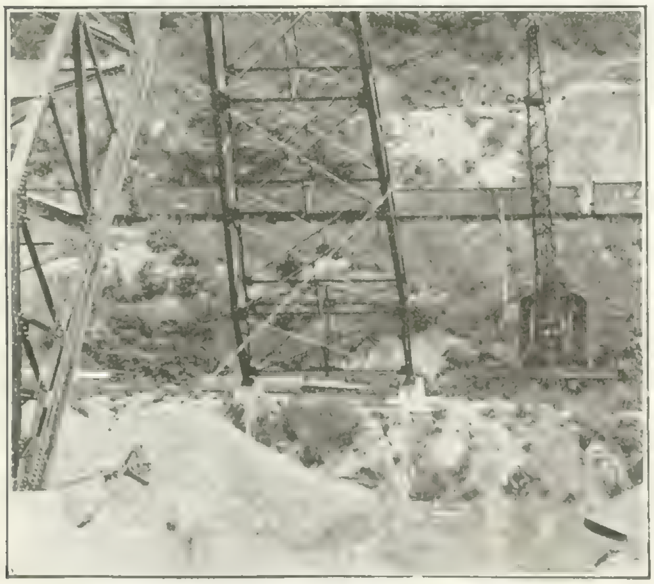


STEEL FLANGES ALLOW EASE IN MOVING MIXER

The information from which this article was written was furnished by the Four-Wheel Drive Auto Co., Clintonville, Wis.

Drag Scraper and Crane Clean up Stockpile

STORAGE of crushed stone by the Canada Crushed Stone Co., Ltd., Dundas, Ont., Can., is effected by distribution with a belt conveyor mounted on a high trestle. To return the material to the crushers and loading bin a belt conveyor operates in a concrete tunnel below the stockpile. When the material in the center, which falls by gravity through gates in the top of the tunnel onto the belt, has been drawn out, a pile on each side is left to be moved over the tunnel. To do this work a crane operating a power drag scraper on an adjacent side track is utilized. As the material is located on both sides of the tunnel half of it must be pulled toward the crane and the remainder dragged away from the crane. The set-up as shown in the photograph is arranged for reverse scraper operation.



DRAG SCRAPER OPERATED BY CRANE TO PULL MATERIAL OVER MATERIAL TUNNEL

The storage pile varies from 100 to 150 ft. in width at the base so that it is too long a reach for the boom to handle the material in one pick-up with a clamshell even were there room between the columns of the trestle legs. As most of the material has to be moved only a short distance the scraper can be operated faster than a clamshell.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Tables and Formulas for Wind Stresses in Office Buildings

By Camillo Weiss

Structural Engineer, Bethlehem, Pa.

FORMULAS and tables are presented herewith for the determination of wind stresses in the steel frames of tall buildings. They are based on the cantilever method (R. Fleming's Method I, *Eng. News*, Mar. 13, 1913). Column sections are assumed to be equal, and the unit wind pressure is taken as constant from the story under consideration up.

The underlying assumptions, briefly repeated, are: (1) All columns in any given story have equal sections, and the direct stresses are proportional to the distances from the neutral axis of the bent; (2) the point of contraflexure of each column is at mid-height of the story, and the point of contraflexure of each girder is at its mid-length; (3) the joints are perfectly rigid. In addition, the unit wind pressure has been taken as constant from the story under consideration up. If the unit wind pressure is a variable, the values obtained are to be modified as stated below.

These assumptions, although more or less arbitrary, are not so artificial as to vitiate the very satisfactory application of the method to most practical cases. Comparison with exact methods revealed it to be more nearly correct than either Method II or III of Mr. Fleming's article (See W. M. Wilson and G. A. Maney, Bull. No. 80, Eng. Exp. Sta., Univ. of Ill.).

In the case of an irregular bent the formulas will furnish results more rapidly than can generally be obtained by the analysis of successive joints.

For the case of a symmetrical bent with equal spans the tables give coefficients of direct stresses and bending moments in columns, and bending moments at the ends of girders, for bents of one to ten spans.

Variations in the heights of consecutive stories have no influence on direct stresses and no material influence on bending stresses. Where such variations occur, and accurate bending moments are desired, they are obtained by multiplying tabular values by the correction factors given with the formulas.

FROM JOB AND OFFICE

For Contractor and Engineer

S. W. Bradshaw, Assistant Engineer of the Bethlehem Steel Bridge Corp., checked the formulas and tables.

In the formulas given below, the following notation is used:

L_A, L_B, L_C, etc. = spans, feet;

H = distance from the top of the story under consideration to the top of the building, feet;

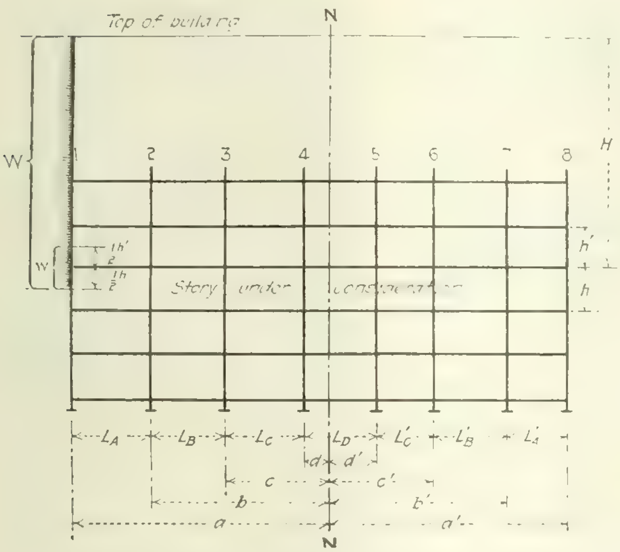
h = height of the story under consideration, feet;

h' = height of story above, feet;

W = total wind load above midheight of the story under consideration, pounds;

w = wind load in a story height, pounds;

D_1, D_2, D_3, etc. = direct stresses in columns 1, 2, 3, etc., in story under consideration, pounds;



OFFICE-BUILDING DIAGRAM FOR WIND PRESSURE CALCULATION

M_1, M_2, M_3, etc. = bending moments at ends of columns 1, 2, 3, etc., in story under consideration, foot-pounds;

M_A, M_B, M_C, etc. = bending moments at ends of corresponding girders in story under consideration, foot-pounds;

N-N = neutral axis, so located that

$a + b + c + d + \ldots\ldots = a' + b' + c' + d' + \ldots\ldots$

in which $a, b, c, \ldots a', b', c', \ldots$ are the distances from the neutral axis to the corresponding columns, feet;

$Q = (a)^2 + (a')^2 + (b)^2 + (b')^2 + (c)^2 + (c')^2 + \ldots\ldots$ etc.

Direct Stresses in Columns—Direct stresses are,

$$D_1 = \frac{W}{4Q} \times (2H + h)a$$

$$D_2 = \frac{W}{4Q} \times (2H + h)b$$

$$D_3 = \frac{W}{4Q} \times (2H + h)c$$

TABLE I—DIRECT STRESSES IN COLUMNS DUE TO WIND

Bent symmetrical about center line; all spans L equal

No. of Spans in Bent	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
	Coefficients of $\frac{W}{L}(2H + h)$					
1	$\frac{1}{4}$	$\frac{1}{4}$				
2	$\frac{1}{8}$	0	$\frac{1}{8}$			
3	$+\frac{3}{40}$	$+\frac{1}{40}$	$\frac{1}{40}$	$\frac{3}{40}$		
4	$+\frac{2}{40}$	$+\frac{1}{40}$	0	$\frac{1}{40}$	$\frac{2}{40}$	
5	$\frac{5}{140}$	$\frac{3}{140}$	$\frac{1}{140}$	$\frac{1}{140}$	$\frac{3}{140}$	$-\frac{5}{140}$
6	$\frac{3}{112}$	$\frac{2}{112}$	$+\frac{1}{112}$	0	$\frac{1}{112}$	$\frac{2}{112}$
7	$+\frac{7}{336}$	$\frac{5}{336}$	$-\frac{3}{336}$	$+\frac{1}{336}$	$\frac{1}{336}$	$-\frac{3}{336}$
8	$+\frac{4}{240}$	$+\frac{3}{240}$	$-\frac{2}{240}$	$+\frac{1}{240}$	0	$-\frac{1}{240}$
9	$+\frac{9}{660}$	$+\frac{7}{660}$	$+\frac{5}{660}$	$+\frac{3}{660}$	$+\frac{1}{660}$	$-\frac{1}{660}$
10	$+\frac{5}{440}$	$-\frac{4}{440}$	$+\frac{3}{440}$	$-\frac{2}{440}$	$\frac{1}{440}$	0

The direct stresses are tension (+) in the columns on the windward side and compression (—) in the columns on the leeward side of the neutral axis of the building bent.

Bending Moments—The bending moments at ends of columns are

$$M_1 = \frac{Wh}{Q} \times \frac{aL_A}{4}$$

$$M_2 = \frac{Wh}{Q} \times \frac{aL_A + (a + b)L_B}{4}$$

$$M_3 = \frac{Wh}{Q} \times \frac{(a + b)L_B + (a + b + c)L_C}{4}$$

Etc.

TABLE II—MOMENTS IN COLUMNS AND GIRDERS DUE TO WIND

Bent symmetrical about center line; all spans equal and two consecutive story heights equal

No. of Spans in Bent	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Span 1	Span 2	Span 3	Span 4	Span 5
	Moments at Ends of Columns, Coefficients of Wh						Moments at Ends of Girder, Coefficients of wH				
1	$\frac{1}{4}$	$\frac{1}{4}$					$\frac{1}{2}$				
2	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{8}$				$\frac{1}{4}$	$\frac{1}{4}$			
3	$\frac{3}{40}$	$\frac{7}{40}$	$\frac{7}{40}$	$\frac{3}{40}$			$\frac{3}{20}$	$\frac{4}{20}$	$\frac{3}{20}$		
4	$\frac{2}{40}$	$\frac{5}{40}$	$\frac{6}{40}$	$\frac{5}{40}$	$\frac{2}{40}$		$\frac{2}{20}$	$\frac{3}{20}$	$\frac{3}{20}$	$\frac{2}{20}$	
5	$\frac{5}{140}$	$\frac{13}{140}$	$\frac{17}{140}$	$\frac{17}{140}$	$\frac{13}{140}$	$\frac{5}{140}$	$\frac{5}{70}$	$\frac{8}{70}$	$\frac{9}{70}$	$\frac{8}{70}$	$\frac{5}{70}$
6	$\frac{3}{112}$	$\frac{8}{112}$	$\frac{11}{112}$	$\frac{12}{112}$	$\frac{11}{112}$	$\frac{8}{112}$	$\frac{3}{56}$	$\frac{5}{56}$	$\frac{6}{56}$	$\frac{6}{56}$	$\frac{5}{56}$
7	$\frac{7}{336}$	$\frac{19}{336}$	$\frac{27}{336}$	$\frac{31}{336}$	$\frac{31}{336}$	$\frac{27}{336}$	$\frac{7}{168}$	$\frac{12}{168}$	$\frac{15}{168}$	$\frac{16}{168}$	$\frac{15}{168}$
8	$\frac{4}{240}$	$\frac{11}{240}$	$\frac{16}{240}$	$\frac{19}{240}$	$\frac{20}{240}$	$\frac{19}{240}$	$\frac{4}{120}$	$\frac{7}{120}$	$\frac{9}{120}$	$\frac{10}{120}$	$\frac{10}{120}$
9	$\frac{9}{660}$	$\frac{25}{660}$	$\frac{37}{660}$	$\frac{45}{660}$	$\frac{49}{660}$	$\frac{49}{660}$	$\frac{9}{330}$	$\frac{16}{330}$	$\frac{21}{330}$	$\frac{24}{330}$	$\frac{25}{330}$
10	$\frac{5}{440}$	$\frac{14}{440}$	$\frac{21}{440}$	$\frac{26}{440}$	$\frac{29}{440}$	$\frac{30}{440}$	$\frac{5}{220}$	$\frac{9}{220}$	$\frac{12}{220}$	$\frac{14}{220}$	$\frac{15}{220}$

If consecutive story heights vary considerably, these moments should be multiplied by the factor

$$\frac{4H + (h - h')}{4H + 2(h - h')}$$

The bending moments at ends of girders are,

$$M_A = \frac{wH}{Q} \times \frac{aL_A}{2}$$

$$M_B = \frac{wH}{Q} \times \frac{(a + b)\,L_B}{2}$$

$$M_C = \frac{wH}{Q} \times \frac{(a + b + c)\,L_C}{2},$$

Etc.

(Note that for constant unit wind pressure throughout height H we have $wH = Wh - \frac{wh}{2}$).

If consecutive story heights vary considerably, the girder moments from the formulas should be multiplied by the factor $\frac{4H + (h - h')}{4H}$.

Unit Wind Pressure a Variable—Some building codes prescribe variable unit wind pressure, as the building laws of Boston and Philadelphia, for instance. If the unit wind pressure varies throughout height H, the direct stresses in the columns are obtained from the overturning moment, M, by the formulas $D_1 = Ma/Q$, $D_2 = Mb/Q$, etc.; or, for symmetrical bents with equal spans these stresses may be found by multiplying $\frac{4M}{L}$ by the coefficients given in Table I.

The bending moments at ends of columns are obtained directly from the formulas and tables for constant unit wind pressure. However, when variations in consecutive story heights are taken into consideration, the correction factor is

$$\frac{h + h^1}{2} \cdot \frac{2W - w}{Wh + (W - w)h^1} \text{ in place of } \frac{4H + (h - h^1)}{4H + 2(h - h^1)}$$

The bending moments at ends of girders are also obtained from the formulas and tables for constant unit wind pressure, except that the quantity $\left(Wh - \frac{wh}{2}\right)$ must be used in place of wH in all cases, as these two quantities are not interchangeable for varying unit pressure. The correction factor for variation in consecutive story heights also changes from $\frac{4H + (h - h^1)}{4H}$ to $\frac{h + h^1}{2h}$.

Arrangement of computations in tables will be found the most convenient form for making, revising and reviewing calculations.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Concrete Paving Marker and Sander

EQUIPMENT to mark concrete paving with workmanlike even width center lines on tangents and curves has been developed in the Wisconsin Highway Commission by F. M. Balsley, engineer-inspector. In addition to the marker is an apparatus to apply sand to blot the tar so that it will not be streaked over the pavement by traffic.

The marker consists of a wheelbarrow frame mounted on a wooden wheel, 5½ in. wide and 2 ft. in diameter. A sheet-metal rim fastened to the face of the wheel carries a felt pad, ½ in. thick and 4 in. wide. The marking fluid, cold Tarvia B, is carried in a 7-gal. can, mounted above the wheel and dripped onto the felt strip from a gas pipe. The flow is regulated by a stop cock to which is attached a lever extending back to a

FIG. 1—CENTER STRIP CONCRETE PAVEMENT MARKER

FIG. 2—TAR SANDER

point on the handles within easy reach of the operator. The cast-iron lead wheel is faced with leather. Its function is to keep the marking wheel from slipping sidewise. Under the legs of the barrow frame are two small cast-iron wheels which carry the remaining weight of the machine. Between the lead wheel and marker is a steel wire brush to clean the pavement and prevent foreign material from collecting on the felt pad. In operation the pavement is marked down the center with a chalk line to guide the operator.

The sander is a two-wheeled apparatus equipped with 30x3½-in. pneumatic tires. One wheel is keyed to the axle on which is mounted a sprocket wheel and throw-out clutch. In the hopper above is a disk on the perimeter of which is attached eight sheet-metal cups. The disk is mounted on a ⅝-in. shaft operated through chain drive from the axle. In rotating the disk picks up sand and throws it through an opening leading by a downspout directly over the tarred strip. The sander is attached to the rear end of a truck which follows the marker. It is fed by one man with a shovel.

Six laborers and a truck driver are required to handle the marker and sanding equipment efficiently. About 5 miles of pavement is a fair day's work. Ten gallons of tar will mark a mile of pavement and ½ yd. of dry sand will blot the tar.

FROM JOB AND OFFICE

For Contractor and Engineer

Estimating the Cost of Buildings by Superficial Areas

By W. F. Silliman

Asst. Engineer, Dept. of Valuation, Phila. & Reading Ry., Philadelphia, Pa.

The extensive work involved in the government valuation of railroad properties has necessitated extensive study in devising short-cut methods of determining true values with the minimum of labor.

The general method adopted for estimating the cost of buildings is that of pricing by the cubic feet of volume, placing the buildings in various types dependent on similarity of construction and design. Although this method will give a fairly true total value in dollars for all the buildings assigned to any one type, it does not, owing to the various shapes and heights of the buildings, always reflect the true value of the individual building in the type.

For illustration, take two brick buildings of similar construction, one 40 ft. square x 15 ft. high and the other 20 ft. wide, 80 ft. long and 15 ft. high. The cubic-foot volume of these two buildings is the same, and the same cubic-foot price would be applied to determine the cost of each. However, the wall area of the second would be 600 sq.ft. greater than that of the first, and if the walls were 12 in. thick, this area, computed into material would represent approximately 12,500 brick. Excess quantities would be the rule on all material used on vertical surfaces and running around the perimeter of the building. The actual cost of the second building, therefore, would be greater than that of the first. It is true that the first building would require additional intermediate supports, but the cost of this is negligible compared with the additional material in the second building.

With slightly more labor this inconsistency in estimating the cost of buildings may be overcome by the superficial area method; that is to say, by estimating on the basis of the areas which by their nature require different construction. In a simple one-story brick building the areas above the foundation would consist of the wall, roof, floor, ceiling and partitions.

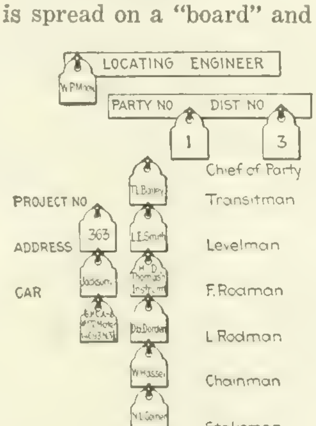
A bill of material would be taken off for the building and the quantities obtained allocated to the areas in which they occur. Generally speaking, the wall area would consist of the brick, windows and doors, plaster, trim, hardware and paint. The roof area would consist of the roof covering, boarding, rafters, collar-beams, cornices, gutters and downspouts. The floor area would consist of the floor joists, bridging, sub-floor and finished floor. The partition area would consist of the studding, doors, trim, plaster, hardware and paint. The ceiling area would consist of the ceiling joists and plaster. By applying the cost of material and labor to the quantities included in the various areas, and dividing the products by the corresponding superficial areas, the quotients will be the unit prices to apply to the corresponding areas of any similar building.

This method may be used in the same manner as the cubic-foot method, by creating types, or would be adaptable to all ordinary buildings by working up a sufficient number of superficial area unit prices.

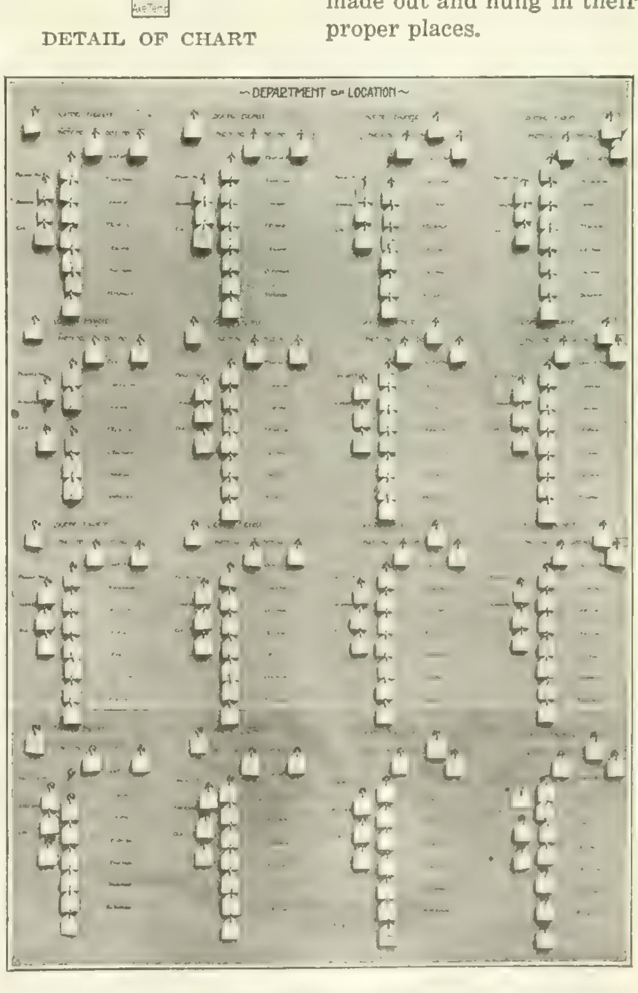
Chart Records Movements and Personnel Changes of Many Survey Parties

With half a score of locating parties being shifted from district to district and from project to project and being enlarged or reduced by transferring employees, the task of recording their positions and personnel is simplified by the flexible chart illustrated here as used by the department of location of the North Carolina State Highway Commission.

This chart has a capacity of sixteen parties. There are listed for each party one locating engineer, a chief of party, a transitman, a levelman, two rodmen, a chainman and a stakeman. This list is lettered on the chart which is spread on a "board" and a small hook is inserted opposite each title. There are also hooks for the district number, the party number, the project number, the address of party headquarters, and the designating number of the party motor car. On the hooks are hung cardboard tags on which are lettered the required numerals or the names of the men or other designating data. When changes occur, the tags are shifted or new tags are made out and hung in their proper places.



DETAIL OF CHART



ROAD SURVEY-PARTY CHART

A New Method of Purifying Water

By H. W. Clark
Chief Chemist, Massachusetts Department of Health, Boston

Abstract of paper presented at the New England Water Works Convention, New Bedford, Mass., Sept. [illegible]

PROBABLY the chief objection to slow sand filtration is that it seldom removes from the comparatively clear but often highly colored waters of the eastern states more than from 25 to 30 per cent of color, and hence does not produce a filtrate as clear, sparkling, low colored and altogether attractive as that from coagulation and rapid filtration. On the other hand, perhaps the chief objections to coagulation and rapid filtration when applied to these soft, highly colored waters, are the tendency of this treatment to increase the corrosive properties of the soft water treated, the difficulty of obtaining as good bacterial results, generally speaking, as by slow sand filtration, and the fact now again being widely commented upon that occasionally aluminum sulphate does pass through rapid filters. A process of water treatment that will produce a sparkling water of low color without increasing its corrosive properties has been much desired. Such a method I believe we have worked out at the Lawrence Experiment Station of the Massachusetts Department of Public Health.

Filter Loaded with Coagulant—The process consists of loading the sand of a slow sand filter with the ordinary coagulants used in mechanical filtration and operating the filter at slightly more than the usual sand filter rates, or about 5 or 6 m.g.d. per acre. Filters loaded in this way remove a very large percentage of the organic matter especially the coloring matter of the applied water and produce a clear, sparkling and altogether attractive effluent, containing no more carbonic acid than was in the raw water although the carbonate constituents are slightly increased.

This method of water treatment has many advantages over each of the other methods and but one drawback [the drawback is low bacterial removal—Editor]. The advantages are as follows: (1) The corrosive properties of the effluent are not increased, or if so, not materially, and neither is aluminum sulphate found in the effluent; (2) the aluminum hydroxide with which the filter is first loaded is regenerated whenever its color-removal properties begin to fail and hence is used over and over again—that is, the primary cost of coagulants is practically the final cost; (3) when receiving comparatively highly colored water from storage reservoirs practically free from mineral matter in suspension, such as silt, etc., the method of filter regeneration or removal of stored color which we employ, removes practically all organic matter from the surface of the filter, as well as from its deeper portions, and hence the necessity for scraping the filter is largely obviated—that is, the expense of sand removal and sand washing is reduced to a minimum. Filters of this type now in operation at the Experiment Station have been scraped only once or twice during a period of five years' operation at rates of 5 m.g.d. per acre; (4) there is, as I have already stated, practically no consumption of alum. Filters operated now for five years have theoretically used, up to date, taking into consideration the amount of aluminum sulphate placed in the filter and the volume of water filtered, about 0.2 of a grain of sulphate per gallon of water filtered or practically one-twelfth the rate necessary for successful mechanical filtration of the Merrimack River water applied to these loaded filters. As the loaded filter increases in age and the volume of water filtered and decolorized increases, the theoretical or apparent use of alum grows less and less per gallon. Successful mechanical filtration of Merrimack River water costs \$6 to \$7 p.m.g. for aluminum sulphate while with this new method the cost to date has been about \$0.55 p.m.g. If the new process is continued on the present basis for another five years the cost for sulphate will be only \$0.28c. per million gallons.

Operating Methods and Results—To date we have operated eleven filters loaded with aluminum sulphate. One filter, put into operation in January, 1917, with 4½ ft. of sand having an effective size of 0.25 mm., was loaded with 80 tons of aluminum sulphate per acre of filter surface. The aluminum hydroxide was precipitated in the sand by flooding the filter alternately with small doses of solutions of soda ash and sulphate, although the filter can be loaded by mixing an alkali, such as magnesium carbonate, with the dry sand and then applying solutions of the sulphate. During its five years of operation the average color of the effluent from this filter has been 14 and the color of the water applied to it, 41—a removal of 66 per cent. During long periods the color of the effluent has averaged 7, and during portions of these periods the applied water has had a color of 60, 70 and even 75; that is, the filter has given an average color removal during such periods of 90 per cent. In other words, the color line of the effluent has always been nearly straight while the color of the applied water has had many high peaks and the higher the color of the applied water the greater the percentage of the coloring matter removed. To date this filter has removed rather more than 50 per cent of the organic matter determined as albuminoid ammonia and 60 per cent of that determined as oxygen consumed. It has been treated with weak solutions of caustic soda 24 times in five years in order to remove the coloring matter held in the filter by the aluminum hydroxide. After this treatment with caustic such a filter is washed with a volume of water equal to about 2.5 per cent of that filtered between treatments and is then ready for service for a period of two or more months. It is not necessary to use filtered water to wash out the caustic. The amount of caustic used up to date in the filter described has been 0.5 of a grain per gallon of water filtered, and the expense for the caustic used has been about \$2.50 p.m.g. We believe, however, judging from later results, that we have used in this particular filter an excessive amount of caustic.

The bacterial results from this method are poor as the caustic used removes from the sand grains the gelatinous organic matter so necessary for the retention of bacteria but the effluent—clear, colorless and sparkling—is easily rendered practically sterile by the use of small amounts of chlorine, and chlorine is in almost universal use at filter plants at the present time in order that their effluents may be absolutely safe.

This method of treatment is particularly applicable to stored waters of a high color, the improvement of which physically is of more moment than the reduction of bacteria and it has seemed to us that there is no serious objection to it which would prevent its use upon a large scale.

Discussion: In answer to questions, Mr. Clark stated that he had not tried the new method at rates in excess of 6 m.g.d., and that its efficiency would depend upon the amounts of turbidity and vegetable matter in the water. Frank W. Green, superintendent of filtration at the Little Falls plant of the Montclair and allied water companies, said he expected to try the process with his mechanical filters. S. De M. Gage, chemist and sanitary engineer, Rhode Island State Board of Health, remarked that, with exception of the Providence supply, bacterial removal was not a serious matter in Rhode Island, but rather the physical improvement of the water supplies. The discussion brought out the fact that experiments with the new process are to be held at Providence.

Durability of Blight Infected Chestnut

Blight infected chestnut is as durable as sound chestnut according to service records collected by the U. S. Forest Service on chestnut posts, poles and ties. Inspections on posts in one locality during eight years of service showed that decay progresses about as rapidly in undiseased posts as in blight infected posts. The blight fungus attacks living trees and grows in the bark, particularly in the cambium layer, but it does not penetrate deeply into the wood itself. The blight finally kills the tree, effectively girdling it by separating the bark from the wood. Blight-killed chestnut should be cut and utilized as soon as possible.

Reverse Studies Detect Errors in Railroad Location

Two Cases in Which Location Surveys in Opposite Directions Revealed Better Lines—Value of Running Variants

By C. K. Conard
Northport, N. Y.

The necessity for studies of railroad locations from opposite directions, as set forth by A. M. Wellington, has been so forcibly impressed on the writer, that in going over country on location work he finds himself subject to an irresistible desire to keep looking back for possible variants that might improve the line. Even after a location has been made, it is advisable to make studies between the several controlling points, to make sure that the line selected is the most economical.

The following actual incidents illustrate the advantages to be obtained by studying stretches of line from both directions. Some years ago the writer was in charge of surveys for a low-grade freight line that the Erie R.R. contemplated building in Orange Co., New York. The work had proceeded to the point at which projections were being made from the field maps. Just north of Middletown a crossing of the N. Y. O. & W. R.R. held up the grade line in the middle of the 12-mile descent from the Otisville tunnel to the Wallkill River.

The crossing was located at a sag on the O. & W. R.R., where marshy land prevented any lowering of their roadbed. The resulting fill for the Erie line amounted to some three hundred thousand cubic yards. Furthermore, the alignment just west of the crossing was bad. In studying this situation our information was that there was no other feasible crossing of the O. & W. R.R in the vicinity and the profile seemed to bear this out. It looked like a case of accepting a bad situation.

Before doing this, however, a last effort was made. Together with an assistant, each of us carrying a compass, hand level, and aneroid barometer, the writer started out to find some point where the O. & W. R.R. could be crossed underneath, instead of overhead. Just north of Middletown yard limit the O. & W. R.R. starts down grade towards the meadows and the projected crossing. Taking the first culvert as a starting point, although the fill was only about six feet, we easily determined that our location could pass underneath, from the down-grade side. Then, striking across country to the west, and plotting a profile from estimated distances and aneroid elevations, we traversed a line that on being developed proved to be about $200,000 cheaper and a whole mile shorter than the first.

The failure to cover this line previously had come about through following a hillside in working downgrade instead of cutting across a ridge. Viewed from the up-grade side of the ridge it certainly seemed the natural thing to do, and only by working in the opposite direction was the mistake discovered. In this particular case the remedy was so simple that it was embarrassing. It was difficult to explain why the mistake had not been discovered earlier. And when you begin to explain, you are damned.

A more recent case occurred in Central America. A railroad 120 miles long, had been located, and partly constructed, some ten or twelve years ago. The original location was made running from west to east. In relocating the line a party was started at the eastern terminus, and followed the old grading. At Kilometer 8 a ridge was crossed, a 3 per cent grade being used to overcome the 140 m. of rise. As we were using 2 per cent for our maximum grade, some development was necessary. It proved impossible to use the old summit cut, although the grading was 75 per cent completed.

Although the distances involved were comparatively short, the heavy undergrowth of the tropics made it impossible to get a general idea of the lay of country without actually running lines. In this instance stadia was used for distance and vertical angles for elevations. Leaving the spur that carried the old line well out into the swamp land, we struck out on a fairly straight line along the foot of the ridge. Every stream that crossed the line was investigated to its saddle or high enough to prove that it was impracticable.

Eventually, at the end of the second day, a summit was found that promised well, and a transit line and levels were run. The notes, as platted, showed that we were close to the old grading on the west side of the ridge, with a fairly easy side-hill descent from the summit. The projected location on this variant was more than a kilometer shorter; the summit more than 10 m. lower; the maximum grade was 2 per cent instead of 3 per cent, the curvature was reduced one-half, and the grading quantities were less than on the old line. Altogether the old line was a good example of "letting it go at that." Had the construction work been completed, and the line opened for traffic, this mistake would have been discovered as soon as the forest was cleared away. The really surprising part of this discovery was that the new summit cut was towards rising ground from the old summit, and the investigation in that direction was undertaken without the slightest hope of finding anything worth while. We simply expected to make sure that it was impracticable.

As for following out this principle on projection work, there are many conflicting ideas. The writer prefers to project lines from the summits downgrade, on the idea that any necessary development for distance can better be made on low-lands, where valleys tend to be broader, and where there is usually more latitude in placing the line. At summits the line is fairly well fixed. But even so, no line should be accepted without some study of the possibilities of working upgrade.

Nothing is so indicative of inexperience as a set of expensive field maps, on which a single line shows the projected-location study. While it is true that because of map errors the first location run out on the ground in hilly country is seldom the line constructed, the final line should be a refinement of the projected location, and not a new line. Experience only, will give the judgment necessary to say just how far to go in refining a projected line, but it is well to go on the principle of never being entirely satisfied with the line laid down.

The lamentable failure not only in this country, but all over the world, to continue the laying out of new railroads, during the past eight or ten years, has caused a gradual elimination of men expert in location work. Should a period of prosperity, with a changed public opinion, permit a continuation of the railroad program, it is probable that the young men employed on that work would be lacking in practical experience. Without such safeguards as those outlined above, we should have many failures in properly laying out the work.

Precast Concrete Slab Road After Fourteen Months' Use

Abstract of Report of Inspection of Casper-Salt Creek (Wyo.) Road by B. B. Hauser, Highway Engineer, U. S. Bureau of Public Roads

AFTER 14 months' service ending Mar. 11, the 2,400-ft. section of experimental precast concrete road on the heavily traveled route between Casper and Salt Creek, Wyo., was found in general in good condition. No visible lateral movement was observed and very little vertical displacement. In the three joints which showed the greatest amount of movement the vertical displacement was 0.05, 0.04, and 0.03 ft. The displacement of practically all other joints was negligible. All slabs are free from cracks except eight. Three slabs each show one crack across the corner extending into the slab less than 3 ft.; two slabs each show one crack across the corner extending into the slab less than 6 ft.; two slabs each show one crack extending entirely across the slab, and one slab shows one crack extending the entire length of the slab with one crack extending half of the width. All of the cracks are too fine to show in a photograph and apparently are not becoming larger, which would indicate the value of the steel reinforcement. Some of the cracks have been filled with asphalt. Eight consecutive slabs show some wear. It is understood that a number of the slabs were cast during freezing weather and wearing is undoubtedly due to frost, which is not considered a bad showing.

CURVED JOINT WITH NEAR CORNER OF ONE SLAB SETTLED .04 FOOT

Very little difference was observed in the service rendered by the different types of joints.

Present indications are that the precast slab pavement will continue to give good service for a considerable time with very little maintenance other than to keep the shoulders in place.

During the year 1921 trucks of 30 to 40 oil companies, the principal users of the road, made 13,000 round trips over the pavement carrying a net weight of 40,000 tons and gross weight of 97,000 tons. Considering 313 days per year the average number of trucks per day was eighty-three. All of the trucks were loaded one way only from Casper to or toward Salt Creek. About 60 touring cars daily pass over the road. It is estimated that 30 to 40 per cent of the trucks are equipped with pneumatic tires. About 50 per cent of the haulage is done by the Mid West Oil Company which has fourteen 3-ton, five 2½-ton, and one 5-ton trucks and several trailers. The average rate of speed is 12 miles per hour for the 3-ton trucks, 14 to 15 miles for the 2½-ton trucks. The heaviest single load was a crankshaft and engine base having a net weight of 22½ tons. The load was hauled on two reconstructed trailers and was equally distributed on eight 42-in. steel wheels 10 in. wide.

[*The results of the inspection of the monolithic concrete section of the same road are given in the following article.* —EDITOR.]

Inspection of Casper-Salt Creek Monolithic Concrete Road

FEDERAL inspection in March of the 4-year-old Casper-Salt Creek (Wyo.) monolithic concrete road carrying heavily laden trucks to the oil fields indicated that 92.6 per cent of the slabs are in good condition, and with a small amount of maintenance should continue to give satisfactory service for an indefinite period. The remainder need considerable maintenance. Four slabs needed replacement and in seven small portions were disintegrated. Two slabs showed wear due to poor concrete or improper curing, and one slab, which showed several hair cracks, did not show perceptible wear or disintegration.

TABULATION OF CLASSIFICATION

Class	Number of Blocks	Per cent of Whole	
A	288	33.4	
B'	64	7.4	
C'	110	12.7	92.6
B	82	9.5	
C	256	29.6	
D	44	5.1	
E	6	0.7	7.4
F	4	0.5	
Special	10	1.1	
Total	864	100.0	100.0

B' pavement has only a few plainly visible transverse cracks which extend less than one-half the distance across the pavement.
C' pavement has only a few plainly visible longitudinal cracks which extend along the pavement less than one-half the length of the slab.
Special classification shows in more detail conditions of slabs which could not be placed under any of the above classes, such as small disintegrated portions.

"Taken as a whole," states B. B. Hauser, engineer, Bureau of Public Roads, who made the inspection, "considering the heavy truck traffic, the quality of concrete appears to be good and the pavement is wearing well. The cracks are undoubtedly due to uneven settlement of the subgrade."

The classification of the 864 blocks given above is according to the method used by the

CASPER-SALT CREEK PRECAST CONCRETE PAVEMENT
Eight slabs slightly worn probably [illegible] in freezing weather.

TYPE OF CHAINS USED ON TRUCKS ON CASPER-SALT CREEK ROAD

bureau in the study of the California highway system with two additional subsidiary classes and a special description applied to a few slabs (See *Engineering News-Record*, March 17, 1921, p. 469).

Zoning Ordinance Adopted at Akron, Ohio

UNUSUAL features of the zoning ordinance unanimously adopted by the City Council of Akron, Ohio, in accordance with recommendations of the City Planning Commission, are the restriction of building lines of all residence districts and showng them on a separate set of maps as part of the zoning ordinance; the method for taking care of uses classed as "indeterminate" and "institutional;" and provisions for garages under restrictions as to repair facilities, etc., in retail business districts.

The ordinance provides for six classes of use and one class of special use districts, the latter divided into three parts; and for five height districts and also for five area districts. The six use districts are dwelling, apartment house, retail business, commercial, ordinary industry, and heavy industry; and the special uses are subdivided into obnoxious, indeterminate, and institutional. The limits in each of the height districts are 35, 50, 75, 105, and 136 ft. The area districts provide for the following number of square feet of lot area per family: 4,000, 2,000, 1,000, 500, and 310 sq.ft. On corner lots 10 per cent may be deducted from the area per family.

As to the building lines in residence districts, the commission states:

> The zoning plan also establishes building lines on all streets in residence districts and on some streets in business and industry districts to maintain front yards, along residence streets and to provide adequate distances between buildings required by traffic conditions and the anticipated height of buildings, in the interest of public health, safety, convenience, comfort and general welfare. In residence districts, the building lines established generally conform to the lines provided by deeds, allotment plats or the lines determined by 50 per cent or more of existing buildings. All building lines are shown on a separate set of maps which accompanies and is a part of the zoning ordinance.

The use, height, and area districts are all shown on a single set of maps consisting of twelve sheets, drawn to a scale of 400 ft. per inch.

For the foregoing information we are indebted to Charles F. Fisher, formerly engineer of the City Planning Commission of Akron, Ohio, and now engaged in zoning work at Providence, R. I., under the direction of Robert Whitten.

Sources of Error Occurring in Boundary Surveys

Precise Triangulation Prerequisite to Satisfactory Boundary Determination — Examples of Station Error in Astronomic Method

By C. V. Hodgson
Assistant Chief, Division of Geodesy, U. S. Coast and Geodetic Survey, Washington

THE methods of describing the boundaries of national territories and their subdivisions show only one advance through the centuries—that of using parallels and meridians as boundary lines. Nor have the engineering interpretations of those descriptions made the progress they should.

Notwithstanding the importance of the proper delineation of boundaries, there is lacking an established method of procedure, based upon proper engineering principles for locating boundary lines. The legal principles involved are simple, resting mainly upon the tenet of national law which provides that the boundary line between units of equal sovereignty be defined by mutual agreement of the powers concerned. Here no doubt lies the reason why a standard practice has not grown up for making boundary surveys, for no matter by what method the boundaries are located and marked, a boundary once legally agreed to by both parties will remain the boundary until modified by subsequent agreement.

Aside from the legal aspects, some interesting engineering questions are involved in determining boundaries when defined as being formed by a parallel or meridian, or by a straight line between two designated points. The question as to whether a boundary should be determined by astronomic methods, or a combination of astronomic and geodetic methods has more than academic interest to the parties concerned. Even the simple operation of running a straight line between two points on the earth's surface is not so elementary as it sounds, for C. A. Schott ("Oblique Boundary Line Between California and Nevada," report of Coast and Geodetic Survey for 1900, Appendix 3) pointed out in a mathematical discussion of the oblique boundary between Nevada and California that eight different so-called straight lines may be run between two points on the earth's surface. This condition is due to the fact that the deflection of the vertical at different points on the line varies, and the methods of making the backsight and foresight in lining out the boundary are different.

This station error is the deflection of the plumbline from the normal to the ellipsoid of mean surface of the earth caused by the variations in the density of the earth's crust. Its effect is to shift the observer's zenith.

Examples of Station Error—Some idea of the magnitude of the errors which may be introduced into determinations of geographical positions by this station error may be obtained by an inspection of the geodetic latitudes and longitudes of some state boundary monuments when determined by the precise triangulation of the Coast and Geodetic Survey. This triangulation is based on the North American Datum, which was adopted originally by the United States and later by Canada and Mexico as a triangulation reference datum and so chosen as to bring the continental area of the

United States into its proper geographical relation with the equator and the Greenwich meridian.

The arc of precise triangulation along the ninety-eighth meridian shows that the north boundary of the state of Kansas is nearly 880 ft. north of the fortieth parallel, while its south boundary is over 500 ft. south of the thirty-seventh parallel, its constitutional boundaries. Supposing that the relation between monuments and adjusted latitudes remains the same for the whole length of the state, the state is therefore ¼ mile wider than intended by its constitutional limits.

Triangulation also showed a boundary monument between Colorado and Wyoming to be almost 600 ft. too far south, a monument between South Dakota and Nebraska nearly 660 ft. too far north, the monument at the southeast corner of Montana 650 ft. too far south, and the monument at the northeast corner of Wyoming over 800 ft. too far south.

Longitudinal Discrepancies—The discrepancies in longitude are even greater than in latitude, due no doubt to the far greater difficulty in securing an accurate longitude determination. A boundary monument between Colorado and Utah is over 2,200 ft. too far west, according to its longitude on the North American Datum. One monument on the eastern boundary of Montana indicates that the boundary is almost 1,900 ft. east of its proper location, while another monument about 150 miles further south, on the same boundary and supposedly on the same meridian, is 3,300 ft. east of the proper meridian, defined as the twenty-seventh meridian west of Washington.

The boundary line marked between Nevada and Utah exhibits a similar divergence from a true north and south direction, for in latitude 39 deg. 10 min. a boundary monument supposed to be on the thirty-seventh meridian west of Washington is about 1,040 ft. too far east, while in latitude 41 deg. 20 min. it is nearly 3,300 ft. too far east. It should be stated that the distances given above are in round numbers.

These discrepancies between the astronomic and geodetic latitudes and longitudes, while large, are excelled in size by those found in other countries. As one of several examples that could be cited a relative discrepancy in geographic position was found between two astronomic stations in Turkestan 65 miles apart amounting to 76 seconds of arc—almost a mile and a half. This is an average error of 120 ft. to the mile. Again, in the vicinity of Dehra Dun, India, there is a total deflection of the vertical of 62 sec. of arc, and within five miles the change in the meridian component of the deflection amounts to more than 12 sec. of arc. In other words, the difference of latitude between the two ends of that five-mile line would be in error more than 1,200 ft. if determined astronomically.

It will be seen from the above that a boundary line located by astronomic methods will be seriously out of relation to the geographic position of the adjacent terrain as determined by a general system of triangulation, but an even more serious defect in its location is found in its zig-zag course, due to the effect of the change in the deflection of the plumbline along the boundary. Each astronomic station will have its zenith deflected in a different direction or amount from the preceding one, and the line carried forward will have its direction affected accordingly. This explains in part why two successive locations of a boundary never agree, for while two astronomic determinations of the geographical position of any one point will agree within one or two tenths of a second of arc (about ten to twenty feet) a line extended from that point for fifty miles to another astronomic position may show a discrepancy of several hundred feet in the position of the second point.

Where there is existing adjusted triangulation or a standard datum for horizontal control proper geodetic methods will give a boundary line which will meet the fundamental requirements that the boundary be in proper relation to geographical position to the adjacent territory as mapped, and also that all points on the marked line shall be on the meridian designated as the boundary, or on the arc of a great circle between the two points designated as the terminal points. No other location is satisfactory from an engineering or mapping standpoint though it may meet the legal requirements.

Satisfactory Boundary Determination—To secure this result two things are essential. The first is that the termini of the boundary arc be determined by precise triangulation and by it connected to the standard datum of the country. The second is that precise triangulation shall follow the boundary so closely that offsets can be measured from a sufficient number of triangulation stations to the boundary to define the boundary adequately. Before the offsets are measured the entire triangulation should be adjusted to the general control scheme of the country. The offsets can then be measured to the boundary according to the computed distances and directions, and the monuments tested visually for alignment.

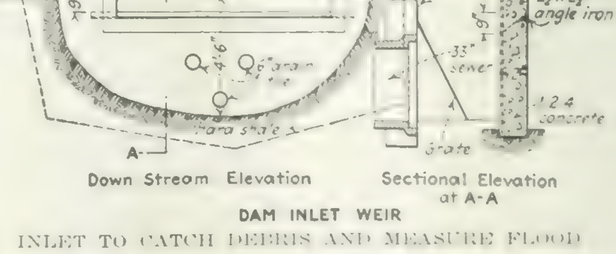
The location of the boundary lines of a nation or of its subdivisions is of such prime importance that the methods used should correspond in accuracy to those employed on the most accurate control surveys.

Combined Dam, Sewer Inlet and Weir

By R. E. Spear

Formerly Borough Engineer, Ambridge, Pa.

SPECIAL structures consisting of a combined weir, dam and inlet to measure the water during flood period, to hold back the debris that comes down the steep ravines and to act as an inlet to a sewer have recently been constructed in the hill sections of the Borough of Ambridge, Pa. The form is shown in the accompanying drawing. In one rain one of the structures held back 120 cu.yd. of debris, thus enabling the



DAM INLET WEIR

INLET TO CATCH DEBRIS AND MEASURE FLOOD

sewer inlet to function properly rather than being completely covered up and permitting debris to be carried to streets and property below. The average cost of construction is $60. Many times this amount has been saved in one season.

Zoning Progress in the United States

By Mary T. Voorhees
Division of Building and Housing, [illegible] of Commerce, Washington, D. C.

Zoning regulations to control the use, and in the majority of cases also the height and area of buildings, in accordance with a practical plan of municipal development, have been adopted in 78 cities of the United States within the past few years. The police power of the state under which zoning ordinances are enacted is usually delegated to the city by the state legislature, although some cities have zoned under home rule provisions, which they believe to be a sufficient grant of power.

Twenty-five states and the District of Columbia have passed laws granting to their cities the right to zone. In some of these states, all municipalities, including counties, may zone, while in others only particular cities or classes of cities have been given this power. A number of states will place zoning enabling acts before their legislatures in 1923.

Large cities, particularly, have felt the need of this sort of municipal protection. At the present writing 7[illegible] per cent of the cities of over 100,000 population in the United States are zoned, or expect to zone shortly. However, the small cities and towns far outnumber the larger ones in zoning activity.

The first comprehensive zoning ordinance in the United States was enacted by New York City in 1916. The entire city was divided into zones or districts to each of which appropriate regulations of the use, the height and the area of buildings applied. Some cities have adopted ordinances limiting only property uses.

The accompanying table lists the state zoning laws and city ordinances thus far passed. The language of the act in each state law has been retained so far as is consistent with space limits. The writer will be glad to be informed of additions to this list.

STATES AND CITIES WITH ZONING LAWS AND ORDINANCES REVISED TO SEPT. 1922

"Comp." indicates a comprehensive zoning ordinance; [illegible] districts or zones only. The listed [illegible] the various ordinances were adopted

CALIFORNIA—Any incorporated city and town may adopt zoning		
Alameda	Comp.	1919
Berkeley	Use	1920
Coronado	Comp.	1920
Long Beach	Comp.	1921
Los Angeles	Use	1909, 1916, 1921
Oakland	Use	1919
Palo Alto	Comp.	1918
Pasadena	Use	1919
	Comp.	1922
Pomona	Use	1917, 1920
Sacramento	Use	1917, 1919
Santa Barbara	Use	1920, 1922
San Francisco	Use	1921
Turlock	Use	1918
CONNECTICUT—Applies to New Haven		
DISTRICT OF COLUMBIA—Applies to Washington.		
Washington	Comp.	1920
GEORGIA—Applies to Atlanta, as amendment to city charter.		
Atlanta	Comp.	Ordinance with race districts 1922
ILLINOIS—Each city, village and incorporated town.		
Evanston	Comp.	1921
Glencoe	Comp.	1921
Oak Park	Comp.	1921
River Forest	Comp.	1922
Winnetka	Comp.	1922
INDIANA—All cities.		
IOWA—Cities of first class, including cities under commission form of government and cities under special charter.		
KANSAS—Cities of first class having pop. exceeding 20,000.		
Hutchinson	Comp.	1921
Wichita	Comp.	1922
LOUISIANA—Cities with pop. over 50,000		
MASSACHUSETTS—Any city or town.		
Brockton	Comp.	1920
Brookline	Comp.	1922
Milton	Use	1922
MICHIGAN—City and villages		
MINNESOTA—Cities of first class and any city of 50,000 pop.		
St. Paul	Comp.	1922
MISSOURI—Every city having or attaining pop. not less than 200,000 and not more than 600,000; each incorp. city or town of 50,000 or less		
Springfield	Use	1921
Richmond Heights	Comp.	1922
St. Louis	Comp.	1918
University City	Comp.	1922
NEBRASKA—All cities of metropolitan class		
Omaha	Comp.	1920
NEW JERSEY—All municipalities		
Bogota	Comp.	1921
Bound Brook	Comp.	1921
Caldwell	Comp.	1921
Cliffside Park	Comp.	1920
East Orange	Comp.	1921
Glen Ridge	Comp.	1921
Hoboken	Comp.	1922
Irvington	Comp.	1922
Jersey City	Comp.	1922
Maplewood	Use	1921
Montclair	Comp.	1921
Newark	Comp.	1920
Nutley	Comp.	1922
Paterson	Comp.	1921
Rahway	U	1920
	Height and area regulations in residence districts 1921	
Roselle	Comp.	1922
Roselle Park	Comp.	1921
Rutherford	Comp.	1922
South Orange	Comp.	1922
Verona	Use	1922
Westfield	Comp.	1921
West Orange	Comp.	1921
NEW YORK—Cities not of the first class, and villages, and to New York and Rochester as amendments to city charters		
Bronxville	Use	1922
Gloversville	Comp.	1921
New Rochelle	Comp.	1921
New York City	Comp.	1916
Niagara Falls	Comp.	1920
No. Pelham	Comp.	1921
Rochester	Use	1919
Scarsdale	Comp.	1922
Syracuse	Use	1922
White Plains	Comp.	1920
Yonkers	Comp.	1920
NORTH CAROLINA—City planning law with zoning provisions applies to cities in the counties of Buncombe, New Hanover and Wake		
OHIO—Any municipality.		
Akron	Comp.	1922
Cleveland Heights	Comp.	1921
E. Cleveland	Comp.	1919, 1922
Lakewood	Comp.	1922
OREGON—Any incorporated city and town		
PENNSYLVANIA—Cities of the first and second classes.		
RHODE ISLAND—Any city		
SOUTH CAROLINA—Park commission law with zoning provisions applies to Spartanburg		
TENNESSEE—All municipalities of pop. in excess of 160,000 in 1920.		
TEXAS—Cities and towns having pop. more than 5,000		
Dallas	Use	1922
	Race segregation	1916
UTAH		
Salt Lake City	Use	1920
VIRGINIA—Any city		
Richmond	Use	1922
WASHINGTON		
Tacoma	Use	[illegible]
WISCONSIN—Every city and any village [illegible] of pop. of 250,000 [illegible]		
Cudahy	Use	[illegible]
Janesville	Comp.	1922
La Crosse	Use	1921
Milwaukee	Comp.	1920
Neenah	Use	[illegible]
Racine	Use	[illegible]

A Legal View of Fire Protection

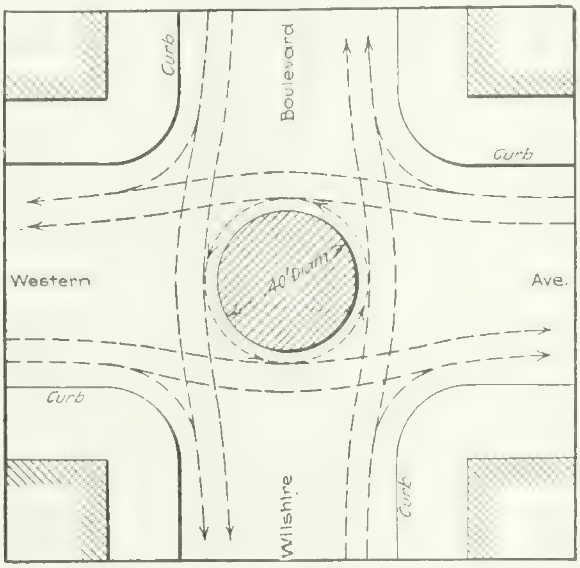
A decision recently rendered by the Court of Appeals of New York State in a case involving the mandatory installation of fire windows throws light on the attitude of the legal mind toward the technical questions of fire protection. The fire commissioner of New York City, under a provision of the city charter, ordered a building owner to provide certain windows in his building with metal or kalamein frames and sashes with wired glass and make them of self-closing construction. The owner sued to prevent the execution of this order, on the claim that such installation constituted a structural change. Rudolph P. Miller outlines the case as follows:

The question seems to hinge on an interpretation of the city ordinance which requires that "the owners and proprietors of all manufactories shall provide such fire hose, fire extinguishers, buckets, axes, fire hooks, fire doors, and other means of preventing and extinguishing fires as the fire commissioner may direct." By a previous decision of the Court of Appeals the fire commissioner has no authority under this provision to order structural changes. The lower court decided against the defendant, the Appellate Division reversed this judgment, and the Court of Appeals again reversed the Appellate Division. In confirming the judgment of the trial court, the upper court held that installations of the windows is not a structural change. In explaining this decision the court of last resort said (italics ours):

"So far as the window frames or sashes are concerned, defendant could comply with the order of the fire commissioner *by painting or coating them with a certain kind of fireproof mixture.* This involves no structural change. The same is true of the requirement for wired glass in windows. A window pane is of such fragile and therefore temporary and changeable character that we do not think that anybody would regard it as a part of the permanent construction of the building as would be an elevator, a chimney, or a wall. The feature of making the windows self-closing is a matter of detail involving the use of some simple device, and certainly would not involve anything more in the way of permanent construction than would the appliances which are attached to an ordinary fire door causing it to close when fire approaches."

Traffic Circle Relieves Crowded Street Intersections

A METHOD of traffic control for relieving congestion at street intersections has recently been put into operation in Los Angeles by Major John A. Griffin, city engineer who states that it has clearly demonstrated itself to be capable of handling up to 5,000 vehicles per hour without the aid of a traffic officer. The timing of vehicles by stop-watch as they entered the apparent congestion in the double line of traffic revolving around the circle, according to Major Griffin, showed that even



TRAFFIC CIRCLE AND LINES OF TRAVEL

loaded trucks with trailers would go through the intersection and be clear in slightly less than a minute. Ordinary cars took about 40 sec.

A 40-ft. circular enclosure is laid out in the center of the intersection so that all machines must turn to the left striking the line of traffic obliquely instead of at right angles. This has the effect of causing each machine to turn in behind the machines already using the crossing and the rotation of the entire mass provides for 100 per cent utilization of the roadway, whereas with a traffic officer on the intersection only 50 per cent of the roadway can be used at any one time.

When the traffic circle was tried out it received much adverse comment from those who saw it for the first time. However, actual experience with the plan, Major Griffin asserts, proves that there is not as much confusion as would at first appear because each machine continues to move toward its objective.

Radio on the Salt River Project, Arizona

A radio broadcasting station has been installed to facilitate the operation of the Salt River Irrigation Project. The *Reclamation Record* for August reports:

Gages are placed in the upper Verde and also at Cave Creek, so that any appreciable rise of water caused by sudden storms can be noted and broadcasted from the station to the manager's office in Phoenix and to all ranch owners who listen in, thus providing a timely warning and preventing great damage. The inlet from the reservoir at Roosevelt Dam will also be controlled by telephone from Phoenix, based on reports from the radio station; thus it will be closed when there is a sufficient water supply and opened when the water in the river is low.

Revamped Sewage Disposal Plant at Chicago Heights, Ill.

Contact Bed Replaced by Sprinkling Filters Dosed From Tanks Having Rotating Slide Valves—New Electric Driven Pumps

BY L. K. SHERMAN
President, Randolph-Perkins Co., Consulting Engineers, Chicago

IN THE remodeled sewage-works of Chicago Heights, Ill. (Fig. 1), the original contact beds have been changed into sprinkling filters, pumps installed to give the requisite head and a novel rotating slide valve apparatus devised to vary the head and quantity fed to the sprinkling nozzles.

Chicago Heights has a population of 20,000, the greater part of which is served by separate sewers. The sewage was treated for several years by septic tanks and contact beds but the beds clogged and became ineffective. Recently the city completed the remodeling of its sewage-works, utilizing so far as possible the old plant. The four contact beds, with a total area of one acre, were changed to sprinkling filters equipped

FIG. 1—CHICAGO HEIGHTS SEWAGE-WORKS
Old contact beds changed to sprinkling filters. Former syphon dosing chamber converted to combined pump house and rotating slide-valve dosing apparatus, supplying beds alternately with variable head on sprinklers.

with 400 Taylor nozzles. Remodeling the old works into an activated-sludge plant would have cost 20 per cent less but the annual cost would have been more than twice that for sprinkling filters.

Since the available gravity head was insufficient to operate sprinklers, additional head is secured by means of two float-controlled, electrically-operated centrifugal pumps. The flow of sewage varies from 300 to 3,000 g.p.m. One pump has a capacity of 1,000 and the other of 3,000 g.p.m. The pumps are set in the same sump and are direct-connected to their respective motors by vertical shafts. The old house which held the siphons for dosing the contact beds was remodeled into a pump station.

The novel feature of the new installation is the intermittent, variable dosing apparatus shown in Figs. 2 and 3. The pumps discharge through separate pipes into a steel dosing tank 4 ft. in diameter and 9 ft. high. Each discharge pipe is provided with a back-pressure flap valve. In the bottom of the tank are four 10-in. pipe outlets, placed 90 deg. apart. Each outlet supplies the sprinkler system of one of the four filter beds. A vertical shaft in the center of the tank is

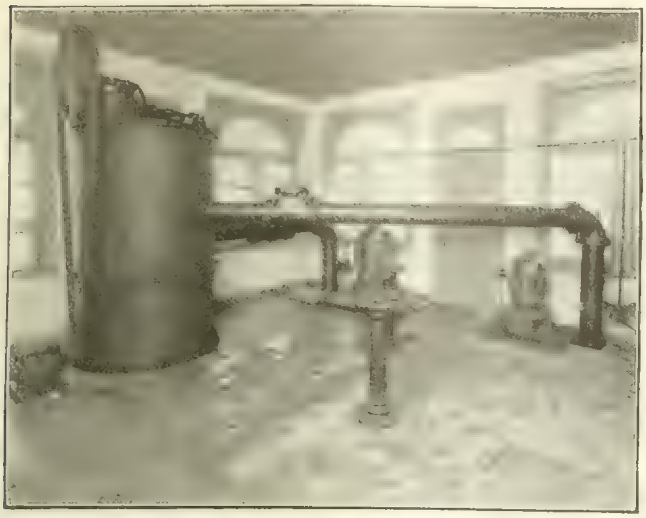


FIG. 2—DOSING TANK AND TOP FLOOR OF PUMP HOUSE

Rotating slide valves connected with shaft driven by ½-hp. motor at left of tank control four outlets in bottom of tank (below floor). Each outlet supplies one sprinkling filter.

turned by a worm gear on top of the tank, driven through belt connection by a ½-hp. electric motor. The vertical shaft carries two plates, or slide valves, each having an arc of 90 deg., placed opposite each other. (Only one valve is shown in Fig. 3.) The valves are geared to make one revolution in 30 minutes. As the slide valve passes one of the 10-in. ports the sewage begins to flow out at an increasing rate until full opening. At the same time the sprinkling nozzles of the bed supplied by that port gradually increase the radius of their spray until they cover a diameter of 11 ft. The flow continues for 8 minutes, when the radius of the spray gradually decreases, comes to a stop and that particular bed rests for 8 minutes. The period between partial and full discharge of the nozzles can be increased to any desired extent by making the edge of the rotating valve on a diagonal instead of a vertical line.

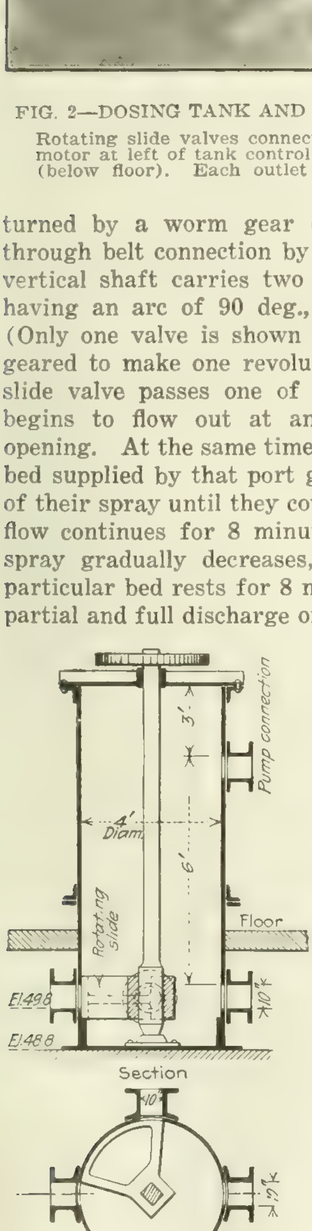


FIG. 3—DOSING TANK

Only one of the two valves is shown. Two beds dosed together normally. Any bed may be thrown out of use by closing valve on supply pipe.

When the larger pump is in operation and when two ports are at full opening, the other two are closed and 100 nozzles on each of two beds are at full spray. With the smaller pump in operation, any two adjacent beds are cut out by closing two gate valves on these beds. About one-third of the nozzles are also cut out by two gate valves in the two operation beds. The cycle of dosing and rest then takes place alternately upon the two beds in service. The maximum head at the nozzles is 2.7 ft. for operation with either pump. The total head, including friction losses, or height of water in the dosing tank, ranges from 4 to 6 ft. above the nozzles.

Normally the smaller pump is sufficient. When the sewage flow is more than 1,000 g.p.m. the four gate valves in the beds are opened, the current is shut off the smaller pump and the large one started. This is the only manual operation required. The city, however, keeps a man on duty at the sewage works to rake off the screens, keep the nozzles clear, regulate flow in the settling basins, handle the sludge, act as watchman and generally follow instructions and keep records for the efficient operation of the plant.

The new works and dosing apparatus was designed by the writer and the construction supervised by M. H. McCoy, city engineer. William F. Hildemann, Chicago Heights, Ill., was the contractor.

Experiment in Asphalt Paving at Philadelphia, Pa.

Base Roughened by Slag Spread on Green Concrete and Slightly Pressed In—Large Stone Used in Binder Course

By Julius Adler

Deputy Chief, Bureau of Highways, Philadelphia, Pa.

WITH the outlook promising traffic of increasing severity on Philadelphia streets, it was felt this year that the time had arrived to try out in an experimental way some changes in the make-up of an asphalt pavement which would be more far-reaching than the ordinary variations which are supposed to distinguish light- and heavy-traffic mixtures.

Since 1917 the prevailing practice in Philadelphia has been a 1½-in. surface with 1 in. of close binder. Previously a 2-in. surface course had been used. A careful examination made about three years ago of these pavements failed to show a clear relationship between the condition of the pavements and the variations in composition which have usually been considered as being influential in this respect, and there was little to suggest that a general improvement in the condition of pavements in Philadelphia could be effected by a closer control of the paving mixtures from the standpoint of composition.

It was decided that the logical procedure was along other lines than varying the composition and as an experiment, contract has been entered into for repaving 22nd St., from Locust to Fitzwater Sts., situated on the edge of the central business section and carrying heavy one-way traffic, principally on one shoulder. The street is 32 ft. wide, with a single car track in the center, and the improvement consists of smooth dressed granite blocks between the rails and for runners, and sheet asphalt shoulders. The base is a 1:3:6 cement-concrete, 6. in. thick.

As the basis for arriving at the specification changes, it was concluded that in the creeping and pushing of asphalt pavements, two principal factors are to be contended with; (1) movement of the entire pavement on the surface of the foundation, and (2) insufficient stability or rigidity in the pavement itself.

In numerous instances, it has been found that asphalt pavements have moved bodily on the foundation and this has been attributed to the fact that under heavy motor traffic the thrust imparted to the asphalt has not been transmitted through the surface to the foundation in a path sufficiently short to prevent buckling. Under the condition here assumed the asphalt pavement takes

on some of the characteristics of a horizontal column of uncertain length, which deflects under the horizontal component of thrust from the traffic. The attempted method of solution of this difficulty, which is to be employed in the project under discussion, consists in making the surface of the concrete base of such character as to provide almost immediate means of transmitting horizontal stresses from the asphalt pavement to the rigid foundation.

In the matter of increasing the stability of the surface mixture, the general scheme to be employed is to reduce the thickness of the surface course, which is considered to be the least stable portion of the pavement, and to increase the rigidity of the binder course as later described.

Base Surface Rough—The first innovation in the specifications is to produce a determined uniformly rough surface to the concrete as contrasted with such accidental roughness as commonly occurs in the finishing of concrete base, and which varies greatly with the character of aggregates used and the method of manipulation.

The concrete when deposited is to be of the usual quaky consistency and is to be "spread and compacted as required to bring it to a true surface free from irregularities, depressions or marked surface voids." Shortly after the concrete has been deposited, but before initial set has taken place, there is to be cast over the surface 1½ in. crushed stone or crushed slag, which is to be lightly rammed into the concrete so as to be firmly imbedded, with the points projecting from ½ to ¾ in. above the original surface of the concrete. To insure uniformity, it is further required that the peaks of the projecting points will be separated by an average distance of 1½ to 2 in. but not to exceed 4 in. and the surface must be preserved in this condition until the asphalt binder course has been laid. Roughening the surface by the use of toothed rakes or any similar substitute method will not be permitted.

As previously stated, the roughening of the concrete surface is intended to form a mechanical bond or key between the asphalt surface and the foundation so that horizontal forces will be promptly and uniformly transmitted from the asphalt to the concrete. On one section of this contract, the concrete foundation is to be finished in accordance with the city's standard specifications.

Thin Top Surface—In the matter of increasing the stability of the asphalt pavement, the initial step is the reduction of the thickness of the surface mixture to the minimum practical, namely 1 in. For the binder course it was believed that the best available method of increasing the stability lies in employing a coarse aggregate of larger average dimension than that usually used. The specification therefore provides for the use of a well-graded coarse aggregate, ranging from 2 in. maximum diameter down to approximately ¾ in. This mixture will be a close binder containing from 4½ to 6½ per cent by weight of bitumen, 15 to 25 per cent of sand, and the remainder coarse aggregate. In proportioning, the attempt will be made to produce as dense a mixture as possible without developing a surface under the roller which will be so smooth as to reduce the bond between the surface mixture and the binder course.

In the matter of size of aggregate, it may be noted that in the construction of the Byberry and Bensalem Service Test Road in Philadelphia, in 1912, there was included a section of asphaltic concrete in which the coarse aggregate used was a trap rock of the size specified for the binder course in the present case. In the preparation of this mixture at the plant, it was found that mixer blades slightly shorter than usual must be used to prevent breakage, as a result of large pieces of the aggregate being wedged between the blades and the liner plates; and moderate temperatures must be employed in order to retain a proper coating of bituminous mortar on the large stone. No other difficulty whatever was experienced in the use of this material and this section of pavement is still notably free from waves.

Binder Course 2 in.—Accompanying the decrease in thickness of surface course, and the increase in the size of the binder aggregate, the thickness of the binder course has been increased to 2 in. Allowing for the usual wedge-shaped character of the aggregate and the fact that the fragments almost invariably bed themselves on a flat face after the roller has passed over, it is not anticipated that there will be any appreciable number of single pieces of aggregate extending from the surface to the bottom of the binder course.

The 1-in. surface course is considered the least depth practicable to rake and roll as a course separate from the binder. Provision is also made for the use in this surface mixture of not to exceed 25 per cent by weight of clean trap rock chips, with a view of effecting some stiffening, but the exact amount to be used will be determined by weather conditions at the time the work is done. In the event of cold weather a surface mixture with the maximum amount of stone, and 1-in. in thickness, would be subject to excessive honeycombing.

For purposes of comparison the lower portion of this contract, as previously mentioned, will have a concrete foundation laid and surfaced according to the usual specifications and on this section, the asphalt pavement to be laid will consist of 1½-in. binder and 1½-in. surface mixture with no deviations from ordinary specifications in either case. Work under this contract is scheduled to begin in the latter part of September.

Chemical and Atmospheric Corrosion Differ Bureau of Standards Shows

Recent comparisons of tests on alloy steels at the Bureau of Standards have shown a decided difference in comparisons based respectively on chemical and on atmospheric corrosion. In tests where hydrochloric acid was used as corroding agency, the most resistant materials were a high nickel-chromium steel, invar, pure iron, and medium carbon steel very slowly cooled from a high temperature. The acid attacked a steel at 13.7 per cent chromium content much more rapidly. However, in atmospheric corrosion (test made by partial immersion in water and exposure to the air) the order of resistance of these materials was reversed, the high-chromium steels resisting the action most successfully, while the low-chromium steels and the pure iron showed rust spots early in the test. Nickel and chromium in combination appeared to make the steel resistant to both acid and weather attack. The effect of heat treatment was found to be minor, though in general the steels which were quenched resisted corrosion better than annealed samples.

Street Cleaning Methods and Costs at Akron, Ohio

Hand and Machine Methods Compared—Sidewalks Flushed by Tank Wagons—Quantities, Costs and Performance Given

BY FRANK C. TOLLES

Superintendent, Bureau of Public Works, Akron, Ohio

STREET cleaning costs for the year 1921 together with a brief notation of methods and of the manner in which the data are gathered and compiled are here presented for Akron, Ohio.

Akron is estimated to have a population of 165,000. It covers an area of 25 square miles and has about 160 miles of surfaced streets—chiefly brick. Street cleaning is performed by city forces and is paid for from special frontage assessments. The assessment rates range from 5c. to 60c. per front foot per annum. The rate is made dependent upon the frequency of cleaning.

An average force of 85 men and 16 pieces of motor apparatus is employed. The total cost for 1921 was $127,195.17. The equipment includes three pickup sweepers, one gutter sweeper, two flushers, one catch basin cleaner, seven two-ton trucks, one service car and one roadster.

Work Reports—As the basis for levying assessments and to enable costs to be determined, the foreman of each gang and the operator of each piece of equipment submits in form a daily statement of the streets covered. In the case of mechanical equipment there are also included data as to gas and oil consumption. The garage reports and purchase orders furnish information as to repairs. The street mileage is secured for each day by means of a map scale and is converted into square yards by applying the average width of Akron paved roadways, 23.8 ft. The resulting yardage is listed as the performance of the equipment; it is a nominal performance and departs from the true in variable amount. Flushers for example cover the full area, whereas motor sweepers normally broom but a 7-ft. swath on each side of the street, or about 60 per cent of the pavement area. In all cases, however, instructions call for leaving the street clean and adherence to orders is insured by inspection. The clerical work resulting from this procedure is slight.

Methods of Cleaning—The methods of cleaning include hand brooming—by gangs or by patrol—flushing, and motor sweeping. The business area is cleaned at night. The difficulty encountered from the practice of sweeping out stores and walks in the morning after the roadway has been cleaned is met by sidewalk flushing. This work is necessarily confined to summer months and is patterned upon Chicago methods. Two horse-drawn, pressure flushers each of 700 gal. capacity are used. They are equipped with hose attached to a gooseneck swivel at the top of the tank. A driver and two men serve each flusher. The results are shown in Table I.

TABLE I—SIDEWALK FLUSHING, PERFORMANCE AND COST, AKRON, OHIO, 1921.

Performance		Cost	
Days operated	125	Labor and team hire	$4,182
Sq.yd. flushed	4,362,000	Water allowance	261
Gal. water per M. sq.yd.	375	Supervision	350
Sq.yd. flushed per gang per hr.	2,180	Capital charges	100
			$4,893
		Cost per M. sq.yd.	$1.12

Tables II, III and IV present summary costs covering handwork and mechanical cleaning.

	No 62 Pickup Sweeper Gutter Broom Attached 1920 Model			No 73 Pickup Sweeper Gutter Broom Attached 1920 Model			No 74 Pickup Sweeper without Gutter Broom 1916 Model			No 75 Gutter Sweeper 1920 Model		
Performance												
Number of Days operated	222			205			165			176		
Number of Hours operated	1702			1362			1095			1253		
Street Cleaned - 1000 Sq. Yd.	17809			23658			12107			12489		
Dirt Removed - Cu. Yd.	2478			3173			1691			–		
Costs												
Driver-Wages		$1414.00			$1058.00			$849.11			$831.45	
Helper-Wages		549.90			508.65			389.00			–	
Gasoline and Oil		637.11			536.05			364.53			289.97	
Total Operating			$2601.01			$2102.70			$1602.64			$1121.42
Repairs - Wages		711.68			614.12			865.52			512.09	
Repairs - Parts		585.31			488.76			882.04			776.70	
Total Maintenance			1296.99			1102.88			1747.56			1288.79
Tire Cost			–			–			–			–
Depreciation @ 5 Yr		1192.26			1092.79			828.00			720.00	
Interest @ 5%		331.19			303.55			230.00			200.00	
Total Capital Charges			1523.45			1396.34			1058.00			920.00
Total Cost			5421.45			4601.92			4408.20			3330.21
Units												
Cost per 1000 Sq. Yds.			0.304			0.195			0.36			0.267
1000 Sq. Yds. per Hour	10.46			17.37			11.05			9.96		
Cu. Yds. Dirt per 1000 Sq. Yd.	0.139			0.134			0.140			–		

COST OF MOTOR SWEEPING ...... 53,574,600 SQ. YD.
(PICKUP SWEEPING ONLY)

Machine Cost	$14,431.57
Pickup Truck @ 0.60 Cu. Yd.	4,405.20
Pickup Labor, estimated	1,230.00
Garage Rental (allow)	1,600.00
Overhead	2,980.00
TOTAL	24,646.77
PER 1000 SQ. YD.	0.46

TABLE II—SUMMARY OF COSTS ON MOTOR SWEEPING IN AKRON, OHIO, COVERING 53,574,600 SQ.YD.

	Truck No. 42, 1917, 5 Ton White Chassis, 1200 Gal. Studebaker Tank, Auxiliary Motor for Pump			Truck No. 71, 1919, 5 Ton White Chassis, 1500 Gal. Studebaker Tank, Auxiliary Motor for Pump		
Performance						
Number of days operated	185			245		
Number of hours operated	1,783			2,647		
Water—Million gallons	5,795			[illegible]		
Street flushed—Thousand Sq.Yd.	12,176			23,537		
Costs						
Driver—Wages		1176.69			901.46	
Helper—Wages		—			—	
Gasoline and oil		1002.69			844.90	
Total operating			2179.38			3746.36
Repairs—Wages		740.80			555.17	
Repairs—Parts		590.52			422.29	
Total maintenance			1331.32			977.46
Tire cost			178.19			
Allowance for water			930.00			1788.00
Insurance			174.25			174.25
Depreciation @ 5 Yrs		1223.46			529.58	
Interest @ 5%		339.85			424.89	
Total capital charges			1563.31			1954.47
Total cost			6356.45			8640.54
Units						
Cost per 1000 Sq.Yd. flushed			0.522			0.367
Gal. water per 1000 Sq.Yd.	476			473		
Sq.Yds. flushed per hour	6,580			9,610		

Cost of flushing 35,713,000 Sq.Yd.	
Machine cost	$ 14,996.99
Garage rental allowance	1,000.00
Overhead	1,610.00
Total	17,606.99
Per 1000 Sq.Yd.	0.493

TABLE III—COST OF FLUSHING 35,713,000 SQ.YD

Using 5-ton trucks fitted with either 1,200 or 1,500-gal. tanks the unit cost is found to be 0.493 cents per 1,000 sq.yd.

A summary of performance subdivided as to method is shown in Table V. This table does not include sidewalks flushing, catch basin cleaning, collection of paper from waste receptacles, snow removal or clearing pavements of debris resulting from extraordinary storm water wash—all these items being under division control.

TABLE V—SUMMARY OF STREET CLEANING COSTS AT AKRON, OHIO, 1921

Method	Sq. Yd. Cleaned	Per Cent of Total	Cost per 1,000 Sq. Yd.
Hand sweeping (gang)	37,378,600	24.1	0.98
(station)	15,748,600	10.2	0.81
Flushing	35,713,000	23.1	0.49
Motor sweeping	66,063,000	42.6	0.42
	154,903,200	100.0	0.61

Comparison of Methods—It is not practicable to eliminate hand cleaning. The practice locally is to concentrate most of the work into eight or nine months of the year. The amount of dirt on the streets after spring thaws is too heavy for the brooms; it must be removed by hand. The best results in residential areas are secured from alternate sweepings and flushing according to schedule. It is found less expensive and more satisfactory to clean periodically than to await littering of the street.

The flushers in use are of the two-unit type, and operate under 40 to 60 lb. pressure. It is difficult to maintain the auxiliary motor in working conditions, but the results are more satisfactory than when a single power plant is used. Although many pavements are built upon a sand base, pressure flushing has not been found to have an adverse effect. All division of street cleaning activities are under the control of H. R. Russell as superintendent. E. A. Zeisloft is Director of Public Service.

Hand Sweeping—Gang Work: Days Wk'd	Man Hours	1000 Sq.Yd. Cleaned	Cost: Labor	Cost: Foreman	1921 Month	Hand Sweeping—Station Men: Days Wk'd	Man Hours	1000 Sq.Yd. Cleaned	Labor Cost
[illegible]	[illegible]	[illegible]	$[illegible]	$[illegible]	Jan.	27	[illegible]	2,288.6	$[illegible]
[illegible]	3842	1,493.6	1,930.10	390.75	Feb.	[illegible]	[illegible]	1,662.7	[illegible]
27	4592	1,537.0	2,206.50	470.10	Mar.	30	[illegible]	2,523.6	1,623.27
26	4843	2,408.0	2,252.80	456.95	Apr.	30	[illegible]	2,570.7	1,572.02
26	3601	[illegible]	1,426.09	459.85	May	31	2878	[illegible]	1,203.40
26	6147	4,853.1	2,446.00	565.90	June	30	840	[illegible]	336.00
28	5575	5,350.7	2,229.60	616.75	July	31	758	658.6	309.60
27	5888	4,818.8	2,355.20	637.30	Aug.	31	828	630.5	[illegible]
26	5107	5,398.9	2,050.00	626.40	Sept.	25	974	1,202.0	[illegible]
27	2175	3,679.0	903.75	637.45	Oct.	31	630	390.4	[illegible]
25	1644	2,731.2	657.60	622.50	Nov.	30	619	481.5	[illegible]
24	995	1,325.5	398.00	99.60	Dec.	30	214	103.7	85.60
309	**47592**	**37,378.6**	**$20,504.69**	**$5,952.55**	**Totals**	**353**	**16867**	**15,748.6**	**$8,924.24**

Gang Work		Station Men	
Labor	$26,457.24	Labor	$8,924.24
Pickup @ 0.60 CY	9,000.00	Pickup (estimated)	3,230.00
Overhead	1,275.00	Overhead	530.00
Total	36,732.24	Total	12,684.24
Per 1000 Sq.Yd.	0.983	Per 1000 Sq.Yd.	0.806

TABLE IV—SUMMARY OF COSTS OF HAND SWEEPING AKRON STREETS

It has not been found practicable to [illegible] hand cleaning. [illegible] streets that are difficult to clean [illegible] cents per 1,000 sq.yd., and by Station men [illegible]

How Portland Supplies Water Outside City

The terms under which the city of Portland, Ore., stands ready to supply water outside the city limits have been formulated by the Bureau of Water-Works, of which L. S. Kaiser is superintendent. On petition, and after making estimates of costs and revenues, and finding a given project feasible, the bureau will contract for water with (1) the council of an incorporated country town; (2) with country residents who by vote form a water district under which the property benefited is assessed for first cost of the improvement; and (3) with regularly organized water companies. In any one of the three cases the party contracting with Portland for water has to build a main up to the city line and install a water meter there to measure the entire volume of water supplied by the city. As a rule, the outside water authority requires individual users to provide meters. The meter rate per 100 cu.ft. charged by Portland for water sold outside the city is 16⅔c. for the first 600 cu.ft.; 12½c. for the next 20,000 cu.ft., and 10c. for all above 20,000 cu.ft. The city charges a minimum of $1 a month for each town, district, or company which it supplies.

Road in Inaccessible Canyon Built by Novel Method

Grading Job in Oregon Done Speedily by Laying Out the Work in Successive Stages for Power Shovels of Different Sizes

IN BUILDING a road twenty miles long up the Clackamas River in Oregon to the site of the Oak Grove power development which is being undertaken by the Portland Railway Light & Power Co., it was necessary to follow the steep banks of the stream through a nar-

TYPICAL CONDITIONS MET BY GAS-ELECTRIC SHOVELS

Brush and timber were removed and narrow roadway built ahead of gas shovels. Wagon used for hauling dynamite has $3\frac{1}{2}$-ft. gage.

row valley in a region so rough and inaccessible that construction equipment could be gotten to the proposed line only at the lower end. By operating in the usual way, however, at one end of the work only, the desired speed could not be made and consideration was given to gettig small power shovels up the river on barges so grading could be carried on simultaneously from several different points. A still better plan was finally worked out whereby a small gas-electric shovel was advanced very rapidly over the proposed route, followed by a similar shovel that widened the roadbed and was in turn followed by still other shovels of standard size that could handle the heavier grading in the most economical way.

The first step was to clear the right of way and at the same time to grade by hand methods a trail wide enough to accommodate a wagon with a $3\frac{1}{2}$-ft. tread. Two such wagons were built and used to convey supplies to the clearing camps maintained ahead of grading operations. The first gasoline-electric shovel began at the lower end of the work and did just enough excavation to enable it to move ahead. In this way, by working three eight-hour shifts, it was advanced $8\frac{1}{2}$ miles in $2\frac{1}{2}$ months, through extremely rough country, leaving a roadbed for the most part about 8 ft. wide. The crews ahead of this shovel, in addition to clearing the right of way, blasted rock ready for excavation, using heavy charges so as to facilitate handling with the $\frac{3}{4}$-cu.yd. dipper. Tractors working behind the shovel were used to remove stumps and operate graders and scrapers in surfacing the roadway across flat country.

The second gasoline-electric shovel was started out immediately after the first, but was expected to handle more yardage and make slower progress. It cut the grade to the prescribed 5 per cent maximum and increased the width of the bench cut to 14 ft. except where long slides or excessively heavy grading was encountered. Steam shovels of standard size came last and completed the work, handling the bulk of the yardage where the cuts were deep and heavy.

Gas-electric shovels were selected for the advance work because of their small size and light weight, the low haulage cost on fuel of this grade and also because of the low fire risk. Because the line traverses heavily timbered country, during the summer season the fire risk was an important consideration.

At first the light for night work was supplied by a generator driven by the main engine on each gas-electric shovel. As this left the work in darkness when the main unit was shut down for repairs or for other reasons, a separate lighting system was provided, consisting of a Delco storage battery set mounted on a sled. From this leads were run to projectors and lamps placed on the shovel or to convenient points scattered about the work.

Only two men were regularly employed on each gas-electric shovel crew, one of these operated the control mechanism while the second acted as helper and made himself generally useful on the ground. The advanced shovel, working three 8-hour shifts, advanced at times as rapidly as 15,000 ft. in twenty days.

The work was taken over under the present contract on May 8. Two and a half months later the first shovel had progressed $8\frac{1}{2}$ miles; the second, a similar piece of equipment doing more extensive grading, had advanced $4\frac{1}{2}$ miles, and the heavy work was being handled effectively by the steam shovels. The last operation in the

GAS-ELECTRIC SHOVEL WIDENING NARROW ROAD

This was the advance shovel, whose function was to make speed. Over a period of 20 days it made average daily progress of 750 lin.ft. in 24-hr. day.

construction of the road is to be the placing of a 15- to 18-in. rock base covered with crushed rock and rolled with 10-ton steam rollers.

The plan of construction by successive stages was worked out by the Hurley-Mason Co., contracting engineers, Portland, Ore., who are constructing the road under contract for the Portland Railway Light & Power Co.

Placing Concrete By Several Methods on Same Job

Chuting, Batch Boxes Moved by Crane and on Trucks and Buggies All Needed in Building New Bridge at Bethlehem, Pa.

In the construction of the Hill to Hill bridge at Bethlehem, Pa., a structure being erected under the supervision of the Bethlehem Bridge Commission by Rodgers & Hagerty, New York City, the concreting plant layout is such that concrete can be chuted to piers and arches on practically all of the work. However, at the extreme ends of the three main approaches and at other more or less inaccessible points, other methods of handling concrete had to be devised. In all, four methods are used.

Mixing Plants—The bridge proper is about 2,000 ft. in length but with the approach ramps and the three main approaches this length is extended to about 6,000 ft. By referring to the accompanying figure the difficulty of devising one system to handle all concreting work is apparent. To handle the heaviest portion of the concreting both in piers and arches, the chuting system as indicated in the accompanying figure was devised. Inasmuch as the two mixing plants (also indicated in the figure) were utilized to mix for tranportation to those portions of the bridge inaccessible by chuting, large capacity mixing plants were required. Each of the two concreting plants was fitted with two 1-yd. mixers, a sand bin holding about 400 cu.yd., a stone bin of 800-cu.yd. capacity and cement sheds holding approximately 1,000 bags each. Sand and stone is clamshelled from stockpiles at the mixing stations into the bins.

Handling concrete by chutes is carried on with little difficulty and as many as 600 batches were chuted an average distance of 400 ft. during a ten-hour day. The chuting plant consists of three towers one 160 ft., another 240 ft. and the third 200 ft. high and approximately 3,500 lineal ft. of chuting of various types. In addition approximately 18,000 ft. of cable guys and chute supports are needed. Cable guys are of $\frac{5}{8}$-in. and the chute supports $1\frac{1}{4}$-in. steel cable.

The second method of placing concrete was used at the south approach and will be used on the approach ramps at the southern end of the bridge. A locomotive crane which had been used in excavating for piers and abutments at the south approach was also used in handling concrete batch boxes from trucks to placement points in piers and abutments.

Handling Concrete by Truck—For other points, concrete is handled by batch boxes hauled in trucks from the two mixing stations. Each truck usually carries two 1-yd. steel batch boxes, except in those instances where spilling outside the forms is not feared. In that case larger batch boxes are used. Where possible these batch boxes are handled direct by derrick from motor truck to pier forms. This method was possible on piers just outside the radius of operation of the 200-ft. tower on the northeast approach. On the southeast approach concrete is handled first by batch box and truck, then dumped to an inclined material bin and transported to place by concrete buggies.

A feature of this job is the use to which stiff-leg derricks with 80-ft. booms are used as anchorage points and redistribution towers for the chuting system. The derricks were mounted on 40-ft. timber towers. The utility of such a scheme is fully recognized by referring to Fig. 2.

Materials and Their Procurement—Approximately 107,000 cu.yd. of concrete will be placed in the entire structure. Of this the amount in footings and piers will be about 46,000 cu.yd. and the rest in the superstructure.

All cement is trucked from Bath and Allentown, Pa. So far the contractor has discovered that cement costs less by using this method of transport than by the rail-

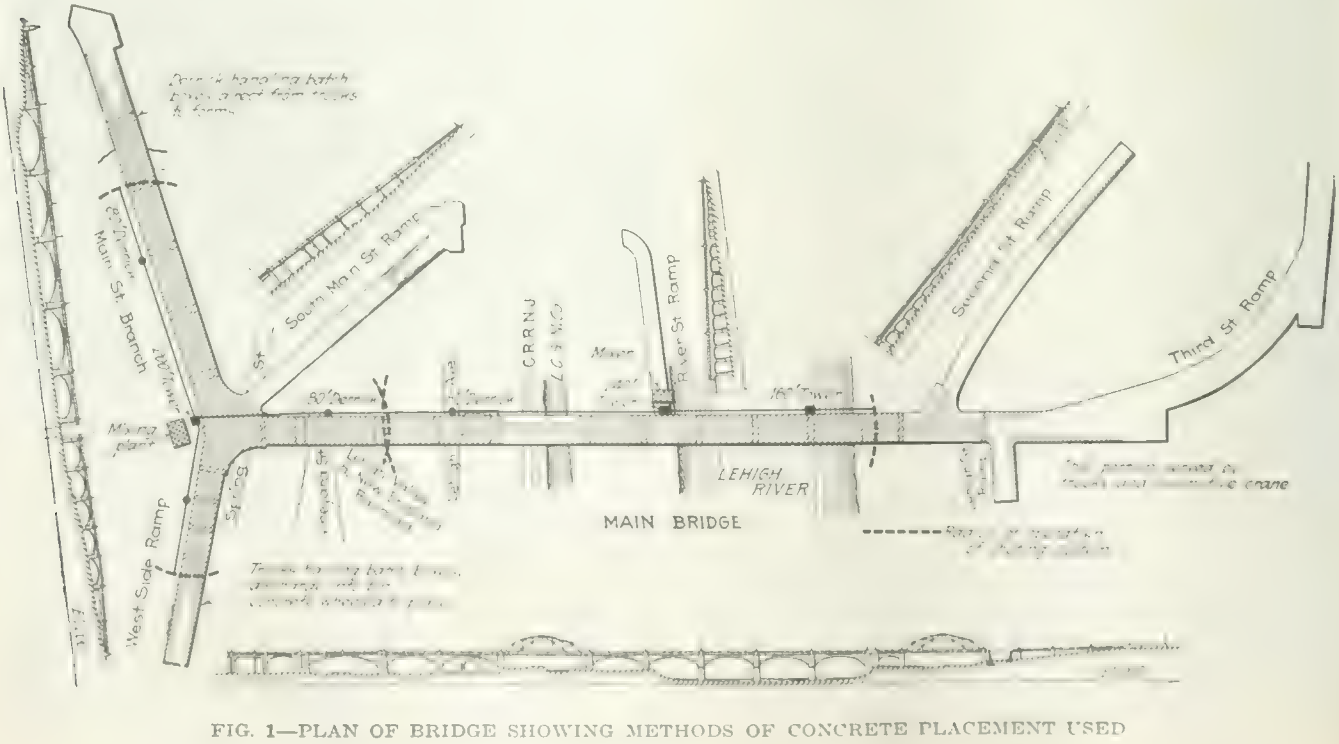


FIG. 1—PLAN OF BRIDGE SHOWING METHODS OF CONCRETE PLACEMENT USED

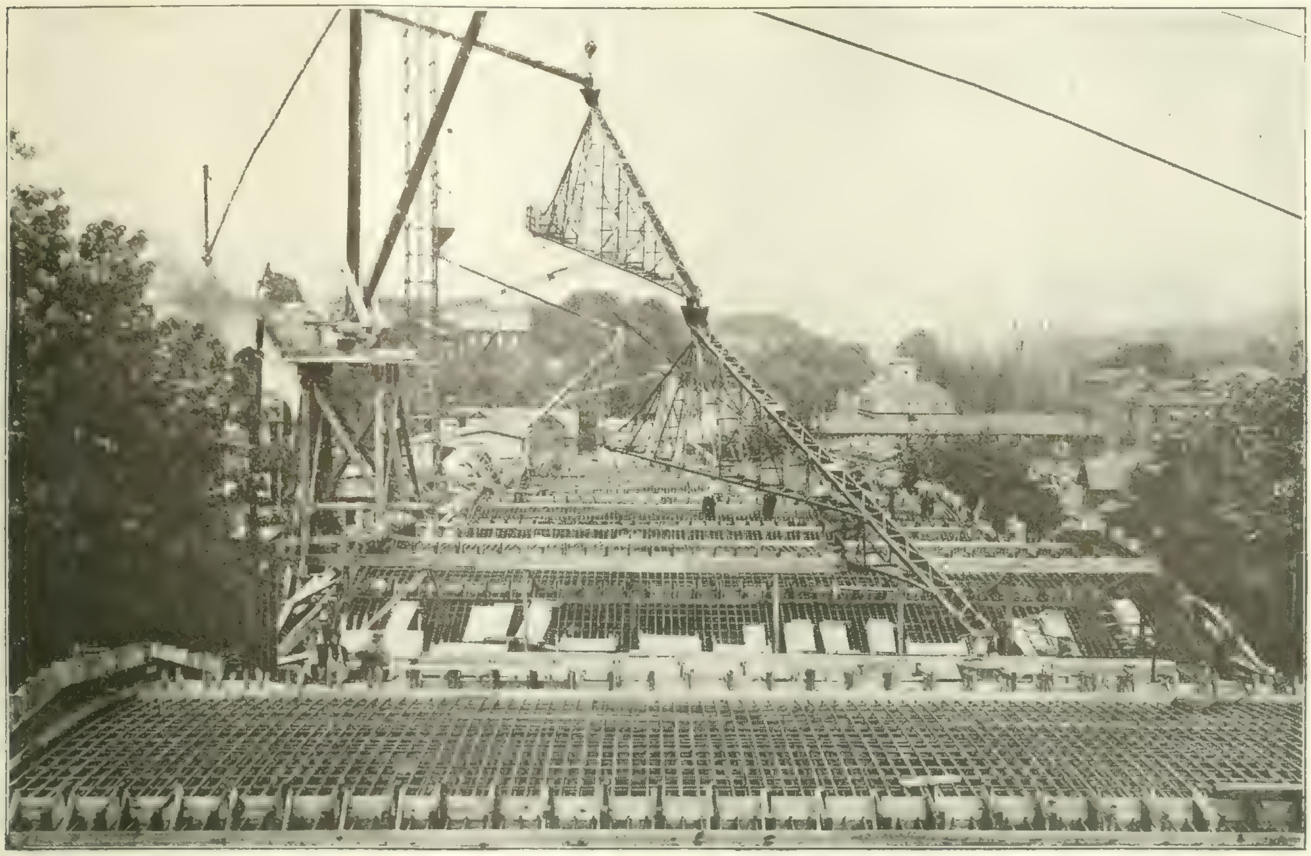


FIG 2—STIFF LEG DERRICKS MOUNTED ON 40-FT. STAGING ARE REDISTRIBUTION TOWERS

road. Rehandling charges necessitated by rail haul is a saving the trucks effect.

The contractor has opened his own stone quarry about a mile and one-half from the bridge site. There is being operated a quarry face about 70 ft. high and with a length of 200 ft. Three crushers have been installed, a primary jaw crusher 24 x 36 in. and two secondary gyratories. The smaller of the secondary crushers is used for crushing screenings. There is a scalping screen used from the jaw to the gyratory crushers for removing the dirt from the stone. About twenty men are employed in the quarry and it is estimated that 100,000 tons will be used from this quarry.

Clarence W. Hudson is the designer of the bridge and consulting engineer to the Bethlehem Bridge Commission. H. J. Finebaum is resident engineer for the Commission. W. Caccia is resident engineer for Rodgers & Hagerty, the contractors, with George Angel as general superintendent.

The cost of the bridge will be in the neighborhood of $2,500,000. It will be completed early in 1924.

Health Ministry Rules for Refuse Tips

Suggestions for preventing nuisances at municipal refuse tips have been formulated by the British Ministry of Health. The main point of the suggestions are that refuse be tipped in layers which should not exceed 6 ft. in depth, and should be covered wherever exposed to the air with "at least 9 in. of earth or other suitable substance"; that reasonable precautions should be taken to prevent the breeding of flies, the breaking out of fires, or the blowing about of paper, etc.; and that so far as practicable each layer of refuse should be given time for settlement before another is added.

Relative Durability of Native Wood

A TABLE showing the relative durability or resistance to decay of untreated woods has been prepared by the Forest Products Laboratory. Service records and information collected by the laboratory form the basis of the table but it is stated not enough records exist on some of the woods to be accepted conclusively and the rating is subject to correction. The table follows:

RELATIVE DURABILITY (RESISTANCE TO DECAY) OF UNTREATED WOODS

Durability of commercial white oak taken as 100 per cent

Conifers

Cedar, eastern red (juniper)	150-200	Pine, pitch, sugar	45-55
Cedar, southern white	80-100	Pine, shortleaf	60-80
Cedar, other species	125-175	Pine, So. yellow (dense)	80-100
Cypress, bald	125-175	Pine, western white	65-80
Douglas fir (dense)	75-100	Pine, white	70-90
Douglas fir, (ave. mill run)	75-80	Pine, western yellow, pond, loblolly, lodgepole	35-50
Fir (the true firs)	25-35	Redwood	125-175
Hemlock	35-55	Spruce, Engelmann, red, Sitka, white	35-50
Larch, western	75-85	Tamarack	75-85
Pine, jack	35-45	Yew, Pacific (western)	170+
Pine, longleaf, slash (Cuban)	75-100		
Pine, Norway	45-60		

Hardwoods

Ash	40-55	Gum, red	65-75
Aspen	25-35	Hickory	40-55
Basswood	30-40	Locust, black	150-200
Beech	40-50	Locust, honey	80-100
Birch	[illegible]-50	Magnolia, evergreen	40-50
Butternut	[illegible]-70	Maple	40-50
Catalpa	125-175	Mulberry, red	150-200
Chestnut	100-120	[illegible]	40-55
Cottonwood	30-40	[illegible]	100
Elder, pale	[illegible]-35	Oak, chestnut	70-90
Elm, cork (rock), slippery	65-75	Osage orange	[illegible]
Elm, white	[illegible]-70	Poplar, yellow	40-55
Gum, black, cotton (tupelo)	30-50	Sycamore	[illegible]-45
		Walnut	100-120
		Willow	30-40

Cleveland's Westerly and Easterly Sewage-Works in Use

Design Based on Dry-Weather Flows of 32 and 92 M.G.D.—Bar Screens, Grit Chambers, Imhoff Tanks and Disinfection in Bathing Season—Multiple Lake Outlets

By George B. Gascoigne
Consulting Sanitary Engineer, Cleveland, Ohio

During the past ten years the City of Cleveland has spent about $2,500,000 in experimentation, design and construction of sewage-works looking forward to the time when objectionable conditions about sewer outlets should be abated and corrected and the bathing beach waters safeguarded. The general plan adopted is to collect the sewage from the entire city at three separate outlets, each outlet serving a district and the point of concentration serving as a sewage-works site. The three districts are the Easterly, comprising about 50 per cent of the population; the Westerly, 30 per cent;

VIEW OF WESTERLY SEWAGE-WORKS, CLEVELAND
IMHOFF TANKS AND VARIOUS BUILDINGS

and the Southerly, 20 per cent. A low-level district of small population will have to be provided for otherwise. During the past two months two plants have been placed in operation, one located on the lake front at the Easterly outlet, which affords but partial treatment, and the other on the lake front at the Westerly outlet, which is complete in every detail. The plant at the Southerly outlet has not yet been put under construction nor funds for it provided. A bond issue to complete this portion of the project will be submitted to the people in November.

Westerly Works—The Westerly sewage-works comprise large hydraulically-operated sluice gates to control the sewage flow as it enters the plant; bar gratings to remove the coarser substances in suspension and to permit the successful operation of the tank structures; grit chambers to remove sand or inorganic matter; Imhoff tanks to remove the suspended matters which are capable of settling; disinfection equipment operated during the bathing season to destroy disease-producing organisms which remain in the tank-treated sewage; and a multiple submerged outlet to disperse the treated sewage about 3,500 ft. off shore in 35 ft. of water where the organic substances in solution are oxidized by lake water. The settled matter or sewage sludge, after remaining in the Imhoff tanks about six months for digestion and storage, will be barged for the present in its wet condition to the United States Government dumping grounds off the end of East 105th St., where it will be dumped as the dredgings from the Cuyahoga River have been for several years.

Two large interceptors for carrying combined sewage, with storm overflows of the overfall-weir type, cross the westerly part of Cleveland and discharge the sewage at the Westerly works. Generally speaking, the sewage is fresh, although devoid of oxygen at certain seasons of the year, and contains at times large quantities of industrial wastes, principally pickling liquors. Such wastes are present at times in such quantities as materially to affect the degree of purification the plant will accomplish.

The design of the westerly works is based upon an etsimated population of 288,000 persons. The population tributary to the plant when it was placed in operation July 1 is estimated at not over 200,000 persons. The average dry-weather flow for which the plant is designed is 36 m.g.d., while the maximum wet-weather flow receiving some treatment is 159 m.g.d. All devices of the works will treat at least 2½ times the normal dry-weather flow.

Easterly Works—The Easterly works are identical, generally speaking, with the Westerly works except that they are on a larger scale and that the settling tanks have for the present been omitted. It has been necessary to provide a pumping station with a maximum capacity of about 20 m.g.d. here, while the grit chambers have been entirely covered over by a brick building.

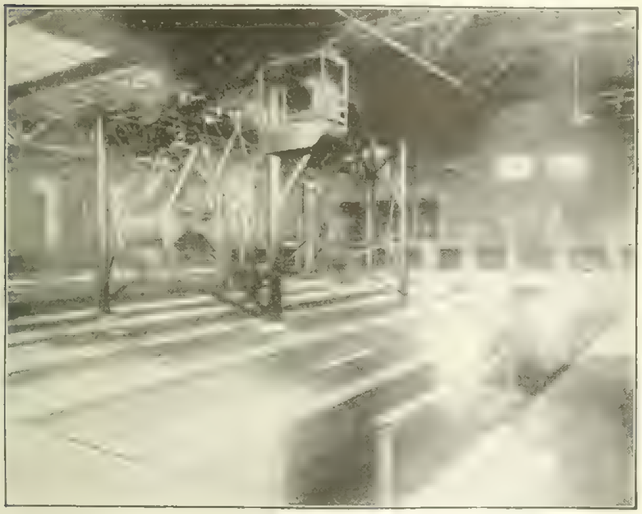
The Easterly plant will treat sewage which is entirely devoid of oxygen at certain seasons of the year. While the sewage contains large quantities of industrial wastes these wastes are so diluted by the domestic sewage that their presence is not patricularly noticeable. The design of the works is based upon an estimated population of 580,000 persons and the average dry-weather flow is estimated at 92 m.g.d. The maximum wet-weather flow reaching the works is approximately 1,000 m.g.d. daily.

Special Features of Works—Some of the special features of these works which may be of interest are outlined below. Sluice gates hydraulickally operated by pressure obtained by means of a booster pump control the sewage flow into the various grit chambers and channels. The grit chambers have pockets for collecting the grit in order that its removal may be facilitated by means of an electrically-operated clam-shell hoist which travels on a monorail. The 16 Imhoff tanks, which are built on natural foundations without piles, occupy a total area of about an acre, the entire tank structure being built in eight independent units so that should trouble develop in any of the units a large percentage of the plant can be kept in operation during repairs. Between the tanks there are constructed two galleries for removing sludge, operating the perforated water lines around the hoppers and emptying the tanks, should this be found necessary, through special drains in the bottom. Skimming chambers are provided at the entrance to each flow compartment of the tanks. The

gas vents are closed with hinged wooden covers. Owing to the lack of isolation the tanks are constructed in such a manner that they can be housed over should subsequent conditions make it necessary.

The sewage flow through the plant is measured by a Venturi meter having the necessary recording equipment. During the bathing season the effluent from the Imhoff tanks just after passing the meter is treated with liquid chlorine. The chlorine is applied by machines, recently developed, in which measured quantities of chlorine are dissolved in water in an ejector. The water solution of chlorine then flows by gravity to a grid where it is applied to the sewage through perforations. Upon the disposal areas there are substantial brick buildings of the type of architecture which is necessary to make the buildings blend with the surrounding park grounds and boulevards.

Construction—The construction of the work has included about all of the difficulties which can be encountered upon work of this kind when carried on during war times. For this reason the construction work has been long drawn out but in spite of these difficulties it is believed that substantial structures have been provided. The contractor for the westerly works was the Masters & Mullen Co. of Cleveland, while the American Construction Co., of the same city, built the easterly works. Of special interest in connection with the westerly plant is the fact that the flow partition walls were built by the cement gun.



EASTERLY SEWAGE-WORKS, CLEVELAND, OHIO
Showing covered grit chambers, sluice gates and grit removal equipment.

Operation—The operation of the sewage-works is financed by the Water Division of the Public Utilities Department. This circumstance is as it should be and it will permit operating the plants in a scientific and practical manner. A. B. Roberts is director of public utilities and A. V. Ruggles commissioner of water.

The results accomplished to date at the Easterly works in the removal of coarse suspended matter by bar gratings has been better than expected. In fact, the effect upon the bathing beach waters has been readily noticeable by those who have occasion to use the beaches. The grit chambers have been found to function efficiently and the method of removing grit is being applied satisfactorily. Although operating data are meager, they are sufficient to substantiate the conclusion stated above. At the westerly plant the effluent from the Imhoff tanks is satisfactory.

The construction of the plants has been under the general supervision of Robert Hoffmann, commissioner and chief engineer, with the writer in actual charge. A. B. Burger was resident engineer on the easterly works and J. M. Heffelfinger on the westerly works. The operation of both plants is under the immediate supervision of F. W. Jones, who formerly operated the Fitchburg works, with the writer as consulting engineer.

Financing the Works—The main sewerage improvements for the City of Cleveland have been in accordance with formal orders of the State Board of Health. The board required eliminating the foul and objectionable conditions in the Cuyahoga River and the lake front waters which are due to sewage pollution. Originally improvements to abate these nuisances were to be in operation by July, 1915, and February, 1918, respectively. On account of the experimental work and the war it was necessary to have the time for the completion of the works extended.

By proceeding in accordance with formal orders of the State Department of Health it was possible to finance the improvements outside of the normal bond and tax limitations of the city. Furthermore, only a majority vote is required for approval of such bond issues.

Tar Heater Ignites Wood Floor Through Sand

In investigating the cause of a fire which occurred on the roof of the U. S. Treasury building in Washington on May 3, while re-roofing work was going on, the Bureau of Standards made some experiments which show that heat transmitted downward from the kerosene burner of a tar heater is likely to set fire to woodwork below unless at least 6 in. of insulating sand cushion is used. Even with a 6-in. insulation the rise of temperature in a wooden floor under the sand cushion was dangerously high. The tests were made with thickness of sand cushion ranging from 2½ to 6 in. in thickness, laid on a double layer of metal sheets on a double board floor 1¾ in. in total thickness, resting on 2x10 joists; in each case the sand was covered with roofing slate ⅜ to ½ in. thick, laid close, and the bottom of the burner was 2¾ in. above the slate. In preliminary test runs with this apparatus, the woodwork of the floor charred somewhat, and as this condition would naturally occur in practice, and as the charring would increase the danger of ignition, some powdered charcoal was placed on the floor boards in the later tests. With this arrangement, in the case of 2½-in. sand cushion, fire was noticed in the floor within less than 5½ hr. after the burner was started up; in the case of 3½-in. sand cushion within less than 7 hr. (but smoke was seen coming from cracks in the floor nearly 2 hr. earlier); and in the case of 4½-in. sand cushion within less than 9 hr. With 6-in. sand cushion a run of two days was made, the first day's run being about 10 hr. and the second day's run about 12 hr., and temperatures ranging from 175 to over 200 deg. C. were reached on the wood, with much charring, but no fire started. In all the tests the layer of slate increased the protection markedly; a special run made without the slate layer resulted in earlier ignition of the wood, though under conditions not strictly comparable with the corresponding tests with slate.

Alternate Lime and Iron with Alum to Reduce Sand Size

CHEMICAL treatment of the Toledo water supply with lime and iron during the last two months in 1920 and first two in 1921 increased the incrustant deposits on the sand grains by 39 per cent and greatly lowered the efficiency. In the last annual report of R. W. Furman, chemist in charge, to George N. Schoonmaker, assistant commissioner, it is stated that subsequent alum treatment removed a portion of this coating and rendered the remaining incrustation semi-porous. Upon again changing to an iron-lime treatment in May a cementing action was started which was not thoroughly broken by washing the filters, and, aided by the porosity of the sand incrustations, entrained sufficient organic material to become heavy and later start the formation of mud balls in two of the filters. There was no surface indication of this disturbance which caused considerable trouble in July. Large quantities of Bryozoa were deposited on the sides and wash troughs necessitating daily cleaning and scrubbing to effect a removal. These troubles were overcome by a change in the wash methods and were assisted by the use of an alum treatment which was continued until the incrustation was partially removed.

The hardness of the water was comparatively uniform throughout the year although some increase was noted in the filtered water while using an alum treatment which was due to the removal of the filter incrustants.

Notes from the Intermountain Country

By W. W. DeBerard

Western Editor, *Engineering News-Record*

Denver and Pueblo

FOUR matters of public interest are vital to engineers in Colorado at the present time: Highways, waterworks, flood control and the Moffat tunnel.

Highways—More than a million people visited the national forests in Colorado in 1921 and more than a quarter of a million visited the Rocky Mountain National Park which is just outside the confines of Denver. The tourist crop, therefore, is an extremely large and important asset to the state. Under modern traffic conditions, highways are a decided essential toward keeping this tourist crop in a flourishing condition. For the last year or so the state highway department has been following a consistent policy of developing the system as a whole rather than piecemeal. This policy has been made possible by reason of the fact that the administration of the department was vested in a single individual rather than in several appointees from different parts of the state with a constituency to please, as was the former case. It is generally considered that the state is now getting more nearly than ever before value received for the money expended. The engineers have not been behind other public-spirited organizations in following the work of the highway department, and in consequence when the chief engineer, Major L. D. Blauvelt, was called to the chief engineership of the

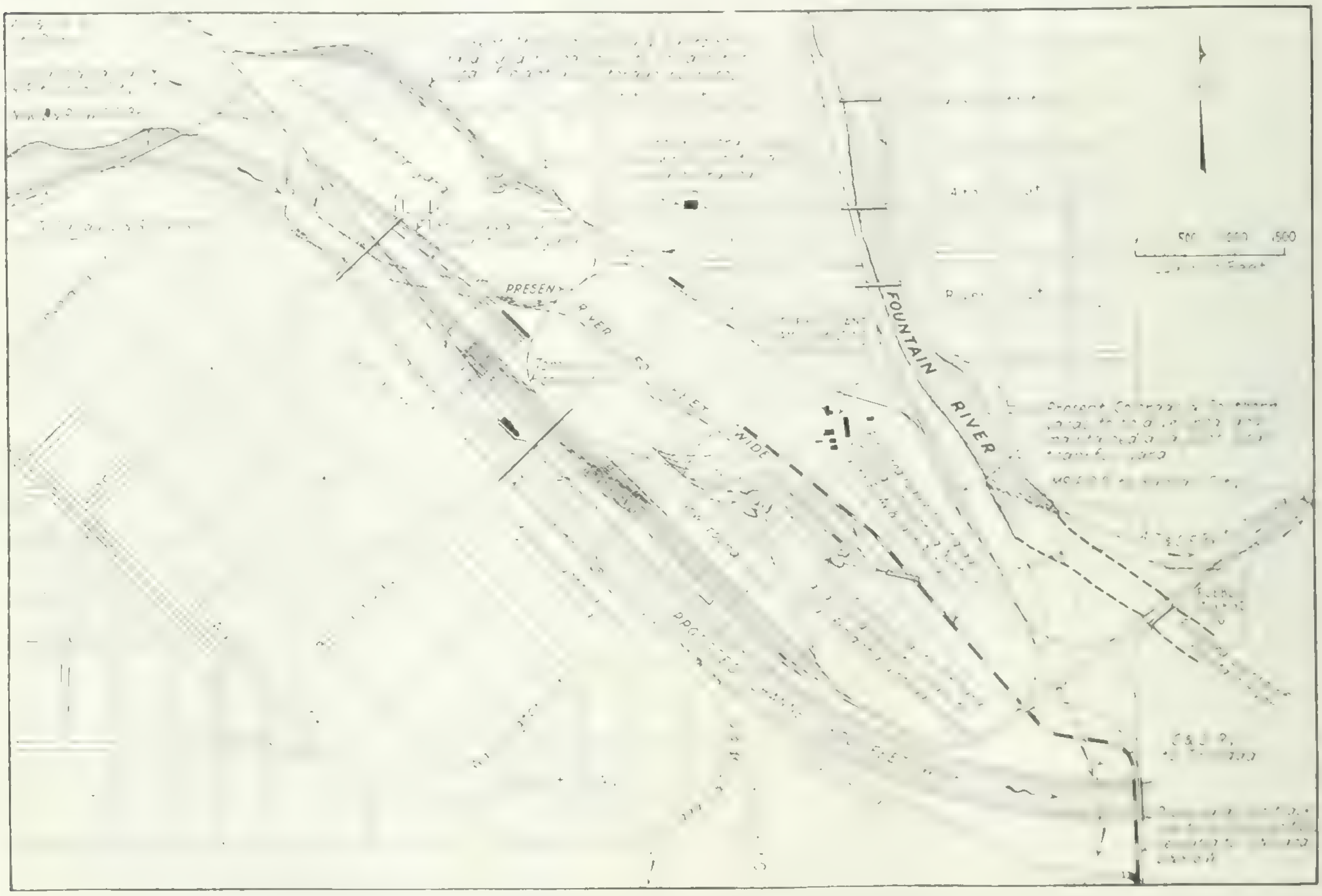


FIG. 1—PROPOSED FLOOD PROTECTION IN PUEBLO BY RELOCATED CHANNEL

Moffat Tunnel Commission, the engineers immediately expressed their opinion to the governor as to the choice of his successor. In Colorado there is a continuous fight between Denver and the rest of the state every time an office is to be filled by appointment. Whether it is political or not there is likely to be an alignment of these two interests. The engineers are alive to this situation and, in the interest of good engineering service and the best welfare of the state as a whole, must keep it constantly in mind.

While road contracts are being let continually and about $11,000,000 is available for construction and maintenance, one of the surprising things that one finds is the lack of all-weather pavements from Denver to the Mountains. Not much hard-road paving is being done in Colorado, but nevertheless trucks and heavy bus transportation similar to that on the Pacific Coast are coming in fast. Buses carrying 18 to 20 passengers now run on schedule between Denver, Pueblo, Canyon City and the Royal Gorge. These buses have a 68-in. tread instead of the usual 56-in. tread and surely require the construction of hard pavements for the country roads if the latter are to hold up under the traffic.

It is likely that the highway department employs as many engineers as are employed by all of the railroads coming into the state, so that the engineering profession is decidedly interested in the highway situation.

Water Problem—For the last quarter of a century the water-works of the city of Denver has been a political football. Buying out the company and putting the plant in the hands of a commission appointed by the mayor apparently has not taken it out of politics. It is not intended to imply that those who are in charge are playing politics now, although they are accused of doing so by Denver's leading newspaper and many citizens. But it is quite certain that the newspapers and many outside are playing politics. Through all the 26 years with which I have been conversant with the Denver problems there has never been a time when the engineer in charge was not loyally and faithfully doing the best he knew how to render service, and most of the time service was rendered. From the sanitary standpoint few cities have a water as carefully guarded. The supply has been under laboratory control for more than a quarter of a century. It is true pressure was not always available in high areas during the summer peak load, but it is also true that the engineer has never had money enough to furnish the unlimited supply which an unmetered system at peak load always demands. The situation this past summer has been acute, with the consumption at times 10,000,000 gal. more than the available capacity of the pipe lines from the mountain supplies to the city reservoirs. Reliance on the low night-time flow and an occasional thundershower period to replace the depleted city storage is precarious. For the last five years a water famine has faced Denver nearly every summer. It seems that it actually must be experienced before finances are provided to avoid it.

All summer long the reports of the commission of experts has been looked for. A plan behind which enough interest can be rallied to put through a bond issue to provide funds for immediate extension is the aim. It will be recalled that a year ago at a bond election the proposition to issue $5,000,000 was defeated. The commission was appointed at the suggestion of the Denver Civic and Commercial Association with the idea of creating confidence in the mind of the voter. Judging from newspaper accounts anything but this result has been accomplished so far. It remains to be seen whether the report of this commission of outside experts is going to be respected and backed or discredited as too many consulting engineers recently have found their reports treated in western cities. How engineering societies are to treat expert reports is a

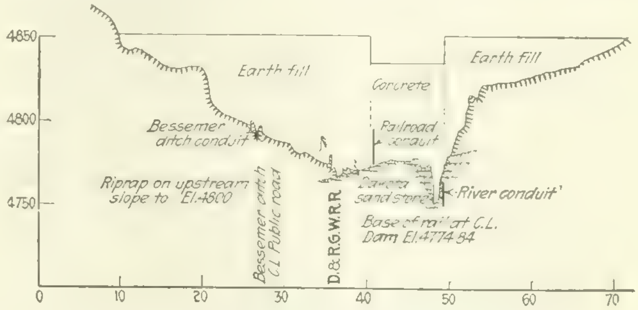


FIG. 2—PROFILE OF PROPOSED ROCK CANYON RETENTION DAM

problem easy to talk about in the abstract but decidedly troublesome in practice. If engineers refuse to accept the findings of their fellows how is the public expected to place much credence in the profession as a whole. The attempt to throw the question of technical decisions into the hands of the common voter should certainly not be the aim of any member of the professeion. This subject may not be a question of ethics but it is near to it. All over the country the same problem arises continually. Engineering societies might with profit discuss the question of handling expert reports from the ethical standpoint.

Pueblo also has a water problem of no small dimensions. It has a North Side commission and a South Side commission, each with a full set of officers and operators. For one of the plants a 4-mile stretch of 24-in. conduit has about reached the end of its useful life. Funds for replacement will be hard to raise and the question of uniting the two systems will undoubtedly complicate the matter, as will the choice of material. Just how far the engineering profession in Pueblo will interest itself in this semi-political and professional problem remains to be seen.

Flood Control—The floods at the end of July in Denver, which carried away several bridges, may activate and bring home anew to the citizens of the state the value of the recent conservancy act, enacted mainly for the benefit of Pueblo. Until the floods of last June Pueblo was a hide-bound town controlled largely by a few large interests. Much public consciousness has been awakened by the late disasters, when 120 lives were lost and 140 individuals were reported missing or unaccounted for, together with a property loss of $20,000,000, due to an estimated peak discharge of nearly 100,000 sec.-ft. D. P. Gaymon, city engineer, states that the city has been very materially waked up. Paving, sewers, waterworks and flood prevention, together with improvements of bridges and viaducts are all being considered seriously. Nearly a million yards of paving by special assessment is being put down. Storm sewer designs are on the boards but must await final decision as to the type of flood protection provided.

As to the flood situation, the county and city commissions have been working in harmony with the com-

mercial organizations and undoubtedly a decision on a choice of one of the three plans which have been worked out by the Dayton-Morgan Engineering Co. under Burton Jones, the resident engineer, will be wisely made. Of the few engineers interviewed there did not seem to be much difference of opinion as to the superiority of one of the plans. The first plan contemplates a storage detention reservoir; the second, an enlargement of the present channel in its present location; the third, moving the present channel to the south bluff of the flood plain and re-locating practically all of the railroad yards, many of which now run transversely across the flood plain. The last plan, shown in the map herewith, is considered the best because it will give the town and the railroads more for the money than either of the other two. This new channel near the south bluff would care for 250,000 sec.-ft. The old channel was constructed for 40,000 sec.-ft. while the flood was approximately 100,000 sec.-ft. Investigations of the engineers indicated that only a comparatively short transfer of the storm center to the west last June would have increased the crest discharge enormously. Plan 3 will require the removal of the present railroad tracks to the opposite side of the Union station and will eliminate the short and inconvenient transverse yards to the north and the south of the station. In their place will be a set of long tracks running parallel with the river and flood plain. Much economy of time and operating expense will be obtained by straightening out the tangle of railroad tracks.

A site for a dam to retain sufficient water so that only 35,000 sec.-ft. may pass has been found. The dam can be located on bed rock now exposed (Fig. 2). It will provide safety, but it has no civic betterment features or any but extremely infrequent usefulness. The railroads will probably be in favor of the dam project unless they can be successfully sold by engineers on the ultimate economy of the project to relocate the channel.

Engineers over the country may have the idea that Pueblo has been laying down on the job. This is decidedly not the case. The solution of the problem has been worked out fairly well in detail. Progress is being made as fast as the legal red tape with reference to the conservancy district plan can be unwound. However, the necessity for speed is nowhere more evident than in Pueblo as may be illustrated by the following incident: Recently a large opera house in the affected district burned to the ground. It is stated that financial interests will not furnish sufficient money to the owners to permit them to clean up the debris, even from the sidewalks, until the flood protection is assured.

Further activities which have been carried on since the Dayton-Morgan Engineering Co. took over the work are evidenced in the reconstruction of the broken levee above town and the building of a line of retards along Fountain River to protect valuable residence districts from a caving bank, and in the strengthening of bridge foundations which were found in a precarious condition. In the construction of the retards old rails were driven 10 ft. apart into shale and covered with No. 9 fence wire. Brush was piled loosely back of this fence. Already a material deposit of silt has been made by a single small flood. It was my observation that the Pueblo situation is in the hands of a united commercial and official city in accord with the engineers. Although the latter have no small problem ahead of them in educating the public to the plan best not only from an engineering but a civic standpoint, they will succeed.

Moffat Tunnel—For more than a century engineers have dreamed of the economy and usefulness of tunneling the range almost directly west of Denver. Ever since the construction of the Denver & Salt Lake R.R. the project has been especially attractive, for Denver would then be put on the shortest and most direct transcontinental route. The road opens up a new empire with anthracite coal fields rivaling those in Pennsylvania, abundant gilsonite, oil shales, timber and mined products. The distance by rail to Grand Junction will be reduced by one half, to 173 miles. The 6-mile tunnel will cut out 23 miles over the Divide as well as the snow sheds and a 4 per cent grade. Engineers estimate that about 40 per cent of the annual profits of the road now are absorbed by snow conditions encountered in crossing the Divide at the 11,660-ft. elevation. The tunnel is to be 16 ft. wide and 24 ft. high. A pioneer tunnel 8 x 10 ft. will be driven 50 ft. to one side of the main tunnel. It is proposed to use the pioneer tunnel to carry power, light and compressed air to ventilate the main bore. Another use is to carry water from the western slope to South Boulder Creek. While at the present time land hunger is not particularly in evidence in the West, it will come again and there is plenty of justification in looking ahead to make accessible all available parts of the country for the development of agriculture. The northeastern part of Colorado and the northwestern part of Utah embrace an immense tract of agricultural land.

Engineers should be gratified that the Moffat Tunnel construction has fallen into the hands of so able an engineer as Major Blauvelt, who put through the Moffat road and knows the history and engineering of the preliminary work of the tunnel from the beginning. At the head of the commission is W. C. Robinson, former president of the Denver Union Water Co., than whom there are few abler men working with engineers to get work done in a smooth and efficient manner. He knows how to handle finances under difficulties and keep things going. It is hoped to let contracts this fall and complete the tunnel in three years. While the work is being carried out under a rather novel law, that of the special benefit district, a friendly suit is now in court to determine its status. If this is decided favorably, undoubtedly other projects of similar character may be put through in the West on the same basis. From now on visits by engineers to Colorado will not be complete unless they get in touch with Colonel Blauvelt and follow the work of this latest railroad development.

No mention of the tunnel would be fitting without a tribute to D. H. Moffat, who at the age of 65, built the road and really died of disappointment 11 years ago because he was not successful in financing the tunnel. Few men have done more for Colorado than did Mr. Moffat. At the age of 30 years he fathered the construction of what is now the Union Pacific from Denver to Cheyenne. He built the "South Park," now part of the Colorado & Southern, and the Florence & Cripple Creek, both heavy dividend payers in their time. As president of the Denver & Rio Grande he constructed the Creede Branch. He poured $20,000,000 into the construction of the Denver & Salt Lake because he firmly believed that it would make Denver one of the leading western cities. Will it?

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Cast-Iron Pipe to Be Used for First Time in Water-Works of Ogden, Utah

Sir—The city of Ogden, Utah, with nothing but steel pipe in its water-works distribution system heretofore, has recently taken a significant step in awarding a contract for some 2½ miles of cast-iron pipe to the F. W. Spencer Co., Salt Lake City, after duly considering much lower bids for steel pipe.

The Ogden water-works were built by a private company which installed steel pipe with the idea that the plant would be eventually sold to the city and that it could probably get as much for the system if steel pipe were used as it could for cast iron. After the city took over the system it continued to use steel pipe. Not long ago there was a change in administration at Ogden and the new city engineer felt that to put steel pipe under pavement in a city having a population of 35,000 was false economy. Accordingly, the first cast-iron pipe ever laid in Ogden is being put down this season.

The entire intermountain country is gradually standardizing on cast-iron pipe. Many other types of pipe have been used in this territory. In fact, it is impossible for many of our smaller communities to legally bond themselves for enough money to put in cast-iron pipe for a water-works system. There is considerable difference in price on account of high freight rates between cast-iron and steel.

C. E. Painter.

Salt Lake City, Utah.

[The work consisted chiefly of furnishing and laying 13,270 ft. of cast-iron pipe made up of 1,520 ft. of 6-, 9,300 ft. of 12-, 2,350 ft. of 14- and 100 ft. of 8-in. In addition there were a few valves, hydrants, etc., to be supplied and set and some miscellaneous work to be done. The entire contract was let for $49,202. The successful bidder offered to do the same job for $40,263 if "M. J. galvanized and dipped [steel] pipe" were used or for $36,960 using the same material, dipped only.

A better comparison of the relative costs of the cast-iron and steel pipe is afforded by giving the unit bids for the 9,300 ft. of 12-in. pipe which makes up the bulk of the job. For this the city will pay, under the award, $3 per lin.ft., and could have had steel from the same bidder at $2.35 for galvanized and dipped and $2.09 for dipped only. The lowest bids for the three classes of pipe were $2.98, $2.30 and $2.05 respectfully. Further details of the bids are given in our Business News section.—Editor.]

Strength of Old Brickwork Due to Hardening of Mortar

Sir—With reference to article on "Brickwork from Building Stronger than Laboratory Samples," appearing on p. 354 of your issue of Aug. 3. The writer of the article in question evidently forgets that the brickwork in question was nearly twenty years old, and that portland cement mortar goes on hardening for many years. Laboratory specimens are rarely tested beyond a few months. If the workmanship in the two cases were equal, the brickwork from the building would be much more than 4 per cent stronger than laboratory specimens. In fact from the data given I would be inclined to draw the conclusion that laboratory specimens have better workmanship than is found in actual buildings, the opposite of the author's conclusion.

Leo G. Hall.

Downers Grove, Ill.
Sept. 19.

No. 19 Gage Too Light

Sir—We wish to call your attention to a slight typographical error which occurred on page 322 of your issue of Aug. 24 in the article by P. F. Jones entitled "Corrugated Culvert Pipe Jacked through Embankment."

The gage of the 30-in. Armco corrugated pipe employed is stated as 19, whereas it was really 10 gage. This we know because we manufactured the pipe in question. It seems to us worth while to call attention to this because so light a gage as the one stated would be extremely inadvisable for corrugated pipe, whereas 14 gage material is usually employed and 12 or 10 gage where subject to unusual conditions. No doubt in this instance the typesetter or typist simply picked up the wrong figure.

California Corrugated Culvert Co.

West Berkeley, Calif.
Sept. 12.

Bridge Builders And Highway Bridges

Sir—On the basis of extended experience in the bridge building industry it seems to me that old-time bridge builders were unduly criticized and modern bridge departments of state highway commissions unduly lauded in the article on the failure of the Marlin Bridge (see *Engineering News-Record*, June 22, 1922, p. 1023).

A complaint that highway commissions build too many structures of an expensive type has been answered by stating that the commissions merely execute the orders of legislative authorities and what is supposed to be the popular will. But there is no authority, legislative or otherwise, which dictates what class of bridge shall be built, except occasionally a local community. On the other hand, nobody calls a commission to account for excessive expenditures, as would be done in the case of local authorities.

In a specific case, local authorities built ten years ago an earth-filled concrete arch bridge at a cost of about $7,000. Near this and over the same stream the state is building a concrete arch rib bridge at a contract price nearly four times as great, although the site is more favorable for the other and less expensive type. Increased prices are not responsible for this great increase in cost. If such a contract had been let by the local county commissioners the taxpayers would soon have put them out of office. But when the state does it, the local officials have no responsibility and the local community is given to understand that the bridge is paid for mainly out of state funds so that the community pays only a small proportion of the cost. Many bridges of crude and extravagant design are being built at a cost 50 per cent greater than that for which well-designed structures might be built, following the same dimensions and specifications. Furthermore, in the central states it is the custom to build concrete through girder or truss bridges with roadways so narrow that in a few years they will have to be widened, which can be done only by building entirely new structures. Steel bridges are now only a small part of the business, but in these also it is believed a good designer could make a large saving in material and workmanship.

One reason for these conditions is that few competent and experienced engineers are to be had for the salaries paid by the state highway commissions. As a result, few of the best men stay in these positions. Many of the engineers have had no previous outside or commercial experience in highway bridge design or construction. To the layman all engineers look alike. He assumes that the engineer will see that only a fair price is paid and no money is wasted. He cannot check up the excessively expensive design of the structure as he could if there were competitive designs.

How can the public benefit from the knowledge of economical design and construction of competent and experienced designing engineers if these engineers are not permitted to demonstrate what can be done with a given situation? To my mind competitive designs certainly appear an improvement on present methods. It is true that local

authorities are not competent to pass on bridge designs and that they judge a competition mainly on the matter of price. Thus sharp competition and limited funds available for construction led to many light structures in earlier days. But with the highway commission and its engineer passing upon the designs the case would be very different.

Consider the plan of having competitive designs submitted with the contractors' proposal at the time of taking bids on the work, it being understood that all designs must meet the approval of the commission's engineer. If the plan of the lowest bidder does not meet the requirements it is rejected and the next one considered, until a plan and bid are found that do meet the requirements. This plan also would provide employment for many engineers in making designs for contractors, and since the plans would be subject to expert consideration these engineers would of necessity consider both quality and cost of the design. The cost of making the designs would be small in comparison with the saving of cost in an economical structure. Under the present monopolistic system there is little regard for economy in design and no incentive to improvement in design.

Many contractors who are now building country bridges have little experience, equipment or resources. Some of them do not last more than one season. Compare this situation with the old bridge building companies of 25 years ago, having their own engineers, full equipment, ripe experience and ample means. Much has been said about failures of old highway bridges, but as the late Horace E. Horton stated some years ago: "No one has shown or can show the actual failures of enough highway bridges within a given period of five, ten or fifteen years, to justify suspicion of the highway bridge as a class." And failures are on record of bridges built under the jurisdiction of state highway commissions, although these structures are comparatively modern.

It is a point to be decided by the engineers themselves, in their own interest as well as in that of the public, whether the proper and economic method is to have highway bridges designed by state engineers without competition or by outside competent engineers in competition but subject to specified requirements and to expert approval. But in my opinion the bridge engineer of a state highway commission should act as a supervisor of design and not as a designer. A BRIDGE BUILDER.

Calculation of Bridge Waterways in Brazil

Sir—It was with the utmost pleasure and interest that I read Ivan E. Houk's article on the "Hydraulic Design of Bridge Waterways" in your June 29 issue, p. 1071. My experience with runoff formulas fully bears out what Mr. Houk says. For some years I have been studying the problem of rational waterway design, and I also advocate the "Rational Method," as used in sewerage practice. My method of procedure may prove interesting to some.

I compute the mean intensity of rainfall by a formula I have evolved,

$$i = \frac{4.75f}{\sqrt[6]{(t+5)^5}} = \frac{4.75f}{\sqrt{t+5}\,\sqrt[3]{t+5}} \qquad (1)$$

in which

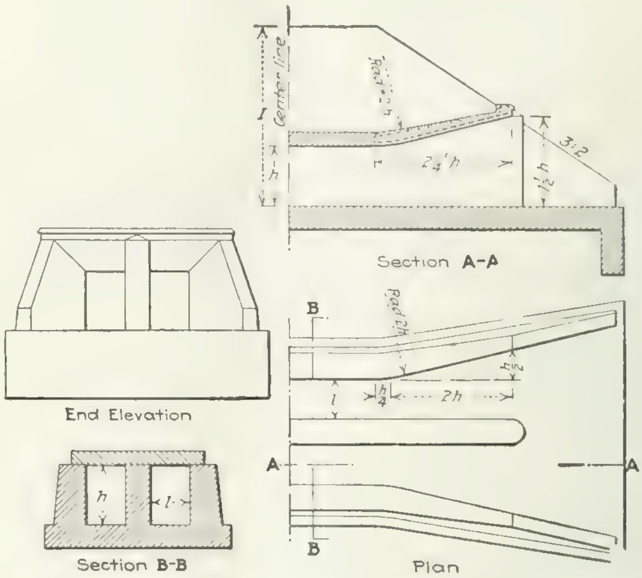
i = intensity of rainfall, in. per hr.;
f = mean annual rainfall on drainage area, in.;
t = duration of storm, min.

The formula represents maximum storms, and I usually calculate culverts and small openings in general for an intensity two-thirds as great. Whenever the data at hand are not very complete, and this unfortunately is often the case, I assume 85 per cent of the rainfall as runoff.

For large areas, values given by eq. (1) have to be properly reduced, as it is a well known fact that mean intensity of rainfall decreases with increasing area of storm. Denoting the drainage area in square miles by A, the formula is modified thus:

$$i = \frac{4.75f}{\sqrt[6]{(t+5)^5}} \times \frac{1}{1+\sqrt[3]{\frac{A}{1000}}} \qquad (2)$$

Of course this formula is more or less of a tentative nature, and does not presume to hold true for every case that may arise. However, small variations in the correction factor for A are unimportant in the great majority of cases.



FUNNEL-SHAPED CULVERT ENTRANCE

For a first trial I proportion the area of waterway by one of the following formulas:

$$a = 2.86Cf\sqrt[6]{A^5} = 2.86Cf\sqrt{A}\,\sqrt[3]{A} \qquad (3)$$

$$a = 5.71Cf\sqrt{A} \qquad (4)$$

where a = area of waterway, square feet;
A = drainage area, square miles;
f = mean annual rainfall, in., on area A.
C = a coefficient as tabulated below.

VALUES OF COEFFICIENT C, FORMULAS (3) AND (4)

Nature of Ground	C
Very steep barren and rocky ground; upper reaches of stream have a much greater slope than lower ones	1.10 to 1.50
Steep, impermeable ground, little or no vegetation	0.90 to 1.00
Mountainous ground, cultivated or pasture; Swamps with no vegetation	0.70 to 0.80
Hilly ground, cultivated or pasture; Swamps with vegetation	0.50 to 0.60
Undulating ground, pasture or cultivated; Flat land, pasture or cultivated	0.30 to 0.40
Long narrow valleys	0.25 to 0.20 or even less
Sandy deserts	0.01 and less

Formulas (3) and (4) were deduced by me from Dun's Drainage Table. The values of C are only approximate and of a tentative nature. I use formula (3) for drainage areas not exceeding 8 square miles, and where the culvert can be made to discharge under a head.

As a matter of fact I try, whenever possible, to make box culverts and such like openings discharge under a head, as large economies can usually be effected in this manner. In order to increase the efficiency of these openings I employ a funnel-shaped inlet as per drawing, to decrease the loss due to entrance head. The outlet is of the ordinary standard type.

Once the trial sectional area of waterway is worked out, it is an easy matter to see if it can take care of the given flood and yet be safe as to scour, etc.

It would be highly instructive and interesting if railway and highway engineers and others could give their views on and cite their experiences and methods for dealing with the problem in hand. GEORGE RIBEIRO,

Chief of Permanent Way Drawing Office,
Leopoldina Ry. Co., Ltd.

Rio de Janeiro, Brazil,
July 30.

NEWS OF THE WEEK

New York, September 28, 1922

New Muscle Shoals Bill Is Introduced

Would Give Secretary of War Authority to Dispose of Units on Best Terms Possible

A new measure for the disposition of the government properties at Muscle Shoals, Ala., which in effect would pass the entire subject back to the Secretary of War, with authority to dispose of the various units on the best terms possible, appeared in the final days of the session of Congress in the form of a resolution introduced by Representative H. E. Hull, of Iowa, a member of the Military Affairs Committee.

The resolution would authorize the Secretary to sell to the Alabama Power Co. the government's interest in the Gorgas steam plant and the transmission line to Sheffield at a price not less than $3,000,000, or if unable to negotiate a sale, the secretary would be authorized to purchase the sites and rights of way from the Alabama Power Co. at a fair price within his discretion or to secure the property by condemnation proceedings if necessary.

Purchase of all property and flowage rights abutting the site of proposed Dam No. 3 and which belong to the Alabama Power Co. at a price not to exceed $100,000 would be authorized, condemnation proceedings to be instituted if agreement could not be reached.

Lease for Two Dams

The Secretary would be authorized to complete at government expense Dam No. 2 and to construct Dam No. 3 and to lease these dams together with the power houses and appurtenances for not to exceed fifty years at a rental of not less than 4 per cent of the cost of finishing Dam No. 2 and constructing Dam No. 3, including in the latter case cost of site and flowage rights.

As to the nitrate plants, the resolution provides that the Secretary in his discretion may lease for not exceeding fifty years Nitrate Plants Nos. 1 and 2 and Waco quarry, either separately or completely, at $1 per year for each plant. The condition of such lease would be that the nitrate plant or plants should be operated at capacity for the production of fertilizer components for sale to the public at a price not to exceed eight per cent profit and that the plants be kept in condition to produce to present capacity nitrates and other components of munitions, the plants to revert to the government in case of emergency.

The Secretary would be authorized to lease the dams and nitrate plants and quarry separately or completely to the same lessee and to make the consideration interdependent.

Authority to sell or dispose of all lands and properties owned by the government not necessary for the operation of the nitrate plants, the steam electric plants or for the construction and operation of the dams will be given the Secretary.

In explaining his resolution, Representative Hull said that its terms would permit Henry Ford, the Alabama Power Co., or any other reliable person or organization to make the contract, and that the resolution would afford the Detroit manufacturer or anyone else a better opportunity to operate the nitrate plants for the benefit of the people of the country than Mr. Ford's own offer.

Fire Destroys Wood and Steel Wharfhouse at New Orleans

On Sept. 15 fire completely destroyed the wharf and wharfhouse of the port terminal built at New Orleans by the government for the war and known then as the New Orleans Army Base. At the present time the terminal is under lease to the local Dock Board and is being used for commercial purposes. Damage to the structure amounts to about $3,000,000 and to the contents of warehouse and cars as much again.

The terminal was described in *Engineering News-Record,* April 24, 1919, p. 823. The part destroyed was a wharf, or quay, paralleling the river and on the river side of the levee. It was 2,000 ft. long and 170 ft. high and was built of wood piles carrying a timber floor. On it was a steel frame warehouse 141 ft. wide. This structure was connected to large shoreward concrete warehouses by bridges but the fire was stopped across the bridges and the concrete warehouses were not damaged.

A full description of the fire and the damage done will appear in the next issue of *Engineering News-Record.*

Begin Dam Survey as First Step in Texas River Control Program

Acting on a petition of officials and citizens of Ft. Worth and Tarrant County, Texas, the State Board of Water Engineers on Sept. 1 began the survey of a reservoir and dam site on the Clear Fork of the Trinity River. The topographic work will be done by the U. S. Geological Survey in cooperation with the Board of Water Engineers. Jay M. Whitman of the U. S. Geological Survey will be chief of the topographic party and it is estimated that the survey will require 60 days for completion. This is the first definite step taken since the flood conferences to control the streams of the state.

For State Control of Texas Roads

The Democratic State Convention of Texas, held at San Antonio, Sept. 5 and 6, adopted a highway plank in its platform approving the highway program of the Texas Highway Association, which calls for a constitutional amendment to turn over the roads to the state for construction and maintenance. This work is now under the direction of the counties.

Child Killed in Collapse of Theater Floor

Rotted Wooden Joists of Lobby Floor Break Under Weight of Crowd of School Children

Collapse of part of the lobby floor of the Strand moving-picture theater, East Liberty, Pittsburgh, on Sept. 22 killed a school child and seriously injured a large number of others. The accident occurred when a crowd of children was waiting in the lobby to see a free performance. The owner of the theater, who was present, also was injured.

The facts of the accident are reported as follows by Edward Godfrey, structural engineer, who investigated the collapse for *Engineering News-Record:*

The theater lobby is about 32 ft. wide between brick side walls. It was floored with a 5-in. slab of plain concrete resting partly over and partly between transverse wooden 2 x 10 joists. These joists extended from wall to wall, entering the brick work about 2 in. At their middle points they were supported by a line of double I-beams extending from front to rear, carried on columns. Some if not all of the joists had 2 x 4's on their sides to carry the concrete. The same floor construction continued throughout the theater itself. The building was erected in 1914; it is not known at present writing whether the floor in question dated from that time or had been put in at a later reconstruction. The cellar was unoccupied and had a dirt floor; the space was not ventilated and was damp.

One-half of the lobby floor, an area about 15 or 16 ft. square, collapsed and fell a dozen feet or so into the cellar, carrying with it the crowd standing on it. The joists were sheared off at the side wall and at the middle line of beams, and were broken up in the fall. Examination showed that they were badly rotted. The damp cellar without ventilation and the impervious concrete floor made ideal conditions for decay, and this appears to have been not long in doing its work.

Commenting on the accident Mr. Godfrey says: "There is no mystery about the cause of the collapse, except the mystery of why any one engaged in building should construct such a trap and why those who are morally responsible for the lives of the public from which they draw their living should be indifferent to the existence of such traps. However, it would be interesting to know why the designer used this heavy layer of plain concrete on a floor wholly supported by wooden joists, and how much he penalized his client by not reinforcing the concrete and omitting the wood. It would also be of value to find out, if possible, what other examples of the same designer's work may be in service. It is certain that a very superficial examination of this building by an expert would have discovered the danger of permitting it to be used by the public."

Port Authorities Convene at Toronto

Discuss Proposed St. Lawrence Channel and Urge Greater Uniformity in Port Design and Equipment

Fifty members, representing the principal American and Canadian seaport cities, attended the annual convention of the American Association of Port Authorities held in Toronto, Sept. 14-16. President Benjamin Thompson of Tampa, Fla., occupied the chair. Official welcomes were extended by Mayor Maguire on behalf of the city and President D. A. Cameron of the Board of Trade. J. Spencer Smith delivered an address on the Port of New York, which had been prepared by E. H. Outerbridge, chairman of the Port of New York Authority, who was prevented by illness from attending the convention. This outlined the methods by which that city is attacking the problem of co-ordinating its rail and water transportation facilities. Chief Engineer B. F. Cresson, Jr., of the Port of New York Authority, urged the importance of adequate freight-handling equipment and advocated greater uniformity as to port facilities and channel depths.

E. St. C. Maxwell, of Baltimore, dealt with the control of waste oil in harbors. Other addresses were: "The Navigation of Industrial Canal of the Port of New Orleans," by General Manager J. H. Walsh; "The Proper Ratio of Berthing Space to the Cargo Tonnage Requirements of Ports," by Capt. S. S. Sandberg, traffic manager, Los Angeles harbor; "Rail Freight Rates and the Development of Lake Ports," by William H. Adams of the Detroit Board of Commerce; and "Destructive Action of Marine Borers," by Dr. Herman von Schrenk of St. Louis.

Discuss St. Lawrence Waterway

On Sept. 14 a banquet was tendered by the city to the delegates and the projected deepening of the St. Lawrence water route was keenly discussed by the speakers. The plan was advocated strongly by T. L. Church, M.P., of Toronto, and J. B. Strauss of Chicago, and opposed by Dr. W. L. McDougall, chairman of the Montreal Harbor Commission, and John N. Cole of Boston. On resolution of B. F. Cresson, Jr., of New York the convention moved that an effort should be made to bring about greater co-operation between those responsible for the development of ports with a view to determining economies that can be effected by greater uniformity in port design and equipment. A committee was appointed to communicate with the authorities of the principal ports throughout the world with a view to determining how far international co-operation in design and equipment can extend and the best method of bringing it about.

The election of officers resulted as follows: Michael P. Fennell, Jr., general manager of the Port of Montreal, president; J. H. Walsh, of the port of New Orleans, first vice-president; B. F. Cresson, Jr., second vice-president; E. L. Cousins, engineer, Toronto Harbor Commission, third vice-president; T. S. McChenney, of New Orleans, secretary; and J. C. Marron, of Seattle, treasurer.

The following were elected as directors: Major General Lansing H. Beach, chief of engineers, United States Army; A. G. King, director, Norfolk Harbor Commission; H. G. Hegart, chief engineer, Harbor Board of Portland, Ore.; Brig. General Thomas Tremblay, Quebec Harbor Commission; B. C. Allen, director of Port of Houston, Tex.; Charles W. Francis, commissioner of Public Works, Chicago; and Major C. T. Leed, consulting engineer, Los Angeles, Calif. Executive committee was elected as follows: John N. Cole, public works commissioner, Boston; Benjamin Thompson, consulting engineer of Tampa, Fla. Harbor Commission, the retiring president of the association, and John H. McCallum, president of the port of San Francisco.

New Orleans was chosen as the meeting place for the next year's convention.

Good Market for Highway Bonds

During the past week two large issues of state highway bonds were reported sold on favorable terms. The largest sale was an Illinois issue of \$7,734,000, 1929-40, 4 per cent bonds, which sold on a 3.9 per cent basis. Michigan sold a \$3,000,000, 1937-42, 4-4½ per cent issue to yield 4-3.95 per cent. A half million of 4½ per cent Alabama road and bridge issue, due in 1931, sold to yield 4¼ per cent. Five issues of county road bonds in various states were offered at interest rates and sold to yield as follows: 4¼ at a yield of 4.05 per cent; 4.75 at 4.5; 5.5 at 5.5; 6 at 5; 6 at 4.75 to 4.76.

Construction Council Executive Secretary Appointed

Pending the complete organization of the American Construction Council, the temporary operating committee is continuing to function. Committees are to be appointed to co-operate with railroads on freight-rate matters, and on finance, membership, building codes and ethics. The temporary headquarters are being continued in the Munsey Building, Washington, D. C. Col. Wm. Couper has been appointed temporary executive secretary and is now busying himself with details relative to financing the organization.

British Plan Next Rail Merger

(London Correspondence)

It is probable that the next step in the British railway grouping scheme will be the absorption of the great Central by the North Eastern Ry. The North Eastern owns 1,714 miles of track and jointly 36 miles more, and the authorized capital is £92,716,199. The Great Central was formerly known as the Manchester, Sheffield and Lincolnshire Ry., the title having been changed on the extension of the line to London for mineral traffic in 1898, and for passenger traffic in the following year. For some years now this line has operated in close relationship with the Great Northern and Great Eastern lines. The authorized capital of the Great Central is £64,043,511. When complete the group to be known as the North Eastern will include also the Great Northern and Great Eastern lines.

Report Advises Abandonment of British Columbia Railway

The Pacific Great Eastern Ry. in British Columbia, now owned by the government of that province, has become a serious financial problem because of the non-revenue producing condition of the road and the heavy interest, depreciation and operating charges which taxpayers have to meet. John G. Sullivan, consulting engineer of Winnipeg, Canada, and former chief engineer of the Canadian Pacific R.R., was retained by British Columbia to advise the province what policy to follow in further management of the Pacific Great Eastern Ry. properties.

A terse summary of the whole situation was recently printed in a Vancouver newspaper as follows: "The Pacific Great Eastern has proven a mirage of hope to hundreds of settlers in the central and northern valleys. It was the plaything of politicians, a gold mine to contractors, a bugbear to engineers and in recent years has been a millstone around the neck of the taxpayers."

Mr. Sullivan presented his report several months ago but no announcement of its contents was made public until recently when John Oliver, premier of British Columbia, gave out a digest of its main features from which the following has been taken:

Sullivan's Report

Except for a 45-mile stretch, the line has been completed from tidewater at Squamish, about 35 miles north of Vancouver, to Ft. George on the Grand Trunk Pacific R.R., 430 miles to the north. Because there is not enough traffic in prospect to pay operating expenses and fixed charges, the abandonment of the entire system is suggested as one alternative. This would make it possible to recover some salvage and would prevent further increase in obligations which the taxpayers of the province will have to meet. In any event no extensions of the present system are advised and curtailed train service and increased rates are recommended. Parts of the line on which there is snow trouble in winter should be abandoned; some of the rolling stock could be sold and gasoline driven motor cars used for passengers and freight on those portions of the line where traffic is heaviest. The possible sale of that portion of the line now operating between North Vancouver and Whytecliffe to a private company is suggested, as is also the possibility of selling other portions of the road to lumber interests.

The report is now before members of the Legislature and decision as to what to do with the railroad properties is expected at the next session of that body.

Deyo's Service on New York Subways

In the obituary notice of S. L. F. Deyo, published in *Engineering News-Record*, Sept. 14, p. 454, the statement was made erroneously that from 1908 to 1913 Mr. Deyo was chief engineer of the Rapid Transit Subway Construction Co. George H. Pegram has been chief engineer of both the Rapid Transit Subway Construction Co. and the Interborough Rapid Transit Co. from 1905 to date.

Los Angeles Aqueduct Breaks Repaired with Steel Pipe

Two interruptions to the flow of water through the Los Angeles aqueduct occurred in the latter part of August but did not curtail the city's water supply because of reservoir capacity at the lower end of the aqueduct. The first break was in the Little Lake division at the upper end of tunnel No. 1. "This district," states William Mulholland, chief engineer, Los Angeles Bureau of Water Works and Supply, in a letter to *Engineering News-Record* dated Sept. 2, "is subject to earthquake shocks and several of these which occurred just previous to the discovery of the break doubtless caused a settlement in the fill which was made of the tunnel dump. Cracks in the bottom of the invert allowed a certain amount of seepage which caused further settlement and resulted in the collapse of the slab due to the length of unsupported span. About 138 ft. of this section was taken out. Within five days after the occurrance a temporary 9-ft. steel pipe on trestles was erected and 85 per cent of the aqueduct flow was passing through this temporary repair. This is to be kept in service until permanent replacement can be made by means of a 9-ft. steel siphon.

"On the morning of Aug. 29 a cloudburst occurred in the Olancha Canyon, discharging over the aqueduct which at this point consists of a lined open canal. No damage was done to the concrete lining, but the aqueduct was completely filled with rocks and mud for a distance of one-half mile. The removal of this debris is simply a steam-shovel job which at the most will require only ten days to two weeks to complete."

Public Building Bill Planned to Carry $80,000,000

An omnibus public building bill, carrying an appropriation of $80,000,000 to $100,000,000, will be introduced and pressed for passage when Congress reconvenes. Before leaving Washington for the recess, Representative Langley, of Kentucky, chairman of the House Public Buildings and Grounds Committee, and Representative Clarke, of Florida, ranking Democratic member of that committee, conferred with President Harding and informed him that such legislation was desirable. No general public buildings bill has been passed by Congress since 1913, and there have been comparatively few special bills enacted to erect government buildings of a permanent nature.

There are pending before committees literally hundreds of bills seeking the erection of postoffice buildings and other quarters for Federal departments in cities other than Washington. The pressure for favorable reports and legislative action upon many of these bills is steadily increasing.

Postmaster General Work recently launched a campaign to convince Congress that it would be financially profitable for the United States Government to build or purchase postoffice buildings in the major cities of the country rather than continue the old system of leasing most of these quarters. The Postoffice Department hopes to have this building done according to a systematic plan rather than to leave it to the chance enactment of legislation by Congress on a piecemeal system.

South Carolina Licenses First Applicants Under New Law

Thirty-seven applications for registration as engineers or land surveyors were approved at a meeting of the South Carolina State Board of Engineering Examiners held in Columbia, S. C., this month.

The organization of this board was The organization of this board was provided for by an act passed at the last meeting of the state legislature, and the thirty-seven who received approval comprise the first "registered" professional engineers and land surveyors in South Carolina. Members of the board of examiners are G. E. Shand, Columbia; L. S. Tellier, Charleston; T. Keith Legare, Columbia; W. S. Tomlinson, Columbia, and George Wrigley, Greenville.

Twining Urges Construction of Broad St. Subway

Immediate construction of a rapid-transit subway extending along North Broad St., Philadelphia, was urged upon the city council by W. S. Twining, director of city transit, on Sept. 21. A four-track line six miles long was proposed, costing with equipment about fifty million dollars, of which about thirty-one million represents the cost of the structure. Mr. Twining strongly opposed an elevated railway as a substitute for the subway, but estimated its cost as twenty millions less.

Suspension Bridge Planned Across Carquinez Straits

A suspension bridge across a narrow strait in the upper reaches of San Francisco Bay—Carquinez Strait between San Pablo and Suisun bays—has been proposed by a company organized for the purpose, known as the San Francisco Transit Co. The structure would have a central span of 1,500 ft. and two 750-ft. approach spans and would be a high level highway bridge, giving a clearance of 135 ft. above water level. The estimated cost is given as $2,500,000.

After a hearing conducted before Colonel Herbert Deakyne, the United States Army engineer officer at San Francisco, the War Department has approved the clearances proposed. Issuance of a permit awaits the grant of local franchises and completion of arrangements for proceeding with the work.

Applications for franchises from Solano and Contra Costa counties, between which the bridge will extend, are now under consideration. The proposition made to these counties is that if the franchises are granted the operating company will, at the end of twenty-five years, turn the bridge over to the counties without charge and in a good state of repair. So far as actual construction problems are concerned, the proponents state that the work could be started within sixty days and the bridge completed and ready for service within twelve to eighteen months.

C. E. Fowler, of New York, is consulting engineer for the company and designed the proposed structure. Edwin Duryea and H. L. Haehl of San Francisco are the resident consulting engineers.

Propose Development Plan for S.P.E.E.

Committee Recommends Comprehensive Plan to Investigate Needs of Engineering Education

Comprehensive plans for the promotion of research in engineering education and for the co-ordination of the various agencies interested in the subject have been reported to the Society for the Promotion of Engineering Education by its development committee. This committee, which consists of C. F. Scott, chairman, M. E. Cooley, J. H. Dunlap, D. C. Jackson and F. W. McNair, was appointed at the Urbana convention of the society last June to study and report on plans for development of its work.

Recommendations of Committee

The full recommendations of the committee are as follows:

I. That there be created within the society a Board of Investigation and Co-ordination, consisting of five members, under whose general direction there shall be organized and conducted (*a*) an active campaign for the promotion of engineering education in light of the needs of the future as those needs may be developed; (*b*) there shall be co-ordinated as far as possible the activities of the various agencies interested in promoting engineering education; and (*c*) there shall be conducted research in engineering education.

II. That there be authorized a Board of Counsellors consisting of representatives from the several fields to which engineering education is related, to advise and assist the Board of Investigation and Co-ordination.

III. That there be authorized a director, with an adequate staff, the director to be appointed by the Board of Investigation and Co-ordination, and when appointed to be ex-officio chairman of the board, the secretary of the society to be ex-officio secretary of the board.

IV. That progress reports to the society be published periodically in *Engineering Education*, the bulletin of the society.

V. That President Charles F. Scott be a member of the board and have authority to appoint the other members; that the terms of the initial members be 5, 4, 3, 2 and 1 years respectively, the individual assignments being made by lot. That vacancies be filled by the council on nominations made by the board and that vacancies be created by the council upon recommendation of the board.

VI. That the objects (among others) for which the board is created shall be considered to be: (1) To ascertain the facts on engineering education, such as concerns (*a*) teachers, their origin, training, experience and effectiveness; (*b*) teaching facilities; (*c*) curriculums; (*d*) students and graduates, their origin, training, experience and effectiveness; (2) to ascertain present and future requirements in the fields served by engineer graduates; (3) to present the facts and requirements for their bearing on the training of the engineer to the end that he may (*a*) develop himself and his profession; (*b*) realize and fulfill his obligation to society; (4) to maintain close

contact with engineering schools enabling them to participate in the investigations; and reporting to them from time to time; to the end that the developments may be continuous from the initial contact between the colleges and the agencies of the board; and (5) to secure the necessary funds for these purposes.

The report is now before the council of the society which will act upon it by letter ballot.

To Hold Second Conference on Highway Education

The second national conference on education for highway engineering and highway transport will be held in Washington, D. C., Oct. 26-28, under the auspices of the Highway Education Board, of which John J. Tigert, U. S. commissioner of education, is chairman. The U. S. Bureau of Public Roads is co-operating in the arrangements for this meeting. It is desired to have present all state highway engineers, teachers of highway engineering and others who are concerned in the mutual problems to be studied.

The program will include papers and discussions of such topics as relation of highway transport facilities to national progress and national defense; the need of trained men in highway engineering; highway research; and the trend of engineering education.

There will be meetings of a number of committees and a symposium on highway educational problems.

Lynch Construction Co. Adds to Its Executive Staff

Plans for expanding the activities of the Lynch Construction Co., New York, to cover general heavy construction, have resulted in several recent additions to its executive personnel. Under the general direction of W. G. Lynch, president, and W. B. Gray, general manager, E. S. Closson has been added to the staff as construction manager, W. E. Giesen as chief estimator, and F. E. Ransome, as noted in last week's issue, as construction superintendent. The company was incorporated in 1918 and is the development of the Lynch Realty Co. which operated on industrial work for about sixteen years in the New England States.

Mr. Closson's experience includes general municipal and railroad work in New York State, six years on subway construction with the New York Transit Commission, town engineer of Montclair, N. J., for four years, consulting and contracting work and service on shipyard construction with the U. S. Shipping Board's Emergency Fleet Corporation. Beginning in 1919 Mr. Closson was chief engineer for the Lock Joint Pipe Co., Ampere, N. J., and last year served as general supervisor of bridges and structures for the New Jersey State Highway Department.

Mr. Giesen, a graduate of 1907 of the University of Texas, has had an extensive experience in estimating on construction work, following early service in the fields, railroads, irrigation, and building. He was chief estimator in 1917 for Stone & Webster in their southwest district. In 1919 he served as chief superstructure estimator for the Foundation Co., New York. During the war Mr. Giesen served in the Marine Corps.

Motor Vehicle Registration Shows Increase

Washington Correspondence

Highway transportation is steadily on the increase in the United States, as indicated by statistics of motor vehicle registration as of July 1, compiled by the Bureau of Public Roads of the Department of Agriculture. The registration of all types of motor vehicles, excepting motorcycles, on that date totaled 10,620,471, an increase of 157,176. This increase is considered to be a healthy growth as the first half of the year is regarded as the off-season for registration of new vehicles.

Motor trucks constitute by far the largest class in the increase, there being 116,701 new trucks, as compared with 35,030 passenger cars and 5,443 buses and taxicabs among the increased registration. The increase in the number of motor trucks as compared with Jan. 1, represents more than 16 per cent. The increase in buses and taxis is equivalent to nearly 11 per cent, as compared with the first of the year. Figures are not available to show what part of the increase in the bus and taxi registration is due to the increase in the number of buses traveling suburban and rural routes, but the bureau officials express the opinion that it is very probable that a considerable part of the increase is due to the development of this new form of transportation.

The statistics issued show a total registration on July 1 of 9,467,874 private passenger cars, 55,992 buses and taxis, and 1,096,605 trucks, making the total of 10,620,471.

The Bureau of Public Roads expresses the opinion that the great increase in the registration of commercial vehicles may be attributed largely to the present activity in highway construction, as motor trucks as a class have been more handicapped by a lack of good roads than have the pleasure vehicles.

Would Electrify Section of M., K. & T.

The Missouri, Kansas & Texas R.R. and the Texas Interurban Lines have entered into a 50-year contract for service from Dallas to Denton, a distance of thirty miles. The Hobson interests will electrify the M. K. & T. instead of building a second interurban line as called for in their contract with the city of Dallas. After some discussion this action has met with the approval of the city administration, and the offer was accepted Sept. 20. Progress now is contingent on the settlement of legal questions. The Texas Interurban interests are now building an interurban line to Terrell, thirty miles distant, which will be in operation by the first of the year.

Canada Turning to Oil for Heat

Because of the coal situation, furnaces in at least 200 buildings in Ottawa have been fitted with oil-burning appliances. As many of these buildings are large, it is estimated that nearly 6,000 tons of coal used last year will not be needed, or will be available for others. Reports from Toronto, Montreal and other large Canadian centers indicate that the sale of oil burners has increased considerably during the last few weeks.

Delay Decision on Current for I. C. R.R. Electrification

Decision as to whether the direct or alternating current system should be adopted in the electrification of the Chicago terminal lines of the Illinois Central R. R. has been delayed by the sudden death of A. S. Baldwin, vice-president in charge of this work. All the material collected by Mr. Baldwin for his report has now been turned over to D. J. Brumley, chief engineer of the Chicago terminal improvements, this work being handled by an organization independent of the regular engineering department of the railway.

Pacific Highway Paving Nears Completion in Washington

On the main north-and-south highway through western Washington, known as the Pacific Highway, with a length of 310 miles in that state, material stockpiles are being placed this winter for paving the remaining 37 miles which will complete a continuous line of paved roadway from the Oregon line to the international boundary. The contracts for this paving will be let early next year. The present plan is to let the work in seven contracts each covering a length of about 5 miles.

Preliminary Power Permit Sought for Ten Cheat River Projects

Washington Correspondence

Much significance is attached by the Federal Power Commission to the application of the West Virginia Power and Transmission Co. for a preliminary permit covering a comprehensive development of the entire Cheat River in West Virginia and Pennsylvania. This is one of the three streams which was considered by the government as a possible site for the government nitrate plant which afterwards was located at Muscle Shoals.

The applicant for this permit is understood to be closely allied with the West Penn Power Co., which has an extensive transmission system throughout the industrial territory tributary to Pittsburgh and Wheeling. It is the idea to develop all the available power on the Cheat River to interconnect with existing plants in the carrying out of a super-power project.

The company already has a permit from the War Department for a large development near the state line between Pennsylvania and West Virginia. It is now asking the Federal Power Commission for a permit to cover ten additional developments which will utilize all the fall of the Cheat River and practically all the reservoir sites along that stream.

The primary power available is estimated at 300,000 hp., but equipment capable of developing at least 500,000 hp. will be installed.

Additions to Industrial Film List

To the list of moving pictures of industrial operations, published in *Engineering News-Record* Aug. 24, 1922, p. 329, should be added "Getting Results on Road Jobs" and "Material-Handling by Machinery," which can be obtained for exhibition purposes by addressing James H. Gregory, The Barber-Greene Co., Aurora, Ill.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.
AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, San Francisco, Oct. 4-9.
AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Convention, Cleveland, Oct. 16-19.

The Houston Chapter of the A. A. E. has announced a fall program as follows: Oct. 11, "Half a Century of Engineering Achievement in Texas," L. A. Guerenger, engineer, Texas Railroad Commission; Oct. 25, "The Essentials of City Planning," Charles H. Wacker, chairman, Chicago Plan Commission; Nov. 15, "How Local Engineers May Aid the Houston Plan Commission," O. F. Holcomb, Mayor of Houston; Nov. 29, "Motor Truck Traffic on Highways: A Highway Builder's Views," Capt. J. D. Fauntleroy, Texas State Highway Engineer; and Dec. 13, "Motor Truck Traffic on Highways: A Railroad Executive's Views," Julius Kruttschnitt, chairman, Executive Committee of the Southern Pacific Lines.

PERSONAL NOTES

G. W. MAYO, highway engineer of U. S. Bureau of Public Roads, is acting district engineer District No. 6, Ft. Worth.

ED R. NEFF has severed his connection with the city of Jacksonville, Fla., where he was employed as assistant city engineer, to become county engineer of Bradford County, Fla. That county has recently initiated an extensive road-construction program, the cost being provided by a $550,000 bond issue.

MAJOR JOHN B. HAWLEY, consulting engineer of Ft. Worth, has been retained by the city council of Teague, Texas, for the purpose of investigating the enlargement of the water supply. The rapid growth of the town, with its consequent extension of the sewer system, as well as the large number of new connections, has proved that the supply received from the present wells is inadequate during the dry season.

HUGH M. HENTON, consulting engineer of Cleveland, Ohio, has arrived at Pullman, Wash., to succeed Prof. Chester G. Warfel, who died this summer, as assistant professor of mining and metallurgy in the Washington State College. Professor Henton has been connected with the Case School of Applied Science and with the South Dakota School of Mines, of which he is a graduate. He has been also director of research for the Aluminum Castings Co. of Cleveland and has at various times served as engineer for Western mining interests.

FRED H. FOWLER has resigned from the U. S. Forest Service to open an office as consulting engineer in the Humboldt Bank Bldg., San Francisco. He has been in the Forest Service for twelve years and since 1913 has been district engineer for California and southwestern Nevada with additional duties as representative of the Federal Power Commission covering extensive western territory.

MAYOR SAWNIE R. ALDREDGE of Dallas, Texas, and Major W. J. Powell, engineer to the supervisor, have left Dallas for New York City to consult Gen. Goethals in regard to a water supply for Dallas sufficient to take care of 500,000 population. Gen. Goethals recently made a report on the feasibility of creating a large lake adjacent to the business section of the city by providing a dam across the Trinity River.

ABEL WOLMAN was elected chief engineer of the Maryland State Department of Health on Sept. 21, to succeed ROBERT B. MORSE, resigned. Mr. Wolman will continue his activities as lecturer in sanitary engineering in the Johns Hopkins University School of Hygiene and Public Health and as editor of the *Journal* of the American Water Works Association.

ALEXANDER W. GRAHAM, former state highway engineer of Missouri, ALFRED T. BROWN, formerly with the Highway Culvert Co., St. Louis, Mo., and FRANK J. BEARD, formerly engineer of surveys and plans of the Missouri State Highway Department, have formed the Highway Equipment & Material Co., Jefferson City, Mo. The new organization will deal in highway equipment and supplies.

COL. C. H. CRAWFORD of Rio de Janeiro and CLIFFORD SHOEMAKER of Washington have been appointed official representatives of the American Association of Engineers at the International Engineering Congress at Rio de Janeiro this month.

COL. GEORGE M. HOFFMAN, Corps of Engineers, U. S. A., has recently succeeded COL. H. C. NEWCOMER as division engineer of the Gulf district with headquarters at New Orleans. He has just made his initial inspection trip over the Texas waterways. At one time Col. Hoffman was assistant engineer of the Galveston district.

OBITUARY

GUS CARLSON, a road contractor of Prairie City, Ore., was recently fatally injured while working on the John Day highway near Baker, Ore., when he was caught in the belt of a rock crusher. Mr. Carlson was widely known in the vicinity in which he was working, having been in the contracting business for a number of years.

CHARLES G. ARMSTRONG, consulting engineer, New York, died at his home in Jersey City, Sept. 11. He was 64 years old and was born in Senator, Ill. He was a graduate of the University of Illinois. Among his professional engagements was service as consulting mechanical engineer on the Singer Building in New York, where he maintained his offices.

From the Manufacturer's Point of View

Too Many Grades of Asphalt Specified, Say Producers

Engineer Co-operation Could Cut Varieties to 7 and Maintain Quality of Construction

PRODUCERS of asphalt for road and paving work believe that the multiplicity and non-uniformity of specification requirements for their material have reached a point which demands nation-wide co-operative action on the part of engineers, contractors, and producers to secure a reduction in the number of different grades of asphalt called for without in any way lowering the quality of construction involved. For construction ranging in type from asphalt macadam penetration to sheet asphalt pavement the producers believe that not more than 7 grades of material are ample, but under present conditions of non-uniformity in specification requirements more than 30 different grades are called for. This adds a host of complexities to the operation of oil refineries, not only in running the stills but also in the necessity of enlarged storage space for stocks of different grades. In the aggregate, therefore, the economic loss becomes large.

The chemistry of asphalt and tests to determine its quality constitute a highly technical problem that is understood by a comparatively small group of specialists. Highway and paving officials, without a full realization of the manufacturing problems involved, have been in the habit of basing their specifications on those used elsewhere for similiar work, injecting special requirements here and there to secure some supposedly special advantage in the product for their own work. The result has been the production of scores of specifications without correlation and with variations in demands which, the producers feel, while accomplishing no real good, hamper operations at the refineries.

REQUIREMENTS NOT UNIFORM

Another angle of the situation has been introduced by recent development of many state highway departments in the establishment of testing laboratories. While not objecting to the material-testing laboratory as a means of insuring the fulfillment of specification requirements, the asphalt producers have noted a tendency on the part of the laboratory personnel toward the introduction of new and special tests and refinements in specification demands carried to unjustifiable limits. With a wide variety of testing equipment available and a staff of technicians on the payroll conditions are created which lead to much individualism in the requirements of the 48 states. This phase of the situation has to do with demands intended to secure a product particularly adapted to local conditions of climate and traffic, all made in good faith, and does not involve cases where special requirements as to qualities of material or tests are introduced to favor a particular product.

The producer's problem would be

greatly simplified by more co-operation among the specification-producing bodies, such as the American Association of State Highway Officials, the American Society for Testing Materials, and the American Society for Municipal Improvements. The state highway officials, particularly, have indicated an attitude of aloofness, the producers feel, in excluding representation from the producing industries on their committees which draw up specifications. For identical purposes the states are now calling for a wide variety of asphalt grades and even in the same state periodic changes in specifications give the producer needless trouble. From the accompanying table containing merely a summary of certain state requirements for asphalt for asphaltic concrete pavement the amount of variation in specifications is apparent.

ILLUSTRATION OF VARIATION AND MULTIPLICITY OF STATE HIGHWAY SPECIFICATIONS FOR ASPHALT FOR ASPHALTIC CONCRETE PAVEMENT

State	Specific Gravity	Flash Point	Penetration	Loss at 325 Deg. F.	Penetration of Residue	Ductility	Melt Point
New York	0.99+	375°+	50–65	4%—	50%+	25+	
			70–85				
New Jersey	1.00+	347°+	50–60	1%—	25+	(c) 30+	
	1.02+	375°+	50–65	1.25%—	30+	(c) 50+	
	1.025+	392°+	55–65	1.5%—	35+	(c) 80+	
	1.03+	401°+	70–85	1.5–3.0%	40+	(c) 90+	
	1.035+	410°+	70–90	1.5–3.5%	45+	(c) 100+	
	1.04+	419°+	75–95			(c) 125+	
	1.045+					(c) 150+	....
Delaware			(a) 40–60	3%—	50%+	(c) 30+	....
			(a) 40–70				....
Pennsylvania			(b) 36–65	3%—	50%+	(c) 30+	....
			(b) 40–65			....	....
			(b) 45–65			....	....
			80–120			..	
Virginia and W. Va.	1.01+	347°+	60–70	1%—	30	..	113°–131°
	1.05–1.07			3%—	40	..	104°–140°
Ohio	1.01+	356°+	40–60	1%—	60%+	30+	....
	1.05+			3%—		50+	....
North Carolina	1.00+	347°+	45–50	3%—	50%+	30+	....
			50–60				
South Carolina	1.03+	347°+	50–60	1%—	25+		113°–131°
	1.05–1.07			[illegible]	30+		104°–140°
Georgia	1.01+	347°+	50–60	1%—	30+		113°–131°
	1.02+		70–80	3%—	45+		104°–122°
	1.05–1.07						104°–140°

(a) Penetration to be varied within limits as directed by Engineer.
(b) Penetration to be varied within a 9-point range as directed by Engineer.
(c) Heated to 50 penetration.
Note.—The figures in the vertical columns are arranged merely to show variations in the particular requirement indicated by each heading; they have no relationship if read horizontally.

Eliminating factors of lesser importance the keynote test for asphalt quality is that of penetration and in any effort to secure greater uniformity in specifications the first effort should be directed toward a reasonable standardization of penetration limits. Many states fix a range of 10 points for a given grade; some of them use an even scale, from 50 to 60, for example, while others adopt odd scales, as 55 to 65. In some recent cases an 8-point or a 9-point range is specified. In other cases very wide limits of penetration are specified, with the notation that within this range the exact penetration will be set by the engineer. Such a requirement places the producer at a great disadvantage as he does not know what limits will be set by the engineer. A 10-point range in the penetration test for asphalts harder than 90 penetration, it is asserted, would result in the securing of a material entirely satisfactory from the construction standpoint and would greatly facilitate production. For asphalt softer than 90 penetration it is believed by producers that a 30-point range is sufficiently close for all practical purposes. The producers emphasize the fact that even in the highest types of asphaltic construction the asphalt itself constitutes 10 per cent or less of the materials employed, the other 90 per cent being made up of the fine and coarse aggregates. Practically all specifications for asphalt involve a degree of refinement which is not carried to the same limits in the case of sand or stone, with the result that no advantage is gained by super-refinements in the case of only one of several variables.

The seven grades of asphalt which the producers maintain could be substituted, without impairing the quality of road construction, for the 30 or more grades now demanded, would be made up of 3 different grades for asphaltic macadam penetration, and 4 grades for mixed asphaltic concrete and sheet asphalt. The penetration limits suggested for these grades are as follows:

Asphalt macadam	120-150 90-120 80- 90
Asphaltic concrete	60-70 50-60
Sheet asphalt	40-50 30-40

At the present time tentative specifications of the American Society for Testing Materials cover the same grades and would seem to offer a good working basis for co-operative standardization on the part of all producing and consuming interests, including the American Association of State Highway Officials. The A. S. T. M. tentative standards covering penetration limits are as follows:

Asphalt macadam	120-150 90-120 70- 90
Asphaltic concrete and sheet asphalt	60- 70 50- 60 40- 50

The manufacture of asphalt block is not considered in the foregoing.

While not as important as in the case of bituminous or sheet asphalt construction, the same need for uniformity as has been previously noted is desirable in the case of asphalt filler for brick or block pavements. Some progress has been made along this line through the efforts of the Asphalt Association, the American Society for Municipal Improvements, and the National Paving Brick Manufacturers Association. There remain, however, some variations in the ductility and melting-point requirements and some of the older specifications now in use are not suited to the changed condition caused by the employment of the squeegee method of applying the filler to brick pavements instead of the hand pouring method formerly prevailing.

In the paving brick industry this year efforts to eliminate variety in sizes of brick resulted in a reduction of types from 66 to 11, with consequent savings in the manufacturing end of the business. The asphalt producers maintain that similar action aimed toward minimizing the number of asphalt grades called for would serve both their own interests and those of engineers, contractors, and the public.

Business Notes

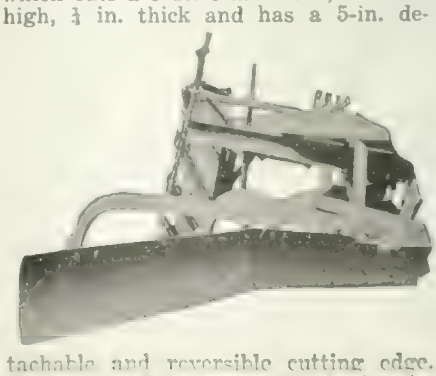
AUSTIN Y. HOY, manager of the London office of the Sullivan Machinery Co., has just arrived in this country to spend a month on business and personal matters.

L. R. TILLOTSON, formerly chief engineer of the Road Supply and Metal Co., is now with the Barrett Co., having headquarters in Topeka, Kan.

Equipment and Materials

Road Grader Improvements

Several improvements to its one-man, power-lift "Road Razer," or road grader, are announced by the Avery Co., Peoria, Ill. The machine, designed primarily for road patrol and maintenance work, weighs 4,500 lb. and is mounted on three wheels to minimize turning space. Power is furnished by a six cylinder gasoline engine. The grading blade consists of three sections, two 5-ft. lengths and one 2½-ft. length, overlapping and hinged at the joints, so that it may be made to conform to the crown of the road. The blade, which cuts a 9 ft. 6-in. width, is 12 in. high, ¾ in. thick and has a 5-in. detachable and reversible cutting edge. By means of the power lift device the entire blade can be raised quickly and lowered when passing over obstructions, such as manholes, water pipes



and street crossings. Compression safety rings hold the blade down when the power lift is lowered. Roller bearings are provided for front and rear wheels.

Three types of lug equipment are provided for the rear wheels—angle cleats, spud cleats, and an extension rim with rectangular flat-bar cleats. Rubber-tired wheels are also provided.

Semi-Trailer Hauls 18-Ton Loads

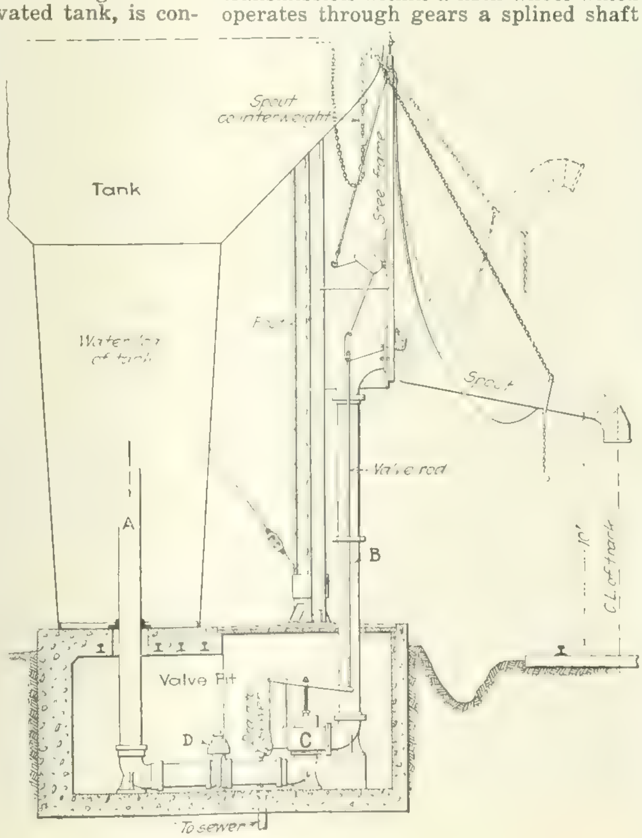
Designed to permit the use of heavy trucks under the Illinois state permissible 16,000-lb. axle loading is a semi-trailer recently put out by the Warner Manufacturing Co. for the use of the Consumers Co., Chicago. The Illinois

law permits an additional 12-ton total weight including load if a trailer with separate axle and separate set of wheels is used and as long as the limit of 800 lb. per inch width of tire is not exceeded. Experiments were started with a 10 to 12-ton vehicle but at the customers request the size was increased to a rated capacity of from 15 to 18 tons, permitted within the city.

Experiments made to determine the best methods of dumping the trailer led to transmission of the truck power through the fifth wheel of the semi-trailer into a hoist although a hydraulic hoist could be used. From the power take-off a sprocket and chain connects to the lower shaft of the transmission within a fifth wheel which operates through gears a splined shaft at the opposite end of which is another sprocket and chain driving the operating mechanism of the hoist.

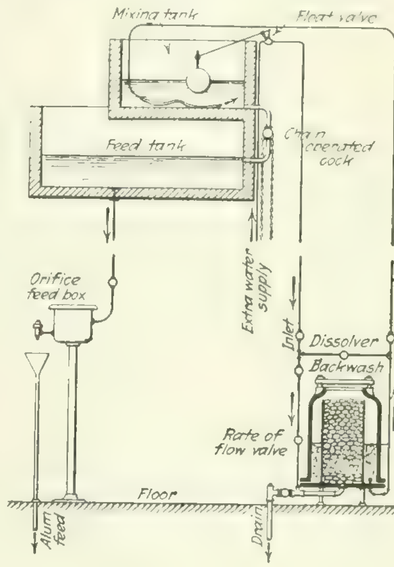
Non-Freezing Spout for Railway Tanks

In the Horton non-freezing spout for railway water tanks which has been put on the market recently by the Chicago Bridge & Iron Works, Chicago, the hinged spout is not connected directly to the tank but is mounted on a vertical pipe or water column which is normally empty. This water column rises from the valve pit and has its head supported by steel framing on the tank posts, as shown in the drawing. The outlet pipe *A*, standing in the water leg of the elevated tank, is connected to the water column *B*, by piping in which is placed a balanced valve *C*. Integral with this valve is an automatic drip-valve having pipe connection to a sewer or drain. When the spout is pulled down to the tender manhole it opens the balanced valve by means of rod and lever connections, thus opening communication with the tank. When the spout is raised it closes the valve *C*, but water trapped between this valve and the spout is drained off automatically by the drip-valve. A gate-valve, *D*, provides for shutting off the water to permit examination of the balanced valve. In experimental service last winter this tank spout arrangement is said to have given satisfactory results.



Alum Dissolved Under Pressure

A recently patented dissolver of chemicals under pressure for use in filter plants to eliminate pumping and mechanical stirring consists principally of a cast-iron cylindrical container having an inner and outer compartment and a hinged water-tight cover. The inner compartment is packed with alum; the outer is partially filled with coarse sand and gravel to filter the alum solution. Water under pressure rises through the alum and flows over into the annular filter compartment down through the gravel and is drawn off through a collecting ring under practically the same pressure as the original. The solution is lead to a mixing tank located at an elevation



above the feed point. A float valve shuts off the supply at a predetermined point, all of the alum having been dissolved in the time taken to fill to this point. A nozzle on the end of the inlet to the mixing tank effects circulation.

Claims for convenience and cleanliness are made by the makers of the equipment, the Bannon Co., Toronto and Buffalo, since the dissolver can be placed near the storage bins and connected by lead piping to the mixing and feed tanks placed in any convenient elevated position, while the orifice box only need show in the head house or other point of application.

Out-of-the-Ordinary Trade Publications

Shellac—THE WILLIAM ZINSSER CO., INC., New York, tells "The Story of Shellac" in a 16-p. booklet. Contrary to popular opinion, the text states, shellac is not the gum or sap of a tree. Instead it is the hardened secretion of insects each about one-fortieth of an inch in length which swarm in great numbers on certain trees in India, commonly known as lac trees. Millions of the tiny red insects suck the tree sap up through their bodies and literally feed themselves to death. In passing through the insect's body the sap undergoes a chemical change and is exuded forming a hard, shell-like mass.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Why 1913 Is Used as Base by Bureau of Labor

It Represents Last Full Year Free from Unusual Disturbances, Although Conditions Were Not Normal

Does the fact that the Bureau of Labor Statistics uses the average of the year 1913 *as the base in its computations of percentages of price or wage changes in subsequent years mean that the Bureau regards* 1913 *as the normal toward which, commercially and industrially, we should strive?*

So many inquiries of this character have been received by the Bureau that Ethelbert Stewart, United States Commissioner of Labor Statistics, has issued a statement "to answer this criticism once and for all."

"Originally the 'base line' adopted by the Bureau," he says, "was the average for the 10-year period from 1890 to 1899 and this was used for a number of years. The reasons for changing this base line were that the figures for the earlier part of the decade 1890 to 1899 were not sufficiently comprehensive, that the more recent figures were much more satisfactory from every point of view, and that under ordinary conditions the base line should be a reasonably recent period, the old base line, 1890 to 1899, being looked upon as being too far in the past.

Ten-Year Base Line Dropped

"When this 10-year period base line was dropped, a plan was adopted of taking the average of the last completed year as the base line. The difficulty with this is that such an index does not give one a comparison over any desired stretch of time. It is desirable to have some standard not affected by present and intervening disturbing conditions when we want to know how this price or that wage rate compares with the price or the rate before the war, and the bureau has and will continue to compute its percentages and establish its indexes upon such a basis. From the beginning of the war, August, 1914, to the present time there has been no period uninfluenced by unusual conditions and which could be accepted as a base line. The year 1913 as a base gives only a sufficient backward look to cover all the essential requirements of an index. It gives one as the desired starting point the last full year free from unusual disturbances, but this must not be confused with our ideas or ideals of normal. In an address before the eighth annual convention of the Association of Governmental Labor Officials of the United States and Canada, I said:

"'The sooner we realize that the World War has made necessary a new world normal the sooner we will be able to arrive at a basis upon which economic conditions can be stabilized and a normal condition attuned to that basis may be reached. I am of the opinion that the phrase, "getting back to normal," is an unhappy and an unfortunate one, if by getting back to normal is meant the conditions in 1913. Personally I do not believe it is possible. * * * I am as desirous as anyone of reaching a normal, but I would reach forward and not backward for it. Before we can readjust to a new normal we must know what we mean by normal.'

"On several other occasions, both in public and in correspondence of the bureau, I have taken occasion to reiterate this position; and the fact that the bureau continues and probably will continue to use 1913 as equaling 100 does not mean that it considers 1913 as equaling normal. It is a false deduction to assume, because the statistician must have a definite base for his percentages and his index numbers, that therefore he considers that base as either fixed, normal, or relatively good. Wages were not fixed in 1913. They were going up and had been going up. Taken over a long stretch of years the increase in wages in the United States had been about 2 per cent a year up to 1913; and no statistician by taking the average for 1913 as his base line would think for a minute that he was thereby fixing a wage level. The same is true of prices. They have been going up for half a century, taking price levels as a whole.

"The Secretary of Labor, in a series of articles in the *Chicago Daily Tribune,* made it perfectly plain that the Department of Labor does not recognize the conditions of 1913 as being applicable to the present time nor as being a condition toward which we should strive.

"It is in the very nature of an index number that where the base is known, it can be shifted and a new index number formed on any other years as a base by the simplest mathematicl process; and for this reason and because it gives the situation from year to year over a considerable period and reaches back to a time before the present world disturbances began, this base line will be retained."

British to Use Unemployed on Drainage Work

(London Correspondence)

The British Ministry of Agriculture announces that, subject to the sanction of Parliament, funds will be available for carrying out drainage schemes for the alleviation of unemployment during the coming winter.

The Ministry, in the case of each scheme approved, will be prepared to advance the whole of the money required, subject to these conditions:

(1) All the work must be done as far as possible by hand labor; (2) seventy-five per cent of the labor must be ex-service men, if available; (3) of the remaining 25 per cent the majority must be married civilians, if available; (4) the wages payable for ordinary labor will be the agricultural rates for the district, as fixed by conciliation committees or otherwise; (5) all work must be completed by March 11, 1923, as no public money will be available after March 31, 1923; (6) on the conclusion of the work, a proportion of the net cost, up to 33⅓ per cent, will be refunded to the Ministry.

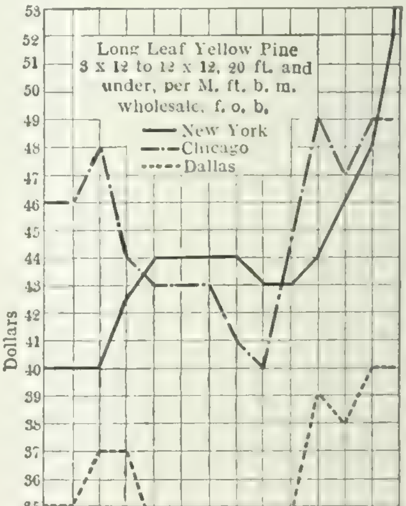
Runaway Lumber Market Not Likely

Prices Show Upward Trend—Production Increasing—Serious Car Shortage Checking Mill Shipments

A nation-wide survey just concluded by the National Lumber Manufacturers' Association to ascertain the possibilities of housing construction being retarded by possibility of a so-called "runaway" lumber market, has brought out the fact that large producers, dreading a feverish market and appreciating the menace to prosperity in a slowing-down of construction activities, are rushing production in order to avoid such a situation.

Reports received by the Association show that price increases on the whole have been small, since Jan. 1, the maximum being 23 per cent, at the sawmills.

Higher wages and other items of production costs and, in many instances, abnormal demand caused by excessive anticipatory buying, have accounted for most, if not all, of the price advances. In some instances, it is reported, manufacturers have sold lumber at a loss, at the sawmills.



The 375 mills reporting to the National Lumber Manufacturers' Association for the week ending Aug. 26, showed production at 236,485,952 ft. b.m,. or normal for that period; 357 mills reporting for the week of Sept. 2, showed production at 3 per cent below normal; while 354 mills in the week ending Sept. 9 reported production at 5 per cent below normal; latest reports as of Sept. 16, from 381 mills, show production at about 4½ per cent below normal, indicating a slight improvement in lumber output.

Orders have fallen off perceptibly, standing at 7½ per cent below normal on Aug. 26; at 15 per cent below, Sept. 2; 25 per cent below, Sept. 9 and 30 per cent below normal for the week ending

Sept. 16. Shipments have likewise dropped off, starting at a point 12 per cent below normal on Aug. 26, a slight gain of perhaps 1 per cent was realized for the week ending Sept. 2; the average dropped, however, to 20 per cent below for the week of Sept. 9 and stood at 23 per cent below normal for the week ending Sept. 16.

With a greater falling off in orders and shipments than in production, lumber stocks, throughout the country, do not approach a condition of depletion. A serious car shortage then looms up as the principal retarding factor in lumber deliveries from the mills.

With sufficient stocks available, held up by car shortage alone, the removal or alleviation of the latter emergency is calculated to exert a curbing effect upon the rising tendencies of the lumber market.

The accompanying chart illustrates the upward trend of pine prices in three of the most important pine-lumber markets of the country. Douglas fir prices have followed a similar upward tendency; in five out of nine cities, reporting weekly to *Engineering News-Record*, the demand for fir being heavier than for yellow pine.

1922 Expenditures on Southern Pacific System to Total $29,000,000

Extensive track work is included in the budget of $29,000,000 to cover construction and betterment on the Southern Pacific System in 1922 as announced in San Francisco on Aug. 23 by F. L. Burkhalter, assistant general manager, Southern Pacific Co.

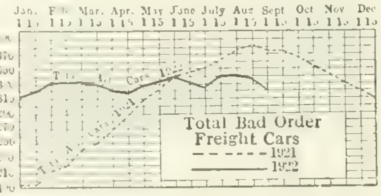
The program calls for an expenditure of approximately $11,300,000 for new rails, ties and ballast; $4,500,000 for new locomotives, $12,500,000 for new rolling stock, and $700.000 for plant facilities. It is estimated that 290 miles of track will be relaid with new 90-lb. rails; a total of 2,518,000 new cross-ties will be placed, and 800,000 cu.yd. of crushed rock and slag ballast will be used. Extensions to sidings at Crystal Lake, Cisco and Troy are being built to accommodate the long 55-car freight trains now being handled across the Sierra Nevada Mountains. The work of double-tracking the line across the Tehachapi Mountains will be continued this year in the portion between Bakersfield and Sivert and between Tehachapi and Cameron, a total distance of 23 miles. The enlarging, relining and concreting of tunnels will also be continued.

In addition to the construction program for 1922, it is announced that an order for $2,000,000 covering 45,240 gross tons of steel rails for use during 1923 has just been placed with the Tennessee Coal, Iron & Railroad Co.

Heaviest Car Demand Comes in Next Two Weeks

While 321,674 of the 2,270,551 freight cars on all lines were in bad order on Sept. 1, 1922, it must be borne in mind that one year ago 370,000 were out of commission. The chart shows the general movement last year and this.

With a falling off in surplus cars of over 35 per cent, during the week ending Sept. 8, also with 14 per cent of all cars, in need of repairs on Sept. 1, a critical situation presents itself as the railroads face the heaviest traffic period of the season, Sept. 30 to Oct. 15. An unusually large number of locomotives, in bad order, also add to the gravity of the situation.



An order issued by the Interstate Commerce Commission, effective Sept. 3, permitting the use of open-top cars, 42-in., or less in height, for shipment of commodities other than coal, released about 34,000 cars; a previous order affecting cars 36-in. in height, had released 62,000 open cars; these together with almost all surplus cars have since been absorbed by the volume of traffic normal to this season of the year.

Loadings in the last three weeks recorded are here compared with the same weeks in 1921 and 1922:

	1922	1921	1920
Sept. 9...	832,744	749,552	883,415
Sept. 2...	931,598	831,288	961,633
Aug. 26..	890,838	828,883	1,001,308
	2,655,180	2,409,723	2,846,356

Aside from a slight drop in car loadings during the week ending Sept. 9, the total for the week of Sept. 2 represented the largest week's loadings thus far in 1922. From the present time until the middle of October, railway facilities will be given a severe test in the handling of anticipated seasonal movements of grain, coal and general merchandise.

The American Locomotive Co. announces that during the ten days ending Sept. 20, orders were received for 176 new locomotives of various types. These engines together with other orders received in the same period, represent a total value of $13,250,000.

River and Harbor Bill Passed

Under the new arrangement of committees in Congress, a so-called legislative river and harbor bill has been brought out and has passed both the Senate and the House. The bill does not carry appropriations but simply authorizes the projects. The appropriations committees will recommend the amounts to be expended after receiving the estimates of the federal departments and conducting the usual hearings. In the Senate the following projects were added to the bill (survey): Westchester Creek, New York; Abescon Inlet, New Jersey; Inland waterway from Norfolk to Beaufort Inlet, North Carolina; Corpus Christi, Texas Harbor; Nogo River, California; Umpqua River, bar and entrance, Oregon; Siuslaw River, Oregon; Lake Washington ship canal, Washington; Tennessee Rivers and tributaries.

The Secretary of War is authorized in the bill to modify the East River, New York project and that of Wrangell Harbor, Alaska.

The Senate also added to the bill a provision that no project shall be considered by Congress with the idea of authorizing an improvement unless there has been a survey of the project within five years. With the idea of avoiding the delays and increased costs of the projects done on a piece-meal basis, the Senate inserted an amendment which authorizes the use of continuing contracts whenever such form of prosecuting the work may be prescribed in the bill carrying the appropriation.

Another Senate amendment to the bill makes it compulsory for carriers on the navigable waters of the United States to furnish such statements relative to vessels, passengers, freight and tonnage as may be required by the Secretary of War. The bill carries a penalty clause fixing a fine of $100 and imprisonment for each violation.

Where 18,299 Mi. of Federal-Aid Roads Were Built, and Types

Types of Federal-aid roads built in different sections of the country, vary largely according to availability of materials, volume of traffic and climatic conditions, as shown in reports of the Bureau of Public Roads, U. S. Department of Agriculture.

The 18,299 mi. of Federal-aid roads completed on July 31, have been distributed among the eight major types of construction, as follows: Graded and drained, 2,528 mi.; sand-clay, 2,222 mi.; gravel, 7,013 mi.; water-bound macadam, 456 mi.; bituminous macadam, 654 mi.; bituminous concrete, 699 mi.; concrete, 3,350 mi. and brick, 287 mi.

DISTRIBUTION OF VARIOUS TYPES OF FEDERAL-AID ROADS AND NUMBER OF MILES COMPLETED, JULY 31, 1922

State	Miles Completed: Roads	Miles Completed: Bridges	Grading and Draining	Water-bound Macadam	Bituminous Macadam	Bituminous Concrete	Concrete	Gravel	Brick	Sand-Clay
Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut	443.1	0.2	......	18.7	154.4	66.3	73.8	129.9		......
New York, New Jersey, Pennsylvania	764.3	..	.	.	23.6	77.1	637.5	3.4	22.7	.....
Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida	2,842.9	24.5	173.5	83.4	204.3	107.0	387.3	270.4	24.5	1,592.5
Kentucky, Tennessee, Alabama, Mississippi	1,046.0	1.1	221.9	46.4	78.7	31.0	34.2	416.6	10.3	206.9
Ohio, Indiana, Illinois, Michigan, Wisconsin	2,391.0	0.5	300.6	60.8	117.2	104.9	1,167.9	409.0	148.8	81.8
Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas	3,250.3	2.0	1,796.0	4.5	41.6	24.9	421.7	828.6	78.5	54.5
Arkansas, Louisiana, Oklahoma, Texas	2,795.8	5.9	118.8	186.8	51.5	197.4	113.2	2,081.8	2.0	44.3
Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada	2,[illegible]59.5	5.0	726.4	29.6	1.4	34.5	217.8	1,407.8	. .	242.0
Washington, Oregon, California	1,[illegible]25.2	2.3	248.4	25.6	......	56.4	296.5	498.3		.

Oregon and Washington Have Extensive Road Programs

The road construction program of the Oregon state highway commission this year including uncompleted work carried over from last year will total $17,000,000 of which it is estimated that $13,000,000 will be completed this year. The entire 1922 program covers approximately 125 miles of pavement, 500 miles of broken stone or gravel surfacing and 400 miles of grading. This includes federal aid for 1922 on post roads amounting to $1,182,000 and government forest road funds for the state amounting to $1,157,000.

In Washington the work done this year by the state highway commission, including federal-aid funds, totals about $5,500,000. This is chiefly on main routes on which the grading has largely been completed in previous years. The total expenditures in Washington for the year are apportioned about as follows: grading, 16 per cent; surfacing, with crushed rock, 29 per cent; paving with concrete, 45 per cent; and bridges of more than 20-ft. spans, 10 per cent. The sources from which these funds are derived are about as follows: federal-aid, 14 per cent; taxation, 32 per cent; motor-vehicle licenses and gasoline tax, 54 per cent. About 90 per cent of the concrete paving now done in this state is 20 ft. wide or more.

The most important north and south route through Washington is the Pacific Highway, 310 miles long. Of this only 45 miles remains to be paved with concrete and most of this will be undertaken next year. A feature of road work in the western portion of Washington is the heavy cost of clearing the right of way. This varies from $100 to $800 per acre according to the stand of timber. The concrete paving standards on state work are for a minimum thickness of 6 in. at the edges and 7½ in. at the center, with a width of 20 ft. Where poor foundation is met, increased thickness up to 11 in. is used. Reinforcing is omitted only where the foundation is very good. Except in remote districts most of the Washington state highway work is contracted on the unit price basis.

The several counties of Washington are this year carrying on road construction programs estimated to total between $8,000,000 and $9,000,000.

A feature of Washington road work that has contributed to economy is the uniform specifications on sand and gravel which have been adopted by state, county and municipal authorities.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of September 7; the next, on October 5.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.04	$3.65	$4.20	$2.92½	$3.05	$3.80	$3.25	$3.75	$3.75
Structural rivets, 100 lb.	3.85	4.35	6.00	3.35	3.52½	4.80	+4.50	4.00	6.50
Reinforcing bars, ¾ in. up, 100 lb.	2.94	3.50	3.50	2.82½	2.95	3.97½	3.00	3.75	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	57%	61.15%	45%	59½%	58.9–5%	43%	47.9%	45%	30.00
Cast-iron pipe, 6 in. and over, ton	55.30	49.00	51.50	46.86	52.00	60.00	51.00	+53.00	50.00
Concreting Material:									
Cement without bags, bbl.	2.60@2.75	+2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.78
Gravel, ¾ in., cu.yd.	1.75	+2.00	2.25	2.00	1.75	1.75	2.25	1.00	1.50
Sand, cu.yd.	1.00	+1.35	2.25	2.00	1.00	0.75	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	1.65	1.60	2.25	3.50	2.25	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+59.00	+42.00	40.00	49.00	40.00	50.00	33.00	24.50	50.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.14½	1.80	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	18.00@20.20	12.00	10.90	11.00	18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	.09	.065	....	.11	.08
Hollow partition tile 4x12x12, per block	.1112	.0776	.115	.0808	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	.91	.99	1.13	.97	1.00	1.12	1.04	.86	1.12
Common Labor:									
Common labor, union, hour	.60	.35	....	.80	......	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.44@.60	.30	.25	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par.) Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Structural shapes and reinforcing bars quoted at $2@$2.25, f.o.b. Pittsburgh; the lower figure applying generally on large orders, with smaller tonnages going at the higher quotation. Structural rivets quoted at $4.50 as against $4.25 per 100 lb., in San Francisco warehouses; discounts on black steel pipe, 2½-in., reduced to 47.9 per cent as compared with a maximum of 49.1 per cent, last week.

Stronger pig-iron market reflected in advance of $2 per ton in cast-iron pipe, in Seattle; prices firm in other cities, with slight scarcity of pipe.

Cement up 4c. per bbl. in Atlanta; New York quotations nominal, owing to keenness of competition. Cement may be had, however, at about $2.60@$2.75 per bbl., delivered, not including cost of bags.

Structural timbers, long-leaf yellow pine, up $2 per M. ft. in New York and Atlanta, following general upward trend due to car shortage.

Advance of ½c. per lb. in red and white lead, f.o.b. New York.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*

Volume 89 — NEW YORK, OCTOBER 5, 1922 — Number 14

Another Lesson for Pier Designers

DESTRUCTIVE fires in shipping piers occur with disturbing regularity. There are no statistics available, but considering the comparatively small number of such piers it seems probable that the fire loss per square foot area is greater in this type of structure than in any other. And yet there are few such fires which could not have been prevented by the observance of simple rules of design and protection taught at great expense in the fires of recent years. The New Orleans wharf, destroyed last month, was only another case in point. The negligence in design and protection are well pointed out by Major Shaw in his article on another page. It is only to be hoped that the next engineer who comes to design a wooden pier will appreciate first, the ease of conflagration spread in the wide open pier; second, the inflammable contents of the ordinary pier warehouse, and third, the tendency of any shipping pier to become unapproachable from shore by fire fighting apparatus. These may lead to a better layout, a more fire-resisting construction and a more efficient supervision than the New Orleans pier exemplified.

An Abiding Problem

AN UNFORTUNATE corollary of the coal miners' and shop-men's strikes is their overshadowing effect on the public mind as it contemplates the problems of the railroads. Even the man in the street knows that one result of the shop-men's strike is a deterioration of motive power and rolling stock. He understands also that an effect of the coal strike is to throw on the railroads a heavy traffic in that commodity just as crop movements are coming to their maximum. The tendency will be, therefore, to ascribe whatever transportation difficulties may develop during the next few months to the effect of the strikes and to overlook the fact that even without these additional griefs, our transportation system could not possibly be up to par. Early last spring the opinion was expressed in well-informed quarters that in the event of a business revival the roads would not be in shape to perform their mission. Deferred maintenance had taken its toll of the railroad substance and it was generally recognized that if the roads were to meet the demands upon them we must rely upon the skill and sustained devotion of the maintenance and operating forces. We cannot afford to forget that the inadequacy of our railroad facilities results from conditions that lie deeper than the recent strikes and that find their roots in our national attitude toward transportation enterprise. Short-sighted and vote-serving labor policies, undiscriminating rate-adjustment both downwards and upwards, punitive regulation inspired by abuses of an earlier day, dalliance with government operation; all have had a share in bringing about these conditions. But if the American people expect ever again to enjoy a transportation service that will be sound in itself and properly articulated with the rest of their industries, they must be governed by their present and prospective needs rather than by ancient grievances and political expediency. If American industry is to be kept healthy and vigorous we must guard against hardening of the transportation arteries; but without an earning capacity attractive to new capital the railroads cannot possibly keep pace with expanding requirements.

Encouraging Gambling

AN IMPARTIAL owner and non-collusive bidders are equally necessary to the sealed bid system of doing construction work. If either element is lacking every interest would be better served by open auctioning of contracts or by arbitrary selection with any system of payment that can be agreed upon. By common consent and by statute collusion among bidders is prohibited but if a growing complaint among contractors is a sign, the owner who uses the bids merely to play the bidders one against the other is becoming all too common. The latter evil takes the form generally of minor revisions in the proposals after bids are opened and the calling of new bids in the hope that knowledge of all the bids will bring about price shaving. In private work, at least, this is quite legal. Its ethics are a bit shady, however, and certainly it is most injudicious and dangerous. It introduces by subterfuge a gambling and speculative element into business which by its very nature has already too much financial hazard. Contractors in various parts of the country are making organized fights against specific instances of this practice and in these fights they should have the assistance of engineers, who appreciate that any method of letting work which imperils a fair price for a good job leads to degeneracy of the whole construction industry, of which they are a part.

Breaking Through Class Walls

CHARACTERISTIC of much present-day discussion on economics and social problems is the practice of dividing all humanity into a few general classes, each conveniently tagged with a word or a phrase that soon becomes a fixed and definite symbol. Among such tags are "labor," "capital," "producer," "consumer," "the public" and "the interests." These are legitimate words and so long as the meaning ascribed to any of them in a specific discussion is kept clear no fault can be found with those who use them; but a moment's reflection will demonstrate how impossible it is to effect so arbitrary and clear-cut a classification of human kind. Too often, however, these labels are applied deliberately to work up fictitious distinctions for political or less worthy purposes. Now and then we encounter an influence that tends to counteract this false gospel but too seldom is its significance made clear. One of these is the growing practice of producing firms to have their consumers for security holders. This works to bridge the gulf between the "producer" and the "consumer." When the producer happens to be a public

utility, it tends also to dim the distinction between "the public" and "the interests." A variant of this is the placing of securities in the hands of employees, one effect of which is to show how shadowy is the line between "labor" and "capital." All this is worth-while and promising and there is room for more of it. It is not, of course, a panacea. Probably the day never will come when there will no longer be clash of interest between individuals and groups. But the life of a growing and prosperous people will be found in the normal interplay of these interests, and progress will arise from general compromise with respect to conflicting viewpoints.

Capacity a Factor in Water Power Value

MANY problems involving the determination of the value of hydro-electric power to an operating power system or the comparison of one hydro plant with another power plant, hydro or steam, can not be solved satisfactorily without taking into account the factors both of capacity, the essential elements of which are the prime-mover equipment and the water supply, and energy, which is the name given the quantity of work done by the water through the hydro-electric equipment.

The usual practice in evaluating hydro-electric power has been to reduce annual charges, fixed and operating, to cost per kilowatt-hour, the unit of energy. This is the easiest thing to do, but to use such a cost for purposes of comparison is misleading except under the rare circumstances when the plants under comparison have exactly the same pertinent characteristics. The best example of a valid use of this simple method would perhaps be a comparison between the costs of output from two plants utilizing Niagara River water and head.

Ordinarily, however, there are important variations. For example, excepting Niagara conditions, there are hardly two hydro-electric plants which do not differ in such important respects as distribution of stream flow throughout the year or series of years, ratio of installed hydro capacity to average stream flow, available storage, etc. Evaluations in terms of cost per kilowatt-hour of output usually take into account the difference between primary and secondary energy, that is, between the energy resulting from that stream flow which is reliably available for carrying a given load for X hours per day or Y hours per week, year in and year out, and that which is only intermittently available. But even with the factor of variation in stream flow thus taken into account the story is incomplete without likewise taking into account *capacity*.

The effect of capacity may be noted in the difference in cost in providing for the generation of a given average quantity of hydro energy per year on a high load-factor, or machine-factor, basis, as compared with a low load-factor basis. Although the difference, taking fixed charges into account, is not so great as in the case of steam-electric plants, yet even in the case of water power 70 per cent (high) load-factor energy may cost only two-thirds as much as 40 per cent (low) load-factor energy. This results from the fact that the cost of the additional equipment, installed solely because of low load-factor conditions, must be distributed over the same number of kilowatt-hours as the lesser equipment. The difference in cost is the more marked in the cases of indirect hydro-electric developments where pipe-line, canal or tunnel capacity must be increased to correspond with power house machine capacity.

The converse effect is found in that class of developments where storage reservoirs are essential for stream flow regulation and where, consequently, the greater the extent to which dry season flow is augmented from storage, the more costly the development as a whole. If, in such a situation, a fixed machine capacity be assumed, the cost per unit of energy output will be less for the lower load-factors—referring now to the load-factor of primary energy.

Even more necessary is it to take capacity into account in comparative studies of prospective steam and hydro plants intended to do the same work. Steam-electric units can turn out energy in an amount and continuity limited only by periodic inspections and repairs, whereas the output of hydro units is ordinarily limited by the available stream flow. But this is only one of a number of factors involving capacity. Assume the case where the problem is to determine whether hydro or steam power should be added to a large system in order to provide increased capacity to take care of market demand. The state of the art is such that transmission lines no longer are a bugaboo. In fact extensive steam-electric power systems in New England, New Jersey and other parts of the East are already dependent on transmission systems to practically the same degree as if the territory were served in whole or in part by hydro power. The reliability and flexibility of a well-designed hydro station is now generally admitted to be superior to that of an equally well-designed steam station, so much so in fact that this superiority may properly be offset against possible weakness in the transmission link. Here evidently the problem is not properly solved unless one takes into account, not merely the cost of fuel and labor and the other items entering into the so-called operating cost of producing energy, but also the fixed charges, such as interest, depreciation, taxes and insurance, against the capacity by means of which that energy is produced.

The necessity of evaluating capacity is perhaps most clearly evidenced under circumstances where the hydro plant would be used as reliable peak-carrying capacity for a large power system. There the consumption of primary hydro energy would be minor in amount. If all costs were allocated to the kilowatt-hour, the unit cost of energy would be shockingly high. Indeed, to omit evaluating capacity in such a case would be little short of absurd.

The choice of proper terms for such an evaluation, of capacity as well as energy, is a problem in itself. Herein is suggested only the necessity for its being made. But it may be said that in its solution one should give serious consideration to the method of making comparisons in terms of equivalent steam-electric capacity, using the steam-electric capacity, so to speak, as a common denominator.

Road Building Hints From England

PENETRATION-MACADAM practice in Great Britain, as it is described on p. 564 of this issue, deserves notice in two particulars of construction which are not often given such careful attention by American road builders. They are (1) testing an old road surface to determine its sufficiency as a foundation and (2) protecting the stone course from rain and removing rain water by means of driers, so that the penetration of the binder is assured.

British road builders instead of sounding the old macadam by an occasional test pit to determine thickness, dig a trench through the surfacing half-way across the street every 450 ft., first on one side and then on the other. While an isolated thin spot may escape disclosure by this thoroughgoing opening up of the old pavement, there is not much chance that any considerable stretch of over-thin macadam will remain undiscovered. As an example of the assurance demanded by English engineers as to the integrity and strength of their road foundations before they place an expensive surface, the procedure described is well worth regard in this country where, relatively, the pavement slab receives the most intensive study.

In constructing the penetration surface the English road builder also takes precautions that are not common in the United States. Penetration work is most successful always when the stone course is warm and perfectly dry. In fact it is almost impracticable if the stone is water-soaked or very cold. A rain storm ordinarily stops penetration construction until the layer of stone has dried out and this is often a slow process in cold weather. To meet this situation English engineers (1) protect the laid stone by covering it with tarpaulins, (2) dry out the stone layer by artificial heat applied by blowers.

Substantially similar methods are known to American road builders but in connection with other kinds of paving work. In concrete paving, movable canvas shelters for the finished slab are common. Again, in brick paving, heaters are used to dry out the joints so that the bituminous filler will penetrate properly. Both devices seem entirely capable of modification for use in protecting and preparing the stone course for penetration macadam, so that the binder can be easily applied. The fact that British engineers have found housing and drying to be economically practicable justifies at least some experimentation with them in this country.

Adding Days to the Construction Year

IN THIS issue begins a series of four articles that have a wide appeal to the construction industry. There are three essential agents in the work providing housing and public facilities—the engineer (with whom we couple the architect), the contractor, and the manufacturer of materials and equipment. Each of these agents has a vital interest in lowering the cost of work. The engineer has a responsibility to his client for costs; the overhead costs of the contractor will be lowered if he can do a greater volume of work; the continuity of the manufacturer's operations will reduce his overhead, likewise, and enable him to put his product at a lower cost into the hands of the contractor.

All past efforts of these three agents at increasing the volume of construction in a given season, except on large building operations, have been directed at increasing efficiency during the present operating time. Relatively little attention has been given to *methods of finding more time in which work can be performed.* An inquiry tending in this direction forms the leading article of this issue.

Nor has this failure to find more working time been due to a lack of recognition of the wastefulness of the industry's use of the working year. Contractors have known that out of the 300 days worked by most industries they were utilizing, except in large building operations, only about 100. Yet a most exhaustive search of the literature of the industry and an equally exhaustive inquiry among engineers and contractors have failed to disclose anything but a negligible amount of study of or progress in this important problem. Recently, however, the need for action has been keenly sensed.

The time is decidedly ripe for a courageous and concentrated attack. We still have relatively high construction costs and, with a large deficiency in construction, with a labor supply inadequate to the demand and permanently diminished by the restriction of immigration, we need to use the available labor and equipment to the utmost. Striking evidence that the subject is coming to the front is afforded by the repeated insistence, while the plans for the American Construction Council were forming, on the need for studies along these lines. In fact, when the Council gets well under way, it is to be expected that it will attack the problem vigorously.

Before results of a large order can be expected, we must, however, broadly educate the entire industry to the tremendous opportunity that lies in the utilization of time now utterly lost. The largest possible volume of public-works construction and housing at the lowest possible cost should be the stirring ideal of the construction trio—engineer, contractor and manufacturer.

It is with the hope of furthering this broad educational work that *Engineering News-Record* had Charles S. Hill, its associate editor in charge of construction work, devote several months of intensive study to the problem. He draws, too, on a life time of experience with construction work. The results are found in the series of articles which begin in this issue.

We fully realize that great progress in the desired direction will come not from isolated articles nor the action of individuals, but from a broad movement supported by the leading organizations of the industry. The engineer, through such organizations as the American Society of Civil Engineers, the American Association of State Highway Officials, the American Society for Municipal Improvements; the contractor, through the Associated General Contractors and its affiliated regional organizations; the manufacturers, through their organizations, must put committees to work within their organization and in participation in joint work with the other branches of the industry. But of that, Mr. Hill will have something to say following the concluding article of the series.

In stressing, however, the need for organized attack on this tremendous problem, we do not mean to absolve the individual from a personal responsibility. The engineer can show his client, or his employer in the case of public works, that it will pay to prosecute work in winter; the contractor can devise ways of executing work in cold weather and of protecting operations so that they will not be interrupted by mud and rain; the manufacturer, particularly of equipment, can develop devices which may be operated with good, or even full, efficiency despite the weather conditions.

It is for these reasons that *Engineering News-Record* believes that seldom has an effort been made through the pages of a technical journal that has a stronger demand upon the attention of the industry than the series by Mr. Hill. That it may stimulate thought, that it may bring home to every engineer, every contractor, every manufacturer and to all their organizations the opportunity that lies in finding more time in which to carry on construction operations is our high hope.

Lost Time in Construction—I

The Causes of Lost Time

Winter Hibernation, Weather Delays, Poor Service, Plant Faults and Inefficiency Cut Down the Construction Year to One Hundred Days Worked

By C. S. Hill
Associate Editor, Engineering News-Record

First of a Series of Four Articles

WASTED time is the crying evil of construction. Winter idleness; Sundays and holidays; rain, snow and mud interruptions; machine delays; transportation delays; labor turnover, inefficiency and strikes; accidents and sickness; frequent plant shifts; yearly reorganization of working forces; engineering delays; illogical practices in letting contracts, and hand-to-mouth planning of construction programs reduce the working days of the year to less than a hundred. In modern construction operations, structure, i.e., masonry walls, steel framework, road pavement, is being produced, on the average, on only about one day in every three or four calendar working days. Engineering construction is about 25 per cent, certainly not over 30 per cent, efficient in its utilization of time. Remedy of this condition is a task for nation-wide effort of engineers and contractors.

It is unthinkable that it shall not be undertaken, that the construction industry, second only to agriculture as the leading industry of the country, will rest under the imputation of being so extraordinarily wasteful of time that about the only comparable business is that of summer-resort hotel keeping. So completely nation-wide is the short-season practice of construction, so woven in is it with the customs of every locality, that reform is a labor for more than the national associations of engineers and contractors. It requires the participation of local engineering and contracting organizations to consider and solve the various problems as they exist in every section of the country: The situation as it presents itself for the consideration of engineering and contracting organizations in respect to each of the principal causes of lost time will be considered under the following heads: (1) Winter idleness, (2) rain and mud delays, (3) management delays, which include plant delays, service delays and delays of direction.

Winter Idleness—Generally, construction is discontinued from October to May of each year. Winter work is attempted to a considerable extent only in building construction, underground work and heavy excavation. Except emergency operations, other kinds of construction are rarely undertaken. In fact effort is made to keep construction operations down to amounts of work which can be completed in a working season. If a larger volume is undertaken, it is specified that certain operations shall be curtailed or else the contractor voluntarily curtails most if not all operations.

Cessation of construction in winter is prompted, of course, by the fact that cold weather, particularly frost, hinders certain processes, makes all work uncomfortable and, ordinarily, adds to the cost of construction. *The processes which are actually prevented by cold weather are few.* In most cases they can be carried out with some added discomfort and at more or less increased cost. Actually cost is the deciding factor. If the owner will pay, any sort of construction can be carried on in winter.

Generally owners have not been willing to pay for winter construction and it has not therefore been practiced. It has followed that both engineers and contractors have come to believe that physical difficulties and not disinclination to pay the cost stands in the way. Habit has developed out of practice and contractors are not inclined to work in winter because it requires an upset of habit.

There is a further reason. Construction is an exacting task for those who direct operations; regular hours are unknown and if difficulties arise long periods of continuous work and worry are required. After a crowded summer's work, construction managers frankly demand a season of comparative inactivity. The custom of not carrying on construction in winter has led the industries which supply construction materials—brick, crushed stone and gravel—also to discontinue or curtail production during the idle season. It is these last two facts which explain the practice of reducing winter construction operations in the Southern states where cold weather does not prevent activity.

In recapitulation, construction is not discontinued in winter because it is physically impracticable. It is discontinued because it costs more. This reduces the problem of extending the construction season through the winter months to one of economics. The truth of this assertion is indicated by the fact that wherever the value of winter construction is certain, means of carrying it on are found without especial difficulty. A similar readjustment of practice for the industry as a whole can be accomplished by showing, if it is the fact, that it pays generally to continue work in winter instead of letting plant and capital remain idle and the owners be delayed in getting the use of the improvement. This calls for concerted action. The individual contractor or engineer or owner can accomplish nothing in the nature of a general change at a cost which he can afford, but he can do something to improve his own practices.

It follows that the labor of reducing time wasted because no work is done in winter is put squarely on the organizations which represent the construction industry—on the engineering and contracting associations and on the manufacturers' organizations. The line of procedure to be followed is the only question for consideration. Investigations are obviously the first action. The following inquiries are needed:

1. Determination of the kinds of work which lend themselves to winter performance. (It seems practicable, for example, to install plant, accumulate materials and supplies and make everything ready for im-

mediate production with the beginning of warm weather even if actual building of some kinds of structures has to await the coming of warm weather.)

2. Determination of methods and equipment for conducting construction in cold weather, involving consideration of housing, heating of site and materials, substitution of machines for manual labor, etc.

3. Determination of costs of winter work compared with the cost of similar work in warm weather, which involves consideration of winter supply and wages of labor, ability to get materials, transportation service, reduction of unemployment, etc.

4. Determination of the limit where extra cost of winter construction ceases to be profitable; affecting the extra cost is the saving due to reduction of idle time of plant and organizations and of the time during which uncompleted construction is returning no service to the owner.

Rain and Mud Delays—Eliminating the winter period, October to May, as a problem for separate disposal in questions of weather delays, and counting out Sundays and holidays as economically justified for rest and recreation, the greatest causes of lost time in construction are rain and mud. In Arkansas in 1920, a very wet season, enough rain to interrupt road construction fell on 30 per cent of the calendar days, and in Iowa in 1921, a fairly dry season, counting working days only, about 15 per cent of the time was lost due to rain and mud. Probably these figures represent the minimum and the maximum of time lost in out-door construction because of rain and mud, considering, of course, the humid sections of the country where construction is most active.

Means of reducing time lost on account of rain and mud fall into the following classifications:

1. Moderating the engineering requirements for dryness, as of road subgrade, before continuing construction.

2. Employing methods and equipment the conduct and operation of which are least affected by wet weather conditions.

3. Employing methods of shedding rain or drying out surface mud.

4. Housing the work.

In none of these ways have engineers and contractors accomplished anything really constructive. Most of them have not given the problem the courtesy of serious thought, accepting rain and mud interruptions of expensive work as dispensations of Providence to be endured with Christian fortitude.

The practicable possibilities of the means enumerated are not imaginary. Certain methods and operations, as industrial railway haulage, are obviously less affected by wet weather than are others. Means of quick drainage, of shedding rain and of absorbing the mud layer have been tentatively demonstrated to be possible in road work, where, experimentally, finished subgrade has been crowned and tarred to shed water and in other instances has been spread with sand or stone chips to "soak up" the mud layer. Even housing, in the sense of tenting, offers possibilities.

Because it is one of the operations most hindered by wet weather and is the largest development of many years in engineering construction, highway construction suggests itself as a specific field for experimentation in methods of reducing time lost because of rain and mud. It is the one kind of construction whose direction is well centralized both nationally and by states and therefore the one kind which can most easily be brought under experimental study. The American Association of State Highway Officials is the body which should organize the inquiry in conjunction with the Associated General Contractors.

Plant Delays—Compared with time lost due to wet weather, plant delays are minor. Oddly enough, however, they, with service delays, have come to be thought of first when lost time in construction is mentioned. Lost time chargeable to plant is due principally to the following causes:

1. Poor co-ordination of the units of the plants;

2. Machine breakdowns;

3. Shifting plant units on the job, and

4. Inexpert plant selection, operation and maintenance.

The corrective to all these causes of delay is skilled construction plant engineering. In modern construction operations planning the plant layout and the selection, operation and maintenance of equipment call for mechanical engineering knowledge and resource well above that required in many factories and power plants where a mechanical engineer is regarded as indispensable. Such engineering direction, however, is not common in construction plants, even though plant investments on single contracts run from fifty thousand to half a million dollars.

Determination of the principles of plant layout and co-ordination and of the best practice in equipment selection, operation and maintenance is a task which the construction industry owes to itself the duty of performing. It includes the preparation of a system of recording machine performance and of keeping operating and maintenance costs. One need of such performance and cost figures is to provide the plant superintendent with data by which he can select and co-ordinate his equipment and plan his plant. The second need is to secure data which will disclose mechanical, structural and service weaknesses and indicate where and how improvements can be made. Standardization will be a logical result of such work.

Investigation of plant delays and of the means of reducing them is a joint task for the American Society of Civil Engineers and the Associated General Contractors. The last association has tentatively approached the task by listing standardization of equipment in its program of activities for the future. These good intentions should be clinched by the creation of special committees to inaugurate the work in a purposeful way.

Service Delays—Time is lost because of delay in delivery to the operation of a sufficient supply of materials to keep construction progressing with the continuity and speed otherwise possible.

A portion of this delay is due to failure of the producer to have ready for delivery the amount of material required at the time it is needed. Generally this sort of delay comes from the fact that the demand for construction materials takes the form of a peak load during the few months of active construction in summer and the capacity of the plant is unequal to this peak load. The producer meets the situation by accepting orders to the full volume of the demand and then jockeying deliveries among his customers so as to keep

complaint by any of them from becoming sufficiently violent to cause rupture of business relations.

The only cure which reaches the trouble fundamentally is some method of spreading the consumption over a longer period of the year and so smoothing out the demand curve to a nearer approximation of the curve of production. Some help may possibly be obtained through determining and publishing plant capacities or through the pooling of orders by a number of plants, but these are only palliatives. The remedy lies in spreading the demand by extending the production period. As this necessitates extending the construction season and co-ordinating transportation facilities with the demand, the problem is entirely worthy of the best talent that engineers, contractors and the producers can bring to its solution.

Another secondary cause of delay in the service of materials is engineering restriction of kind or quality, which limits the sources of supply and introduces long hauls, with, of course, correspondingly greater opportunities for transportation delays. The remedy here is research which will disclose safe methods of utilizing a wider variety of materials and then writing into specifications the modifications necessary to permit the use of these materials. An excellent example of this method of procedure is the investigation by the Iowa Department of Highways by which pit-run gravel from local pits is successfully taking the place in concrete road construction of material which, to meet the requirements of the older specifications, had to be imported. In discovering resources of this sort there is an unlimited field for engineering and contracting research work.

However, most of the service delays in construction are due to insufficient and irregular transportation. The railways at times do not and at other times cannot transport construction materials in the volumes wanted at the times needed. The reasons are many. There are physical limitations of line and equipment, there are preferential industries to be served, there are perishable or seasonal commodities which demand right of way, there are rulings of transportation governing bodies to be obeyed, and there is the paramount reason that when high-classification freight can be had, low-classification freight will always get the fag-end of the service. The problem to be solved is very intricate. To find the solution involves a study (1) in coordinating production, transportation facilities and demand, (2) in applying interstate and intrastate regulation, (3) in developing local supplies and (4) in developing other methods of transportation than rail.

Concerted action by all construction interests is required by the nature of the service delays which have been mentioned. It is wanted particularly because the individual industries, chiefly producers, are now seeking legislation which, while directed toward the eradication of a common evil, is naturally directed along lines most beneficial to specific interests. The construction industry and particularly engineers and contractors cannot evade the responsibility of leadership and they can secure it only through co-operation by their national organizations.

Delays of Inefficiency—Engineers, contractors, and workmen are all guilty of delays of inefficiency. The term is here restricted to the normal or routine duties of actual construction—contract practice, technical control, works management and fabrication.

1. Prevailing contract practice is responsible for an appreciable amount of lost time, although it is a minor cause.

Lack of uniformity, which compels changes in equipment and methods, and, under present conditions of winter idleness, late-season awards which continue the work into the cold weather or compel it to be carried over the winter, are recognizable causes of lost time. At present a joint committee of engineering and contracting associations is investigating the possibility of drafting and establishing uniform contracts. With progress made in its primary task, it is a logical action to make this committee a permanent body to develop improved contract practice.

2. Lost time is contributed by engineering interruptions.

Waiting for plans to be completed or to be changed wastes time. Another cause is waiting for finished work to be approved so that plant and organization can be shifted to new operations. Delays in inspecting and approving materials hold up progress. Bunching operations, as in highway construction, so that more work is concentrated in one locality than the producers of materials and the railway lines can handle expeditiously, is still another cause. Delays in turning in estimates and making payments; delays in approving contracts and in refunding guarantee deposits, and delays in rendering decisions and giving instructions are contributing causes of lost time.

Because none of these causes accounts for a long delay at any one time it is easy to pass them by without counting the aggregate of lost time which they represent. Greater expedition in the engineering operations attending construction would materially cut down lost time. In making this statement it is not forgotten that often the slowness complained of is the result of the too common practice of not providing adequate funds to maintain the quality and size of engineering organization required for prompt action. Other extenuating circumstances come to mind readily, but, in the end, reform lies with the engineering profession.

Hand-to-mouth planning of improvements is a prolific cause of lost time. Usually this is more a fault of administration and financing than it is of engineering. It is generally because he does not know in advance what money will be given him that the engineer plans for each appropriation as it comes along. The contractor has to equip and organize on the same basis; work speeds up as new appropriations are available and slows down as the money draws to an end; organization is built up and torn down. Federal river and harbor improvements furnish a notorious example of this manner of wasting time.

Delays of management are not all on the engineer's side. The contractor's manager by poor planning and faulty co-ordination of operations contributes heavily to lost time. These errors are not universal; the experienced contractor does not often commit them; they are no more common a fault in contracting than in any business, but so far as they prevail they are a condition to be corrected. The Associated General Contractors have this problem to work out through their committee on methods.

Labor turnover, soldiering, accidents and insubor-

dination interrupt work. Strikes and seasonal employment are major causes of lost time. These are all familiar factors of the great labor problem which confronts all business but they are mentioned to establish their place in the list of causes of lost time in construction. But while the great panacea for the inefficiency of labor waits on time to disclose, there are ills in detail which engineers and contractors can palliate by immediate action.

Yearly reorganization of labor forces results in time lost while the men are being trained to their individual duties and particularly in teamwork. Seasonal construction is the cause. Turnover seldom less than 30 per cent a month keeps a large percentage of the force always in training. Individual contractors are successfully reducing turnover and their methods call for study and expression. Accidents add to lost time not only because the man injured is out of service but because every serious accident sends some men away, causes others to lay off for a few hours or a day, and slows down all operations until the incident is forgotten. These are not imaginary effects. An entire blasting gang will often "quit work till after the funeral" because some powderman has received his reward for thawing dynamite at a bonfire. Large construction organizations find accident prevention profitable because it reduces lost time. Its extension calls for concerted effort by engineers and contractors.

Retrieving Lost Time—So much study has been given to methods of retrieving lost time that it seems to be forgotten that double shifts, night work, bonus wage payments, and the other devices of the "efficiency man" are not preventives of lost time. They help to utilize more efficiently only the time worked. *Methods of utilizing the time worked* have had intensive study while *Methods of finding more time for work* have been ignored. An examination of any of the volumes on "scientific management," or "management engineering," discloses this fact too clearly for any doubt. All these methods of increasing efficiency are time savers, as has been made clear, but they do not put more day's work into the construction year. This is the biggest task before the construction industry. It is a task which engineers and contractors must perform by organized action or stand convicted of being unfaithful to their opportunities.

It is not to be assumed that the construction industry has done nothing toward the improvements which help reduce lost time. The efforts have, however, been largely individual and the performances isolated. What value they have is ineffective because the results are not collected and analyzed. Concerted purposeful effort is now demanded. It can be made now with more chance of success than ever before because engineers, contractors and manufacturers are well organized nationally and locally and possess co-ordinating and advisory organizations such as the Associated General Contractors, the American Society of Civil Engineers and the American Construction Council.

The second article of this series—developing the problem of Winter Idleness in detail—will appear in the next issue.

Rectification of Rio Grande Through El Paso Valley Proposed

THE destructive floods which have occurred in Texas and in other states during the past year have caused the citizens of El Paso to investigate the flood problem with which they may be confronted and the El Paso Chapter of the American Association of Engineers was called upon to render assistance in the preparation of a report to cover the subject of river regulation and the possible remedies that might be applied in stabilizing and lowering the river channel at El Paso and through the lower El Paso Valley.

The city is located on the north bank of the Rio Grande at the head of the El Paso Valley, the lower portion of the city being on an alluvial plane of the valley and subject to danger from floods. In recent years there has been observed a progressive rise in the river bottom and in the water table in and below the city. Very moderate flood stages in the river have inundated certain areas threatening valuable property.

In 1915 the Elephant Butte storage reservoir of the Rio Grande Project was completed. This structure, located 120 miles above El Paso, has a storage capacity of 2,600,000 acre-feet. In addition to the function of providing irrigation supply during years of low runoff, it stores flood waters which, previous to its construction, passed down through the valleys and flooded large areas. The river below Elephant Butte Dam and El Paso, however, is subject to inflows from large arroyos draining approximately 8,000 square miles of territory.

The slope of the river below the dam for 100 miles has an average fall of nearly 4 ft. to the mile. Within a few miles of El Paso this changes to approximately 3 ft. and below El Paso the slope has decreased to approximately 2 ft. During August, 1921, discharge from local rains below the storage reservoir resulted in a flow of 4,000 sec.-ft. in the Rio Grande at El Paso, which flooded approximately 4,200 acres. Precipitation records have been kept at El Paso for 43 years, and at various other surrounding points for a shorter period. The greatest precipitation on record was for July 9, 1881, when 7.8 in. of rainfall was recorded in 24 hours at El Paso. The average annual rainfall for the area under consideration is 10 in. On Aug. 25, 1921, an ordinarily dry arroyo near Hatch, N. M., 80 miles above El Paso discharged 7,000 sec.-ft.

Investigations were made of the results to be obtained in lowering and straightening the river below El Paso by means of dredging, cutoffs, levees and an artificial waterway. The solution of the problem is rendered more difficult by the fact that the Rio Grande from El Paso south is an international stream and the approval of both governments must be obtained. The remedy proposed by the report is a general rectification throughout the section of the valley between El Paso and Fort Quitman, Tex., whereby it will be straightened, shortened and deepened. The resulting increase in rate of flow in the channel of the normal amount of water would be sufficient to carry through that section of the valley without disposition, the full load of sediment delivered from the upper valleys.

J. L. Campbell, president of the American Railway Engineering Association and chief engineer, El Paso & Southwestern R.R., acted as chairman of the flood control committee and rendered a report to W. E. Robertson, president of the El Paso Chapter, A.A.E.

Air Photos as Plane-Table Sheets Aid Mapping

Studies Made Along the Knoxville to Chattanooga Section of the Mississippi River—Contours Accurately Sketched in by Field Party—Method Supplies Wealth of Detail

By Harold C. Fiske
Major, Corps of Engineers, U. S. A., Chattanooga, Tenn.

I HAVE noted with interest the letters published in *Engineering News-Record* on the uses of aerial photography in map-making. Some of these are written by men who have had an intimate association with this class of work and others come from those who seem to have had less personal experience with map-making of this kind and to be prejudiced against this method, largely on theoretical grounds. The experiences of the U. S. Engineer Office at Chattanooga, Tenn., along this line may be of some value.

In 1921 a survey of the Tennessee River was ordered with a view to studying future developments in the interests of navigation and possible simultaneous development of water power. A contoured topographic map of all the terrain below an elevation of 60 ft. above the low-water mark of this river was considered necessary. Funds available limited the studies to that part of the river between Knoxville and Chattanooga. In this section there were already available the U. S. Geological Survey quadrangles on a scale of 1:125,000, with a contour interval of 100 ft., made 35 to 40 years ago. This scale was too small, the contour interval was too great and the sheets were otherwise too inaccurate for our purposes. There also existed an excellent map on a scale of 1 in. to 200 ft. of the river throughout this section, but this showed only the river between bank lines, the shoals, character of bottom, profile, etc., and was not reliable at elevations greater than 10 or 15 ft. above low water. It is, however, very accurate insofar as the stream proper is concerned. Many other maps of all or parts of this section exist, but none was sufficiently accurate and detailed for our use. It was then evident that a new map would have to be made, and after careful investigation it was decided to make use of aerial photography in this work.

An airplane with complete equipment and trained personnel was supplied by the Air Service, U. S. A., and about 1,000 photographs of the desired area were taken, developed and printed by that service by Oct. 1, 1921. The plane flew at an elevation of 12,500 ft. and the resulting photographs showed the terrain on a scale of 1 to 15,000. Each photograph is about 7 x 9 in. and covers an area of about 4 sq. miles. Successive views overlap by about 50 per cent and adjacent flights overlap by from 5 to 50 per cent. It has already been brought out by your correspondents that the maximum errors in displacement due to the principles of the lens are to be found along the edges of photographs, and it often happens, after a score or so of photographs have been formed into a mosaic, that more can be added only by the boldest kind of "fudging." In our work this could not be permitted. Moreover, of all the details shown in these views some are of vital importance to us, others are of comparatively little importance and still more of no value at all. It was accordingly decided that from these photographs a map should be prepared on which due prominence would be given to important items while those of less or no importance would be minimized or omitted altogether. The following line of procedure was adopted and has now been in operation for some months.

A survey party was sent into the field with two plane-tables, the necessary accessories, personnel, etc. The photographs were sent to this party and used as plane-table sheets with instructions to so choose among the available views that, as far as possible, the field work would appear in the center of the photograph. Unfortunately, due to the manner of taking these pictures, we have been unable to follow this principle as closely as we would like, but in future flights we believe that there will be no trouble in taking care of this point. With the photographs as a plane-table sheet in the field the surveyor, by the usual stadia methods, locates and determines the elevation of the points necessary for contours and the contours are then drawn on the photograph. All other details, roads, railroads, fields, streams, houses, etc., are already shown on the photograph, and when contouring is completed at one station the surveyor moves on to the next.

While the field work is going on the office draftsman, working on a duplicate set of prints, locates on the photograph, successively, two or more points along the river which are common to two adjacent photographs and easily distinguished. These photographs may be successive ones from the same flight or they may be adjacent ones taken in different flights. The river bank line is traced from the first view on ordinary tracing cloth, then the selected points on the next photograph are brought into position under the same points as taken from the first view. This orients the second view and the bank lines are continued on the tracing, the process being repeated with the third view and so on.

The latest developments in our work permit these points to be away from the river as well as on it, thus increasing the number of checks on the work and the rigidity of the control. In this operation certain differences are noted at times in the scale of adjacent photographs but such discrepancies may readily be eliminated or neutralized. It does not seem worth while to attempt to describe these processes in detail here. Suffice it to say that we have a very accurate check in our 1 in. to 200 ft. ground traverse map. In one of the first plane-table-photograph sheets the bank lines, as given by the ground survey, were finally used for a short distance instead of those obtained from the photographs because of the irreconcilable differences found in the views concerned. Since then our technique in this operation has improved materially and we have not had to use the ground survey for several months. In fact there are places where we are satisfied that our 1 to 15,000 plane-table-photograph map is more accurate than the 1 to 2,400 ground traverse map.

Besides the bank lines of the Tennessee those of large tributaries are traced at this time as well as railroads and the main highways. This office operation furnishes

a complete and rigid skeleton to which the field photographs with their contours, houses, fence lines and other details are added by tracing as they come in from the field. Some office adjustments have had to be made occasionally to secure a perfect fit of these field photographs, but the number of such adjustments has steadily diminished as the technique of the field and

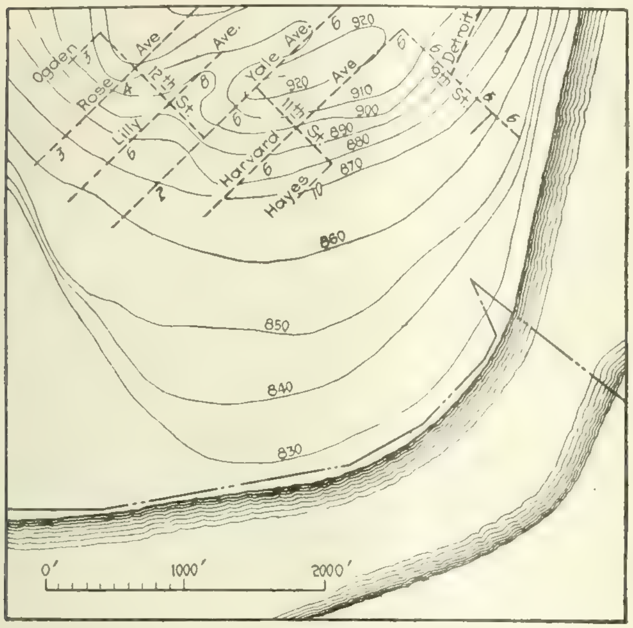


FIG. 1—AREA MAPPED FROM GROUND SURVEY

office force has improved. I should say that this number of office adjustments has never been equal to that commonly experienced in the plotting of the field notes of the standard transit-stadia survey.

P. J. Barry (see *Engineering News-Record*, May 4, p. 746) apparently wants to see a comparison between a map from a first-class ground survey and one of the same area from aerial photographs. Our present survey is being made because no such maps exist for the area we are covering, except the bank line surveys above referred to, which are incomplete for our purpose. At one point, however, we overlap for about 200 acres a contour map from a ground survey made by a well known engineering company of unassailable reputation. The area covered in this section is too small to carry great weight as proof of the superiority of either method over the other, and from the engineering company's point of view, probably, these 200 acres were not of much importance and consequently were perhaps more hastily done than usual.

Fig. 1 is this area mapped by a standard ground survey, and Fig. 2 is the same area as determined by our plane-table-photographic method. Comparing contours, those on Fig. 1 are the standard generalized contours with which engineers have long been familiar, while those on Fig. 2 have an individuality which, to my mind, is in itself proof of their superiority. A comparison of these two maps with the ground will show Fig. 2 to be the more accurate. From Fig. 1 it will be noted that the engineering company omitted the railroad, the railroad bridge and the railroad yards and probably guessed at the width of the river, probably because these items did not enter into any of the problems with which they were concerned. In Fig. 2 the river was of course essential, but the railroad, bridge, etc., were added because of their general interest and potential value, and because these were already shown on the photographs as accurately as they could possibly have been sketched to this scale in the field. The only added time or expense involved was that required of the office draftsman to trace them neatly, only a few minutes work and no appreciable added expense.

Finally, contours can be traced more quickly and accurately on the aerial photograph than on the customary plane-table sheet. In the latter case the topographer has nothing to guide him but the dots with their elevations which he has located on this otherwise empty sheet and the appearance of the terrain as he looks at it, more or less foreshortened, from his station on the ground. I doubt if this foreshortening has ever been given enough serious consideration, for we are constantly running into evidence in the aerial photograph that the ground topographer on other maps made too great or too little allowance for this source of error. The topographer with the aerial photograph has the points which he has established on the photographs and can also observe the terrain as freely as can any other ground surveyor. In addition, his photograph shows him a wealth of easily identifiable detail such as roads, fences, brooks, dry runs, trees, bushes, bare spots on the ground, etc., which are important guides in locating definitely the position of his contours. The result is that on the aerial photograph he can sketch them in with greater certainty and greater rapidity than he can on the standard plane-table sheet. This is not a theory; it is the report of the field topographers after months of experience with the aerial photographs.

As an over-all check the 1 to 2,400 traverse bank line survey was reduced to a scale of 1 to 15,000 and a

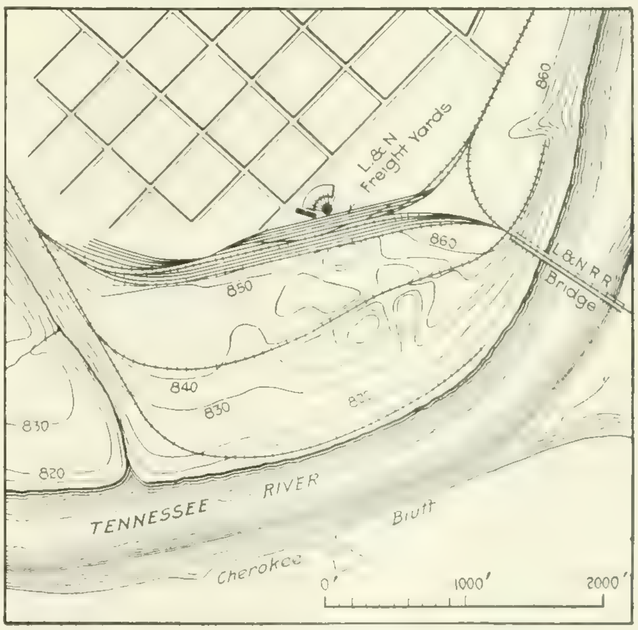


FIG. 2—SAME AREA AS SHOWN IN FIG. 1 DETERMINED BY PLANE-TABLE-PHOTOGRAPHIC METHOD

16-mile section of the river mapped by this method was compared with the same section mapped by our present method where no horizontal control was used other than that obtained from the aerial photographs. The check showed absolute agreement in over-all dimen-

sion as close as these dimensions can be scaled from these sheets. This section of our present map covers about 33 sq. miles. Streams, roads, railroads, fence lines, horses, etc., are shown in practically complete detail throughout this area, also contours up to about 60 ft. above extreme low water. In this way contours are given for about 20 per cent of the area covered by this section. [A print of the map referred to was submitted by Major Fiske with his article and bears out the claims made for it. As it could not have been reduced to a width of only 7 in. to be shown on a page of this size without losing practically all detail a cut of the map has been omitted.—EDITOR.]

The total cost of this sheet covering 33 sq. miles was about $1,500. The field work occupied 38 calendar days, or 32 working days. The preparation of the skeleton control took one man 60 hours; the tracing of detail from the field photographs took one man 24 days. The field work was done by a party of 12 men, including two plane table parties, cook, launch runner, etc., who lived on a quarter boat on the Tennessee River.

The purpose of our present mapping operations is to produce a map which will give all data needed for a thorough study and definite conclusions relative to future developments physically possible along the Tennessee River for navigation or for water power or for a combination of both. Should this work proceed to a point requiring full detailed information relative to dam sites or exact areas involved in damage claims, etc., we suppose that more work will have to be done on the ground. We do not yet know what is the limit to which our present method may be carried with profit, where minute detail is essential. We can undoubtedly go further in this direction than we have so far attempted, but this is a distinctly different problem and forms a bridge which we will try to cross only when we come to it.

So far I believe that our work meets every demand that can properly be made of maps of this scale; that as far as instrumental errors are concerned it is for all practical purposes as usable as that done by ground survey methods alone; and that where errors due to the human equation are concerned our plane-table-photograph maps are distinctly superior to ground-survey maps.

Early Morning Evaporation Greatest

The establishment of the fundamental basis of the law of evaporation from a free water surface is the ultimate aim of an elaborate set of experiments undertaken at Fort Collins, Colo. These experiments are being conducted in still air at the hydraulic laboratory under co-operative agreement between the Colorado Experiment Station and the Irrigation Division of the Bureau of Public Roads, U. S. Department of Agriculture By means of delicate instruments it has been possible to follow the variations in evaporation occurring from small changes in temperature and humidity. Evaporation losses at 5-min. intervals are measurable. One of the unexpected features which this close following at short intervals permits, is that under still air conditions maximum losses occur during the early morning hours, a phenomenon contrary to what is generally expected to occur. Since this work is not yet completed, details of the results of the experiments are not yet available.

Dr. William Dunbar; *An Appreciation*

By GEORGE W. FULLER
Consulting Engineer, New York City

THE untimely death a few months ago of Prof. Dr. William Dunbar, Director of the Hamburg State Hygienic Institute, Germany, removed one of the ablest investigators in the field of biochemistry as applied to sanitary engineering. His book, published some fifteen years ago, on "Principles of Sewage Treatment," remains one of the principal books of reference for those who have occasion to inquire closely into the development of the art and science of sewage treatment.

Dr. Dunbar was an American, the son of a banker of St. Paul, Minn. With his family he lived as a youngster in Germany, where he studied medicine and received his degree about thirty years ago at the University of Giessen. He was attached there in the bacteriological laboratory to the staff of the professor of hygiene, Dr. Gaffky. The latter was a member of the Imperial Board of Health of Germany and when the severe epidemic of cholera broke out in Hamburg, in 1892, he took young Dunbar with him to carry on laboratory searches for pathogenic bacteria in the River Elbe and to study methods of disinfection. Dunbar became an important factor in making these and numerous other investigations at Hamburg and for nearly thirty years was the diligent, painstaking and resourceful director of one of the foremost laboratories in the field of public hygiene.

To many engineers the writings of Dunbar were inspiring. Besides the book already mentioned, his various contributions in the *Gesundheit-Ingenieure* were carefully read in this country and abroad. While not attached directly to any large engineering undertakings he was a technical advisor on a number of important sewage-works in Germany. Particular mention should be made of his searches at Hamburg on the deep-well water supply and of means of freeing it of excess iron.

The official position of Dr. Dunbar and his numerous visits to England brought to him an unusually accurate knowledge of the history of legislation designed to remedy the pollution of streams. On some of the large British sewage disposal undertakings he was a witness before parliamentary committees and he was one of the principal experts retained by Dr. John G. Watson, chief engineer of the Birmingham Sewerage District, in connection with litigation associated with the local works.

In the field of preventive medicine his contributions were numerous and important, particularly with respect to bubonic plague and hay fever.

Dr. Dunbar will be missed by a large number of Americans, particularly sanitary engineers, who far many years during their visits abroad found him a most helpful guide in getting acquainted with activities in the field of sanitation in Europe. Professor Dunbar was well acquainted with developments in America, although his visits here were infrequent, the later ones having been in 1904 and 1908.

Many American engineers will always remember with deep appreciation the many kindnesses extended to them by Dr. Dunbar and will regret his untimely death.

[Dr. Dunbar's "Principles of Sewage Treatment," as translated from the German by H. T. Calvert, was reviewed in *Engineering News*, April 15, 1909, pp. 41-3 of the Engineering Literature Section.—EDITOR.]

Wharfhouse at New Orleans Army Base Destroyed by Fire

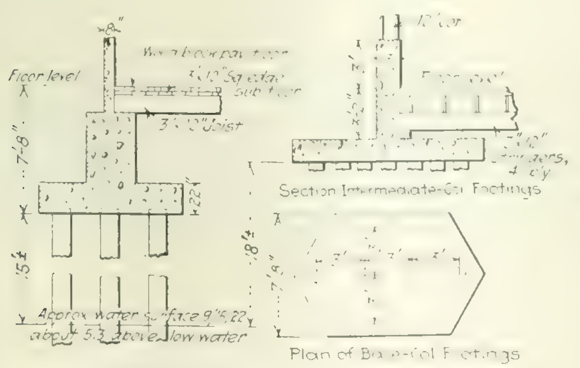
Steel Frame Warehouse and Pile and Timber Quay Total Loss — Concrete Warehouses Not Harmed — Insufficient Fire Protection and Inaccessibility to Fire Apparatus Blamed

BY ARTHUR M. SHAW
Consulting Engineer, New Orleans, La.

ON the night of Sept. 15, 1922, fire destroyed the wharf and wharfhouse which were built by the government during the war, as an adjunct to the Army Supply Depot at New Orleans. The site of these facilities is at Poland St., along and adjacent to the river front, about two and a half miles below the business center of the city. The wharf, or rather quay, was 2,000 ft. in length by 170 ft. wide. The wharfhouse was of the same length by 140 ft. wide, with platforms on either side for handling freight, one of 10 ft. in width on the land (and track) side and one of 20 ft. on the river side. The building was of two stories, the first story being 20 ft. and the second, 17 ft. high. The entire development was described in *Engineering News-Record*, Apr. 24, 1919, p. 823.

As the wharf was constructed entirely on the river side of the levee, it was necessary to carry it on pile supports. The three "Belt Line" tracks at the rear were also constructed on pile trestles. The crown of the river levee was approximately 75 ft. to the rear of these tracks.

The framework of the wharfhouse was of steel columns and beams, the columns being supported by reinforced-concrete footings as indicated in the drawings. The columns were spaced on 20 ft. centers in each direction. Cross fire walls were constructed at 200 ft. intervals. These were also of reinforced concrete and rested on pile supports as shown by the drawings. The walls ended in a "T" head at each end, these heads being 15 ft. in width and forming a section of the outer wall, flush with the galvanized iron covering. It is probable that the height of cutoff of pile supports of fire walls was controlled by the stage of the river at the time that this work was done, and that their bottoms were above the river stage at the time of the fire.

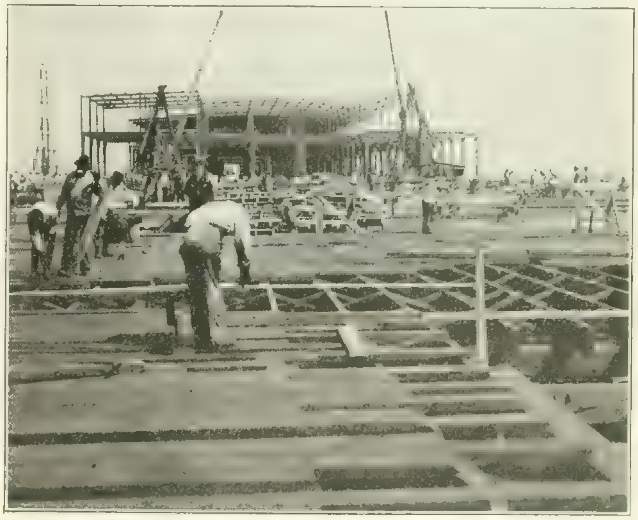


DETAILS OF FOOTING AND FIRE WALL CONSTRUCTION

Left section taken right angles to river. Steel columns rest in wall; base of columns 3 ft. above floor level. At columns wall increased to 21 in. thick to encase columns spaced 20 ft. c. to c. each way. Intermediate columns not in fire wall not encased or protected—Right; details of base of fire wall and concrete column footings.

Floors were of creosoted wood blocks with sand cushion on a sub-floor of 3 in. square-edge rough planks. The type of floor construction is shown in the drawings and in one of the views. All piles and timbers were creosoted.

Both stories of the building were equipped with automatic sprinkler systems, supplied by a 12-in. main running under the lower floor and fed at three points by two 12-in. and one 10-in. connections. These lines were supported by means of ¾-in. round steel stirrups which were hung from floor timbers by lag screws threaded through the single eye which was bent into each end of the stirrup rod.



NEW ORLEANS WHARFHOUSE UNDER CONSTRUCTION

Course of Fire—The fire was discovered at about 8:15 p.m. in a car of burlap which was on the track nearest to the wharf and about 500 ft. below the upstream end of the building. Government and dock employes attempted to put out the fire (after sounding an alarm) by the use of emergency fire hose provided for the purpose but were soon driven back by the intensity of the heat. This hose was in use only a short time, perhaps fifteen or twenty minutes, when the water pressure dropped, rendering the hose ineffective. At the time of the fire, a heavy offshore wind was blowing and a number of witnesses mentioned the fact that the blaze from the burning cars of burlap appeared to be drawn under the floor of the wharf (which was at car floor level) as through a chimney. Investigations have been conducted by various official bodies but while no decisions have been made public, the fact appears to have been established that the fire originated in the car of burlap first discovered and was then driven by the strong wind to the substructure of the wharf. An examination of water main hangers at points where the timbers to which they were attached were only slightly scorched or charred, showed that the ⅝ x 3-in. lag screws lost their grip soon after they became heated, permitting the dropping and rupture of the mains. This doubtless accounts for the sudden drop in water pressure already noted, as well as the failure

of sprinkler systems to operate during the later stages of the fire.

Two vessels were tied to the wharf at the time that the fire broke out, one of these being without steam. This vessel suffered considerable damage before it was towed out into the stream. A panic arose among the crew, seven members jumping into the river, apparently with the idea that the vessel was doomed. Three were drowned, these being the only fatalities in connection with the fire.

LOOKING TOWARD NEW ORLEANS ARMY BASE AFTER THE FIRE OF SEPT. 15, 1922
Destroyed wharf and wharfhouse at left behind ship, then connecting bridges and at right the concrete warehouses which were not harmed by the fire.

Practically the entire fire fighting equipment and organization of the city was called out and was engaged in fighting the fire from the land side while the Dock Board fire tug, supplemented by a number of privately owned tugs, pumped water on the fire from the river side. It was practically impossible to reach the timber substructure with streams from either side, the burning of which was assisted by the strong cross draft already mentioned.

The entire wharf and building were destroyed, resulting in a loss of the government owned wharf and house, together with a small amount of stores awaiting shipment, of about $3,600,000 and commercial property on the wharf and in cars estimated at from one to three millions. Twenty-eight cars were also destroyed. The burned commodities consisted principally of burlap, cotton bagging and news print paper. The wharf had been leased by the government to the Board of Port Commissioners for use as a commercial port facility.

Spreading of the fire to other structures was prevented with the exception that in a number of instances, small fires were started across the river in Algiers by balls of burning burlap which were carried there by the heavy wind. These were extinguished without damage to property. The nearest exposure was the state owned Desire St. wharf which is used by the Cuyamel Fruit Co. as a banana wharf. This was separated from the burned structure by an open basin 180 ft. in width. The main Army Supply Depot buildings of concrete were 320 ft. to the rear of the wharf with no connection other than three all metal conveyor bridges. These bridges were wrecked at the wharf end when the building collapsed. There were no exposures at the downstream end of the wharf as this adjoined the reservation of the Inner Harbor Canal which is to be cut in to the river at this point within the next few months.

CONCRETE COLUMN FOOTING AFTER THE FIRE
Six of the original ten piles still support the footing. Note foundation bolts projecting.

Conditions After Fire—An examination of the burned area, from both land and river sides shows:

None of the fire walls remains standing above the level of column bases with the exception of a few of the "T" heads described.

Some of the fire wall bases have dropped from failure of pile supports. It is not certain whether this occurred before or after the failure of the upper portions as noted below.

The lower portions of some of the fire walls are still intact, it being apparent that the upper portion was pulled over by the falling of the steel superstructure of which the columns encased in the walls formed a part.

Similar conditions were noted with regard to the intermediate column supports, many of these still being supported by charred piles and carrying the steel columns which have bent over at a sharp angle just above the foundation bolts.

While both the fire walls and the concrete column footings show evidence of severe spalling (some of the reinforcing rods being exposed) it was not apparent that failure of any of the concrete was due to this cause.

Some fusing of steel members was noted though this was not general, the most of the members being of original section but badly bent and twisted.

The creosoted timbers and piling, which had weathered for nearly four years since treatment, appeared to have offered considerable resistance to ignition and to burning after ignition, excepting where exposed directly to strong draft. Practically all thin members, such as sway braces, were fully burned. Many instances were noted of timbers which were subjected to extreme heat (but not to direct and continuous draft) which were scorched and charred but the section and strength of which were not seriously impaired.

Failure to Control Fire—The apparent causes of the failure to control the fire are as follows:

No automatic sprinkler system for the most inflammable portions of the structure, the timber and pile substructure.

Design of timber substructure favorable for rapid ignition.

Access to a fire in the substructure made difficulty by the levee, railway trestles and strings of cars.

Insufficient floating fire fighting equipment.

Ineffectiveness of cross fire walls due to their not extending down to low water and to their apparent early failure structurally.

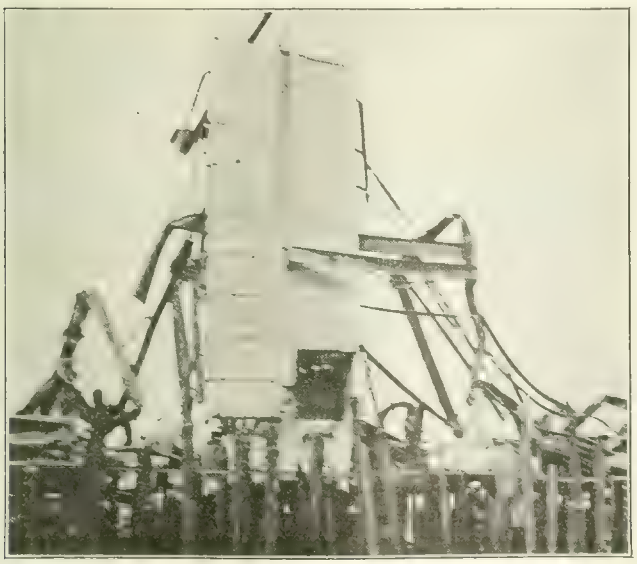
Reduction in available water pressure from dropping and bursting of mains which were carried by hangers of improper design, from wooden floor timbers.

Delay of many of the fire engines in reaching the fire. This was due principally to an insufficient number of well paved streets. There is only one street, leading from the business center of the city to the lower section, which is suitable for ordinary fast traffic. This street (Burgundy) is only 30 ft. wide between curb lines while at intersections, this is narrowed to about 26 ft. by gutters covered by iron plates. It soon became congested by fire apparatus, ambulances and automobiles carrying sightseers.

It is possible that "harbor oil" was also a contributing factor as difficulty has been experienced in this harbor, as well as in most others, in enforcing regulations relative to throwing waste oil out of vessels as they lie in port. Rings of heavy oil, frequently with imbedded rice hulls, were observed on piles in the immediate vicinity of the fire.

It is probable that the most important factor in the rapid spread of the fire was the strong and unobstructed draft under the structure which carried the fire to points which could not be reached effectively by ordinary equipment.

Lessons from Fire—While substantial loss might have resulted, even if all practicable precautions had been taken, it would appear that the fire could have



HEAD OF A CROSS FIRE-WALL AFTER THE FIRE

been held within reasonable limits if the following had been provided:

A system of water mains placed so as to be as nearly as practicable, independent of inflammable or weak portions of the structure.

Fire walls carried down to low water and of such design that they would stand even after destruction of framework.

One or more longitudinal curtain walls, extending down to low water, to cut off cross draft.

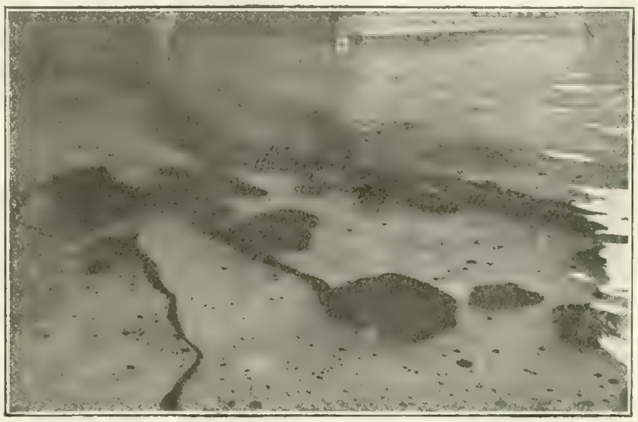
Prompt service of switch engines to move exposed cars.

Suitable regulations to provide frequent openings in strings of standing cars, to permit easy access to the wharf.

More fire plugs adjacent to such structures, to permit the prompt service of a large number of engines.

Drastic control of the "harbor oil" menace.

Better design of timber substructure. Timber wharf construction, at least in this section, appears to have evolved from the railroad pile trestle. It is suggested



FLOATING OIL JUST THROWN OVERBOARD FROM BOAT

There is a possibility that this oil exaggerated the fire menace at the New Orleans terminal.

that a design be developed more nearly along the lines of "slow burning mill construction," eliminating the thin members commonly employed for sway and sash bracing and giving special attention to design of joint details.

In addition to the foregoing, is the obvious necessity for more well paved streets and better police control of unnecessary traffic in the vicinity of the fire which might interfere with prompt and rapid movement of fire apparatus.

High Pressures in Riveting Injurious

Tests of the effect of riveting made by Prof. R. Baumann, briefly abstracted in *Zeitschrift des Vereines deutscher Ingenieure* of May 20, indicate that both the thermal stresses and the stresses caused by high riveting pressures have a tendency to open up cracks in the plates connected. To obtain an estimate of the thermal stresses, comparative tests were made with hot-driven iron rivets and with cold-driven lead rivets, which showed that the temperature stresses exceed the others. Among the conclusions from the tests are the following: A high riveting pressure is likely to produce stresses in the plate exceeding the yield point; the plate reaches temperatures exceeding 500 deg. C. during riveting, and large temperature stresses result from this heating; the most unfavorable stress conditions occur at the faying surfaces, between plates in contact, directly adjacent to the rivet hole; the stresses are largest in the case of rivets close to the edge of the plate; pressures of 90,000 to 115,000 lb. per square inch of rivet shaft are sufficient for producing tight rivets and minimize the distortional stresses caused by the pressure.

Concrete Road Tests Completed at Pittsburg, Cal.

New Road to Be Built Consisting of Ten 90-Ft. Sections of Different Types Including Asphaltic and Cement Concrete

TESTS of concrete pavement that have been under way during the past year at Pittsburg, Cal., latterly under the joint supervision of the U. S. Bureau of Public Roads and the California State Highway Commission, have been completed, so far as the scope and extent of the tests originally planned is concerned. Reports on the purpose and progress of these tests appeared in *Engineering News-Record*, Dec. 29, 1921, p. 1049 and June 29, 1922, p. 1066. Supplementing the data previously published, final figures for total traffic over the Pittsburg pavement from Nov. 9, 1921, when the tests started, to Aug. 21, 1922, the last day of traffic tests, are as follows:

Weight in Pounds			Mileage — Position on Pavement			Number of Truck Trips — Position on Pavement			Tonnage — Position on Pavement		
Front Wheels	Rear Wheels	Total	Inner Side	Outer Side	Center	Inner Side	Outer Side	Center	Inner Side	Outer Side	Center
2,330	6,970	9,300					121			560	
5,250	9,250	14,500	12,987			51,450			373,080		
5,300	9,350	14,650		13,292			49,588			363,290	
4,100	12,300	16,400		5			21			170	
4,150	12,450	16,600	7,800			31,016			257,420		
4,200	12,500	16,700		13,357			49,555		...	414,510	
5,500	16,500	22,000	10,936	5,332		43,492	19,780		478,110	217,660	
6,950	16,700	23,650	39,339			157,586			1,862,470		
7,000	16,800	23,800		41,019			153,449			1,825,800	
6,150	18,350	24,500	3,308	3,467	18,080	13,151	12,878	69,611	161,180	157,860	853,160
6,750	20,250	27,000	390	448		1,546	1,666		20,880	22,470	
6,850	20,400	27,250	....	....	6,470			24,906			339,640
7,500	22,500	30,000	....	13	1		50			750	
7,600	22,650	30,250	....	....	127			491			7,430
10,000	21,400	31,400		2			8			120	
	*32,050	32,050		28			105			1,680	
13,700	25,200	38,900		2			7			140	
9,300	30,400	39,700		32			123			2,440	
16,150	32,300	48,450		2			6			140	
	*61,710	61,710		2			9			280	
22,000	44,450	66,450		2			8			270	
	*70,000	70,000		1			3			110	
	*80,000	80,000		1			2			80	
	*100,000	100,000		1			3			150	
				135			518			3,250	
Also additional loads incidental to special tests.			74,760	77,141	24,677	298,241	287,900	95,008	3,153,140	3,011,730	1,200,230
			Total	........176,578 miles		Total..... ....681,149 trips			Total	7,365,100 tons	

* Two-wheel trailer.

With the conclusion of the first tests comes definite announcement of a new series of tests to be begun at the same site as soon as new pavements can be laid. The new series will have the advantage of experience gained in the work just completed and will comprise a scope and degree of refinement not possible in the earlier series. There will be ten 90-ft. sections of different construction on tangents and transverse tunnels are to be put under each of these. There will also be at least two longitudinal tunnels on the edges of the slabs, a tunnel under joints, and a "room," or combination of longitudinal and transverse tunnels for special tests.

The length of the new test road on tangents will be the same as on the first road. The four 118-ft. sections on the curved ends of the old road were not broken down and it is proposed to use these in the new tests, supplementing them by the addition of old macadam pavement of equal width outside the old curves. Oil macadam of the eastern type will be used on one end and of the western type on the other. This will provide alternate routes on curves so that repairs to either may be made without interrupting traffic and also so that comparative maintenance costs may be observed. It is also proposed to lay two sections of asphaltic concrete pavement on the tangents for a direct comparison with portland cement concrete.

In the light of Wyoming experiments with concrete pavement in precast sections, it is proposed to lay one or more of the 90-ft. sections on the new test road with construction of this type.

In view of the special conditions of practically impervious subgrade secured by the methods of compacting the fill under the first road, it has been suggested that that subgrade be removed and replaced with material deposited as in ordinary highway fills. Management of the new series of tests is expected to be in the hands of the U. S. Bureau of Public Roads and the California State Highway Commission, the same as heretofore.

A. T. Goldbeck, chief, division of tests, Bureau of Public Roads, and chairman of the committee on structural design of roads of the National Highway Research Council, has called a meeting of that committee at Washington, D. C. early in October, at which time it is planned to work out some joint program carrying on the tests at several test roads now under way so as to avoid duplication and co-ordinate the experiments as far as possible. Lloyd Aldrich, engineer in charge of the Pittsburg test, is a member of this committee and is expected to attend the Washington meeting.

Marl Treated Mine Water

Acid mine water containing 17,800 p.p.m. of solids, of which 840 were in suspension, passed through a natural calcium clay or marl at a mine of the Triangle Clay Co., Ulrichsville, Ohio, had in the effluent only 2,520 p.p.m. of solids, of which 60 were in suspension. The solids in the water were largely sulphates of iron, calcium and magnesium, the iron sulphate giving a strong acid reaction which, expressed in terms of sulphuric acid, amounted to 446 p.p.m. Although the other solids in the treated water similarly expressed in terms of acid amounted to 87 p.p.m. they were largely non-acid-forming calcium and magnesium sulphates. The passage of the water was through several layers of the marl in a baffled tank, the last compartment of which was filled with cinders to filter out the suspended matter and results of the chemical precipitation. The system was developed by the stream pollution department of the Ohio Fish and Game Division.—*Coal Age*, Aug. 10, p. 201.

Engineering Construction Work Under Foreign Laws

U. S. Bureau of Foreign and Domestic Commerce Would Help Guard American Contractors Against Pitfalls Abroad

By A. J. Wolfe
Chief, Division of Commercial Laws

Abstract of article in U. S. Commerce Reports

STATISTICS of exports from the United States to foreign countries fail to reveal the full indebtedness of American trade to American engineers and contractors. In Mexico and in South Africa, in Siam and in the Altai region, in Australia and in Peru, in Brazil and in China, the American mining engineer, railway builder, dredging contractor, the builder of bridges have left an indelible impress, but American engineering achievement in foreign countries is hidden to the eye that in statistics sees mere data. It is there neverthless.

In the early days the American engineer went abroad in the fashion of the pioneer. He had training, the American genius for solving problems, and the knack of overcoming obstacles both natural and artificial with the minimum of friction, physical or social. A landslide or a rising, a flood or a bold local chicane—it was all in a day's work. The engineer had to meet situations as they arose; consequently he amassed invaluable experience in coping with all sorts of emergencies abroad, an experience that it is difficult to put in the form of written statements. When the Division of Commercial Laws was organized in the Department of Commerce, and was assigned the task of compiling and disseminating data on the operation of laws abroad affecting the conduct of business by American firms, it planned an investigation into those legal problems which confront the American contractor or engineer who repairs to a foreign country for a limited time to execute an engineering contract, which may be with a government, with a state or municipal authority or with private interests. Or, a force of engineers may be sent to a foreign country where their chief must hire his laborers or other employees directly or through a local labor contractor.

The Engineer's Problems Abroad—Immediately the erecting engineer comes in contact with foreign laws. His position is very different from that of a resident manager of the branch of a commercial house. He is not in the country to stay. The thought of incorporating under the foreign sovereignty would not occur to him because of his temporary stay. Yet in many ways his contact with local laws is more direct and more pregnant with possibilities of trouble. He is frequently the paymaster, he incurs liability under labor indemnity laws, and in many undeveloped districts the opportunity of holding up a supposedly wealthy American corporation may be a serious temptation to irresponsible politicians. An American engineering corporation suggested to the Division of Commercial Laws a worldwide inquiry into the legal requirements concerning American engineers and contractors in foreign countries. As a result a questionnaire was sent to the field men of the Department of Commerce and through the courtesy of the State Department to American consular offices in a selected list of foreign countries. This step was discussed both with engineering corporations and with economists, and while the former were enthusiastic, some of the latter felt that the inquiry would elicit little that would be worth while. One economist specializing in the affairs in Near Eastern Europe expressed his opinion that in that particular territory there was little of interest to American contractors; but the same day there appeared in the paper a news dispatch announcing the conclusion by an American corporation of a gigantic engineering contract in that part of the world, so he was reluctantly converted.

The Commerce Department Questionnaire—The text of the questionnaire finally sent was as follows:

"Contractor's Requirements Abroad

"1. Is it advisable for engineering corporations undertaking temporary contracts in your territory for official or private interests to obtain domestication or to register their company?

"2. How is this effected?

"3. Will it suffice for the engineer in charge, an American citizen, with power of attorney for the company, to register as an individual?

"4. What taxes must the company pay? (In answering this question bear in mind that the company undertakes the work at a fixed price payable in part before the work is started and the balance after the work is finished. Profits can not be determined until the work is completed.)

"5. Describe the liability for injury to laborers under the laws of your territory. Can insurance be obtained for this liability? Can contractors' insurance be secured?

"6. Kindly send any additional information available now or in the future which might be of importance to American contractors undertaking work in your territory.

"7. Can you give names of American companies which have undertaken such work in your territory, so that we may write them direct for the benefit of their experience?"

The questionnaire was submitted to several American companies with experience in foreign engineering contracts, and they expressed intense interest in the investigation. One of these companies submitted the following valuable list of suggestions:

1. (a) An employee of a corporation sent to a foreign country, if there as the sole representative of that corporation, should carry with him a properly executed power of attorney, which power of attorney should be executed to only cover specifically the things said representative is to do. If he goes with general duties, then his power of attorney should be very broad and very general. Aside from specifically naming everything that the representative can do a blanket clause may permit him to do "All and everything necessary even though not specifically mentioned herein." (b) Unless the particular country requires the registration of a representative it would not be necessary to make registration. (c) If no registration is required in the particular country, he should register his name and address, also company represented with the United States Ambassador, Minister or Consul.

2. It is our understanding that (in South America) a citizen of the United States while operating there is amenable to the employers' liability laws, labor laws, etc., if he engages in the execution of construction work of any character or employs anyone in that country to work for him. He may also be liable as a co-employer.

3. A representative should familiarize himself with the commercial laws of the particular country he is operating in and can usually be advised by the official representative of the government in that particular country. Aside from the personal conduct of the representative, above all he should make no promises or commitments which are not to be carried out to the letter. Our general experience has been especially in South America, that it is an easy matter to transact business in the various countries there provided the representative confines himself to statement of facts at all times and the strict carrying out of all obligations or commitments made. Whether or not laws can be mutually agreed upon by your department and corresponding departments in the various foreign countries would of course be of great value and we would be pleased to have you advise us when this has been accomplished.

As the result of this questionnaire sent out about the end of April replies are beginning to come in, notably one from Commercial Attaché Chester Lloyd Jones, Havana, on contractors' requirements in Cuba, and another from American Consul General Claude I. Dawson, of Mexico City, on contractors' requirements in Mexico. These reports together with others still awaited, will be prepared for publication jointly by the Industrial Machinery Division and the Division of Commercial Laws. Contractors and engineers interested in this investigation are invited to communicate with the Bureau of Foreign and Domestic Commerce.

Extensive Boiler-Water Treating on C., M. & St. P. Ry.

Chemical Treatment in Bad-Water District Improves Operating Conditions — Savings Soon Pay for Numerous Plants

By C. Herschel Koyl
Engineer of Water Service, Chicago.

THE first duty of the engineer of water service on a steam railroad is to provide enough water at convenient points, with reliable pumping facilities and adequate storage. His second duty concerns the quality of the water.

In the systematic improvement of water service on a bad-water district of the Chicago, Milwaukee & St. Paul Ry., fourteen water treating plants have shown that they will pay for themselves in one year. Special features of the plants as developed for this service by the writer are: (1) Separate and independent feeds for lime, soda-ash and iron sulphate; (2) solution and feed of soda-ash by water spray; (3) upward flow in the mixing tank to insure agglomeration of the finer particles which cause boiler foaming, and (4) disposal of the sludge from the flat-bottomed settling tank by a system of underdrains.

In the country between Lake Michigan and the Rocky Mountains, part of the "great plains" of pioneer days, the Chicago, Milwaukee & St. Paul Ry. has more than 8,000 miles of steam-operated main track. Because most of this is a country of less than average rainfall, with few streams and fewer lakes, the railroad has many water problems to be solved in providing an adequate supply of water suitable for boiler purposes. These problems are most difficult in South Dakota, on the east side of the Missouri River, where the few streams run slowly through lands so rich in the soluble salts of calcium and magnesium that the river waters are always hard. The more rainfall there is on the adjoining lands and the higher the rivers rise, the harder is the water.

In that part of the country, because of the scarcity of water at or near the surface, most railroad supplies are derived from drilled wells. These wells vary in depth from 50 to 1,500 ft. and the character of the water varies as widely. There are two layers of sandstone whose horizontal cracks furnish the supply. The water from the lower sandstone is very hard, with 80 to 90 grains per gallon, and it carries also 20 to 60 grains of sodium sulphate or chloride. The softer water from the upper sandstone so closely resembles the lower water after softening that it is presumed to be the same water softened in the ground by zeolitic action.

At distances from 100 to 200 miles east of the Missouri, the soft water rises to ground level and is used by the railroad. But near the river the water appears to drain away somewhere because it must be pumped from a depth of 300 ft. Since this soft water is both scarce and difficult to pump, we drill to the lower sandstone and then soften the hard water thus obtained. This water usually rises to ground level. In this vicinity last year we drilled seven sand-proof wells.

Our experience with these waters for locomotive boilers had been so expensive, in spite of all the boiler compound that could be used, that last year we built fourteen water-treating plants on the lines running east, west and south from Mitchell, South Dakota, placing a plant at each water station for the sake of uniformity of water. This was in addition to three plants previously installed. The map, Fig. 1, shows the treated-water district of about 400 miles.

The new plants are continuous in operation. Each consists of the following main parts: (1) a hard water pump; (2) a 40-minute reaction tank within which the mixture of hard water and the necessary chemicals (all fed in continuous streams) is slowly stirred by mechanical means; (3) a 3-hour settling tank; (4) a treated-water pump which delivers to the track tank; and (5) a chemical storage room. All the apparatus is inclosed in a strong and well heated building. The main line plants are all alike. Each is capable of treating 15,000 gal. of water per hour continuously (or 360,000 gal. daily,) but most of them actually treat 12,000 gal. per hour for four to eight hours per day (or at the rate of 288,000 gal. daily).

A typical plant is that at Scotland, South Dakota, shown in Figs. 2 to 4. Everything is of wood excepting machinery and pipe. The 12-in. drilled well under the pump room is 158 ft. deep and furnishes water to the double-stroke deep-well pump which delivers it through

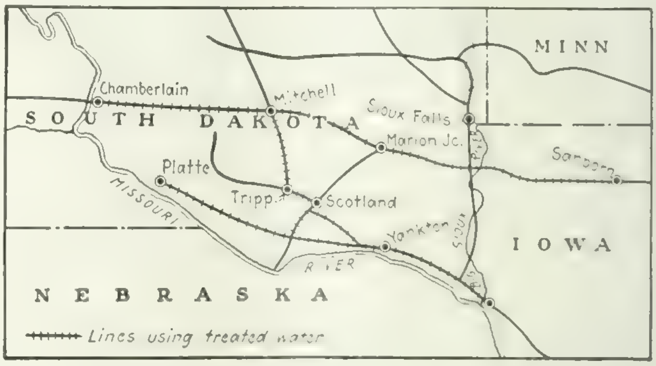


FIG. 1. TREATED-WATER DISTRICT OF C., M. & ST. P. RY.

6-in. pipe to the waterwheel which does the stirring. After passing the wheel, the water flows to the bottom of the mixing tank. As it rises in the tank it meets in succession the three continuous streams of milk-of-lime, sodium carbonate and ferrous sulphate solutions.

Hydrated lime is used in water treating to extract the carbonic acid, which brings about the precipitation of the scale-making limestone carbonates, down to 3 grains per gallon or less. Sodium carbonate (soda-ash) is used to replace completely the scale-making limestone sulphates by non-scaling sodium sulphate. Ferrous sulphate (green sulphate of iron) is used for the treatment of the last three grains of calcium carbonate so that it will not clog the injector or branch-pipe. This it does by converting half of the calcium carbonate into calcium sulphate.

In these plants the reagents are all fed by regulated streams of water from the pipe which supplies the waterwheel (Fig. 2). The milk-of-lime box, holding 480 gal. of water, carries in suspension enough hydrated lime for a 5-hour supply (at Scotland 400 lb.). This milk-of-lime is fed continuously by a small stream of water entering at the bottom of the lime box and overflowing near the top through a 2-in. pipe to near the bottom of the mixing tank (Figs. 2 and 3). The

drawing shows a lime pump at the top of the lime box, but this is only for emergencies.

Once every hour, an hour's supply of dry hydrated lime is added to the supply in the box. This method produces an hourly variation in the rate of lime feeding, but the stirring by the bars in the mixing tank (Fig. 4) is so thorough and so prolonged (45 minutes) that only a slight variation is found in the water as it overflows from the top of the mixing tank to the bottom of the settling tank.

The dry soda-ash, which is replenished every hour, is placed on a shelf in the soda box and is dissolved by a spray, so that it is fed to the mixing tank as a dilute solution. The sulphate of iron is fed in solution from its box by a small stream which enters at the bottom and overflows near the top.

For feeding any reagent to a treating plant the best method is determined principally by the solubility of the reagent in water. In all cases the thinner the solution or mixture the better. The arrangement of feeding devices described above is not theoretically perfect, but has been adopted as the result of experience in handling railroad plants which are frequently miles from a repair shop and are seldom operated by skilled mechanics. The uniformity of results is the best proof of the efficiency of the design and method.

The water, with its chemical reactions practically complete and its precipitate ready to settle, arrives at the bottom of the settling tank and there commences to leave its precipitate as the water slowly rises to overflow through the perforated collecting pipe (see Fig. 2) to the treated water pump in the pump room, whence it is sent to the track tank (Fig. 3). The two pumps in the pump room are operated by a 10-hp. oil engine, each pump having a clutch on the engine shaft.

Once a day the settling tank is freed of its accumulated sludge by opening for 30 seconds the valves controlling the system of perforated sludge pipes lying in the bottom of the settling tank, and arranged as shown in Fig. 4. The perforations are in the bottom of the sludge pipes, and the branch pipes are connected to the main pipes by street elbows so that they are close to the floor. Heating for the pump room and working room is provided by hot water pipes along the walls. The chemical storage room is of 2½-car capacity.

At Scotland the well water has the general character of all the waters derived from that layer of hard-water sandstone, since the upper layer of soft-water sandstone has run out a few miles away. Our laboratory analysis shows its dissolved mineral content as follows:

	Grains per Gal
Calcium sulphate	64.9
Magnesium carbonate	19.0
Magnesium sulphate	11.8
Incrusting solids	95.7
Alkali sulphate	9.7
Alkali chloride	2.6
Non-incrusting solids	12.3
Total	108.0

Analyses of the treated water average as follows, it being understood that there are daily variations up to one grain per gallon due to lack of uniformity in the rate of pumping water or feeding chemicals:

	Grains per Gal.
Calcium carbonate	3.3
Sodium hydroxide	0.8
Alkali sulphate	92.0
Alkali chloride	2.6

The chemistry of water softening is very simple in both theory and practice when working on a small scale and with a filter, but when working on a large scale where the resulting water must be settled instead of filtered, certain precautions are necessary. Experience shows that slow and continuous mixing of the hard water with the chemicals for a period varying from 25 to 50 minutes, according to the temperature and clearness of the water, is necessary to complete chemical action. Experience shows also that unless the softening plant is to be encumbered with filters, which would be a very serious drawback to a railroad plant, other special precautions must be taken to insure the perfection of settling.

In the plants built last year on the Chicago, Mil-

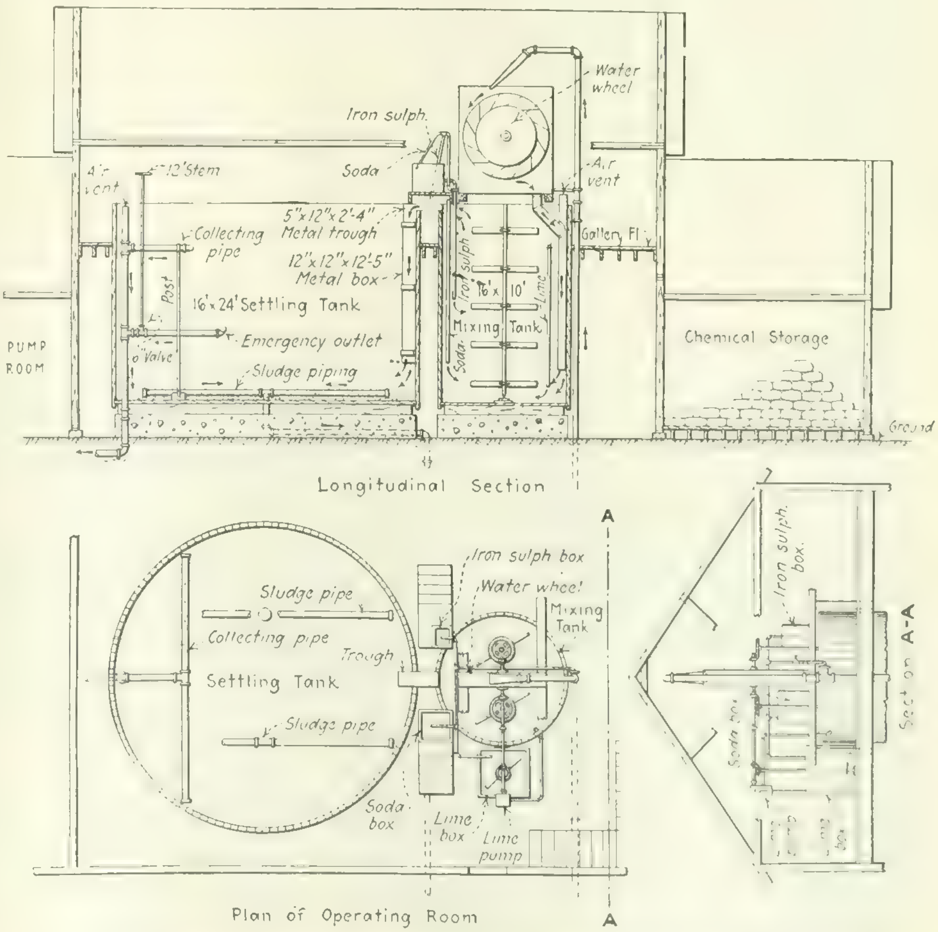


FIG. 2 RAILWAY WATER TREATMENT PLANT AT SCOTLAND, SOUTH DAKOTA

waukee & St. Paul Ry. the advantage of the 40-min. mixing tank with its continuous but slow stirring is that the precipitate is all formed and ready to settle when the water enters the settling tank. Thus there is none left to form just below the top of the settling tank when it is too late to settle.

Another feature of construction insures a character of precipitate which settles easily. When the chemi-

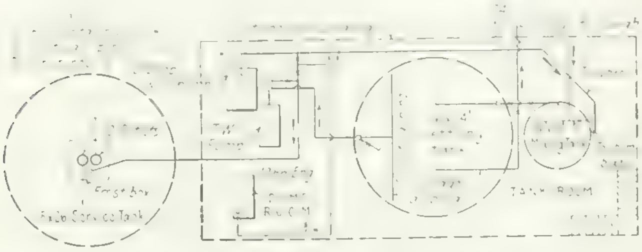


FIG. 3 TYPICAL PLANT LAYOUT

cals first meet the water the rapidity of chemical action is so great that the particles of precipitate formed are very large and tend to settle quickly. But when the chemical work is nearly done and the few remaining molecules of carbon dioxide meet the few remaining molecules of calcium oxide, the particles of precipitation formed are so infinitesimally small that millions of them make only a bluish cloud which will float for hours. This is the bane of water intended for boilers, because precipitate suspended in the water of the boiler is the cause of the foaming attributed to many treated waters.

These small particles, at the moment of coming out of solution, commonly called the nascent state, have great adhesive power and will attach themselves to any solid matter within adhesion distance. In the old way of feeding a reaction tank at the top so that the flow was downward, the heavy precipitate has gone ahead and there was nothing for these last and very small particles to attach themselves to. But in the C., M. & St. P. Ry. plants the hard water and the chemicals are introduced at the bottom of the reaction tank and flow upward.

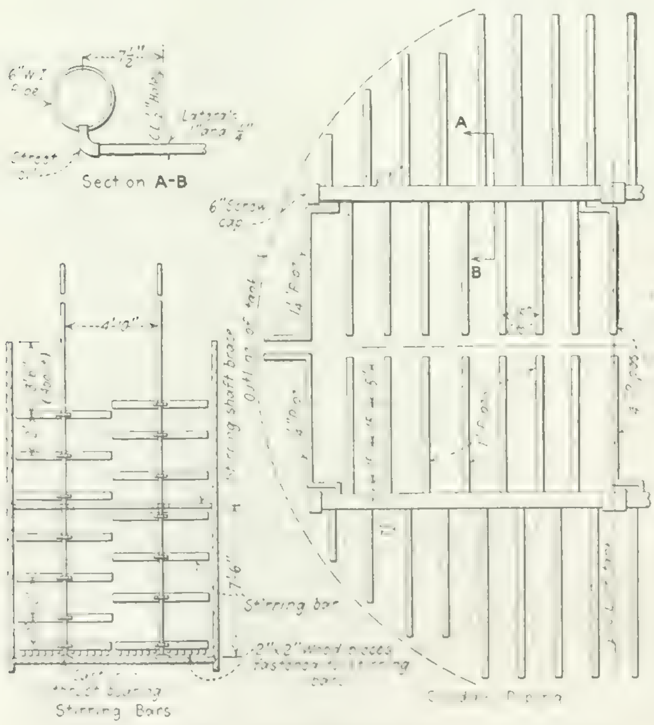


FIG. 4. STIRRING APPARATUS AND SLUDGE PIPES

In this way, since the precipitate lags behind the water, the reaction tank soon becomes charged and remains charged with a mass of precipitate to the full sustaining power of the upward flowing current. These infinitesimal particles as fast as they are born attach themselves to the older and larger particles in immediate juxtaposition. The result is that the water flowing from the top of the reaction tank to the bottom of the settling tank carries only comparatively few large particles which settle rapidly and leave the water free from haze.

Since the installation of these treating plants our boilers have been free from scale and from leaking, and almost free from foaming. There has been some foaming, because sometimes one of those little rivers will change the character of its water 10 grains per gallon over night, due perhaps to a rainstorm a week before and a hundred miles away. At times, also, something may go wrong in the plant and the water be undertreated, but when the treatment is correct there is so little foaming that I never hear of it.

As a result of this water-heating system we save in boiler repairs and coal, and we have a much superior service. The last plant has been in operation less than a year and the accounts are not yet made up, but the plants have paid for themselves (and will do so every year) in items of saving that can easily be calculated in dollars.

We have much bad water on other divisions where traffic is more dense, and it is true that the damage to a railroad from bad boiler-water increases with the number of locomotives which use it. But the waters about Mitchell were so very bad and the difficulties of railroading so great that it was decided to utilize our 1920 money in that district. Other increases of quantity and improvement of quality will follow as we can extend our work.

Port Works and Railways in Chile

The law authorizing the construction of various port works in Chile, together with certain railway works near the town of Constitucion, which are to be constructed only subsequent to the conclusion of definite arrangements for the construction of that port, has been passed. The law as published contains the following provision, according to a recent issue of *Commerce Reports*:

The cost of the various construction contracts shall not exceed the amounts indicated below:

	Pounds Sterling
For Iquique	750,000
For dock and supplementary works in Antofagasta	750,000
For Valparaiso	1,470,000
For Constitucion	900,000
For Talcahuano	920,000
For Lebu	930,000
For Puerto Saavedra	400,000
For Valdivia	1,090,000
For the construction of a breakwater and pier at Puerto Montt	150,000
For the construction of a pier and supplementary works at Pichilemu	40,000
To commence the construction of the railroad from Los Quenes to Curico, of the railroad uniting Parronal to the branch line from San Fernando to Pichilemu, and the continuation of the railroad from Hualane to Constitucion	200,000

Building a Five-Span Concrete Bridge in Cold Weather

Manure Protection Raised Temperature During First 72 Hours — Simple but Effective Methods Used in Placing Protection

By G. F. Scales
General Contractor, Waterloo, Iowa

VERY few complete records of temperatures in cold weather concreting have been published. The accompanying table shows temperatures obtained in the construction of a five-span concrete arch bridge over the Cedar River at Waterloo, Iowa, for the Waterloo, Cedar Falls & Northern Ry., an electric road. This structure, known as the San Souci Bridge, is 30 ft. wide and 440 ft. long, and consists of two 70-ft. spans, two 72-ft. spans, and one 74-ft. span. It is designed for Cooper's E-60 loading.

For handling the work in cold weather a covering of manure was used. The studding was 2x6-in. material and the spaces between the studs were filled, as shown, by nailing just enough cleats and scraps to their outer edges to hold the manure in place. This covering was placed ahead before depositing the concrete, which was heated to approximately 60 deg. in the mixer.

The table of temperatures indicates that there was not more than five degrees loss in temperature during the placing of the concrete. Notice also that the records for 24- and 48-hour periods (after concreting) show that the temperature invariably increased materially. In fact, in some instances temperatures were obtained as high as 118 degrees. The temperatures given in the table are the average of approximately ten holes in each pouring.

The mixing plant consisted of a 9-ft. polygon mixer, with steam power, and a No. 90 Hauck heater, together with a water tank which is heated by direct steam. The rock and sand were not heated except by the hot water and by the heater after they were in the mixer. The average time of mixing was 1½ minutes.

In concreting the arches, the opening at either side was closed with tarred paper and salamanders were placed underneath. The arch faces were covered with manure packed between the studding as above described. The tops of the arches were covered with manure immediately after the concrete was deposited. This manure

RECORD OF TEMPERATURES OF CONCRETE, PLACED IN WINTER IN THE SAN SOUCI BRIDGE, WATERLOO, IOWA

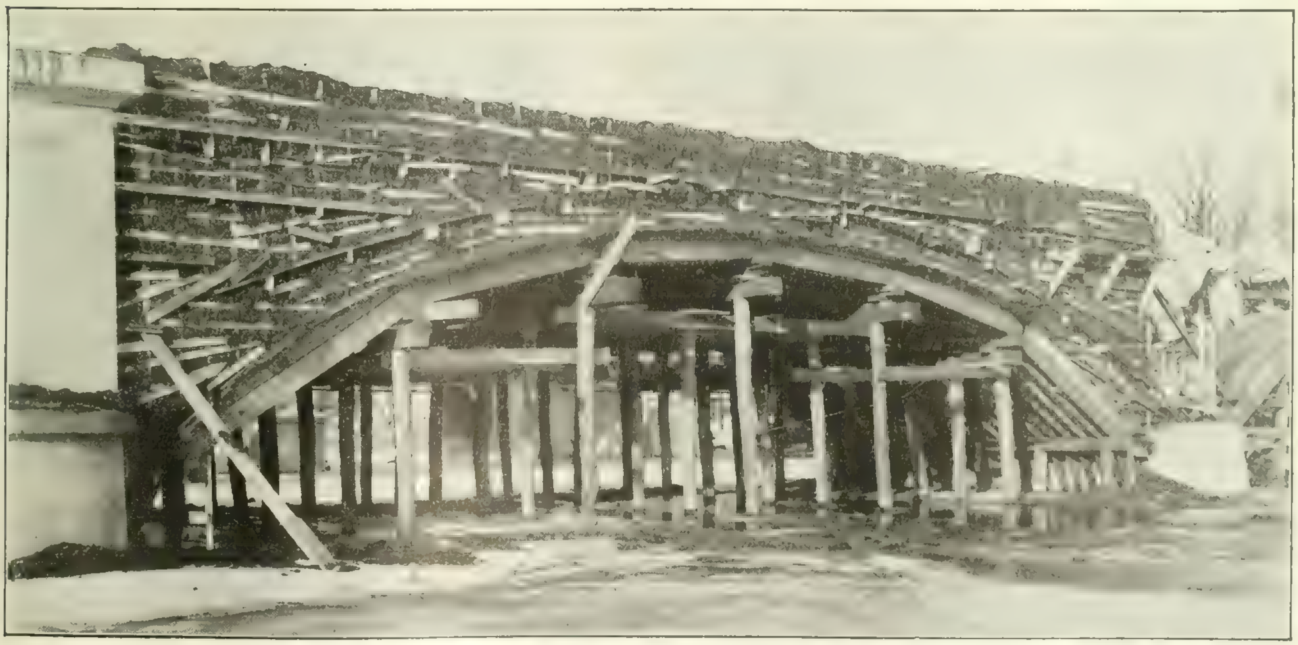
Date of Concreting	Temperatures (Fahrenheit) of Air, Aggregates and Concrete						Temperature Record of Concrete				Remarks
	Outside Air	Sand	Rock	Water	Before Placing	After Placing	After 24 hrs	After 48 hrs.	After 72 hrs.	After 96 hrs.	
Dec. 8	34	34	34	100	75	70					Temperature taken at
1921	35	35	35	113	65	60	90	93	90	85	8 a.m., 12 m and 3 p m
	36	36	36	75	70	65					
Dec 27	2	34	34	170	64	58					Temperature taken at
1921	12	34	34	160	62	58	65	71	77	67	8 and 10 a m and 3 p m
	26	34	34	150	64	58					Concr mixed 1½ min
Dec. 28	24	34	34	185	64	63					Temperature taken at
1921	28	34	34	180	72	65	34	60	58		8 a m , 9 a m and 10 30
	30	34	34	172	63	64					a m Conc mixed 2 min
Jan 10	16	30	30	145	61	60					Temperature taken at
1922	33	34	34	160	64	60	64	65	61	59	9 a m and 4 p m
Jan. 26	30	30	30	160	63	62					Temperature taken at
1922	32	34	34	156	66	62	73	79	79	81	9 a m and 3 p m

Note: The lowest temperature during the actual depositing of the concrete was 2 degrees above zero, and temperature on following day was 10 degrees below zero

was very dry, practically all straw, so that there was no seepage of moisture from it to stain the concrete. No undercovering was necessary. No other heat was used to obtain the result shown in the table, although the concrete was placed in temperatures ranging upward from two degrees above zero.

On the spandrel walls the covering was maintained not less than four days, after which the forms were removed and the concrete was found to be set and cured and in perfect condition. The first concrete was placed in Aug. 1921, and the bridge was completed about Feb. 1, 1922.

The writer had the contract for this bridge and the designer was T. E. Rust, chief engineer of the W., C. F. & N. Ry.



FROST PROTECTION OF MANURE FOR CONCRETE BRIDGE

Practice in Tar Road Construction in Great Britain

Tars and Surface Tarring Procedure—Mixed Tar and Stone Roads—Pitch-Grouted or Penetration Macadam Roads

SURFACE tarring has been applied in Great Britain with advantage to old road surfaces in good condition and to new surfaces which are thoroughly consolidated and dried. The practice is to scrape or brush old road surfaces during the spring months and make good any pot-holes, grooves, waves or depressions, and then to apply the tar by automatic sprayer or by hand, depending on the available labor. This work is now done chiefly by hand, partly on account of the unemployment situation and partly because some road engineers favor the hand method as giving more satisfactory results.

The old road is half or totally closed to traffic before tarring begins and the surface is thoroughly cleansed of caked mud; the sides are strengthened if they have worn thin and, if the road is to be entirely re-surfaced, stone chippings are used to bind in preference to fine material.

The tar used, unless it is a proprietary brand, conforms to one or other of the Roads Department (Ministry of Transport) Specifications. These are known as Tar No. 1, and Tar No. 2.

Specifications of Tar No. 1—This tar was heated to a temperature which will insure that it reaches the road in a highly fluid condition; a boiler specially designed to prevent frothing is employed. The desired temperature in practice is usually found to be between 220° and 240° F.

This tar is derived wholly from the carbonization of bituminous coal except that it may contain not more than 10 per cent of its volume (or distillates or pitch therefrom) produced in the manufacture of carburetted water gas. The specific gravity at 59° F. is as nearly as possible 1.19, but must not be lower than 1.16 or higher than 1.22.

It is laid down by the Roads Department that the tar must not contain more than 1 per cent by volume of water or ammoniacal liquor, which must not contain more ammonia, free or combined, than corresponds to 5 grains of ammonia per gallon of tar.

The amount of water or liquor is determined by condensation from the products of distillation of the tar by cooling with a cold water condenser. Any water so condensed is, after measurement, separated from any light oils present, and the amount of ammonia estimated by direct titration with acid.

On distillation in a liter fractionating flask one-half or two-thirds filled, to conform with the official specification, the tar should yield by weight the proportions of distillates given below:

(a) Below 338° F., not more than 1 per cent distillate (light oils), exclusive of water.

(b) Between 338° and 518° F., not less than 16 per cent and not more than 26 per cent of distillate (middle oils).

(c) Between 518° and 572° F., not less than 3 and not more than 10 per cent of distillate (heavy oils).

The total distillate between 338° and 572° F. must not be less than 24 per cent and not more than 34 per cent, i.e., where the middle oils approach the maximum allowed the heavy oils should approach the minimum, and vice versa.

The distillate between 338° and 518° F. (middle oils) must remain clear and free from solid matter, such as crystals of naphthalene, etc., when maintained at a temperature of 110° F. for half an hour. This requirement may be waived in the case of tar supplied direct from gas works, but tar from which naphthalene has been extracted is preferred to tar in which this constituent is excessive.

The middle oils should not yield to caustic soda solution more crude tar acids (phenol) than 3 per cent by volume of the tar.

The tar should not contain less than 12 or more than 21 per cent by weight of free carbon. This is determined by a complete extraction of the bituminous matter by benzol and bisulphide of carbon; the residue is taken as being free carbon.

Specification of Tar No. 2—This tar is also heated to a highly fluid condition, which has been found to be between 260° and 280° F. For the preparation of tar macadam the tar does not generally require heating to so high a temperature as for surface tarring; the necessary temperature being determined largely by the sensible heat of the stone treated by the tar, and also by the method of application.

This tar is derived from the same source as No. 1 except that it may contain up to 25 per cent by volume (or distillates or pitch therefrom) produced in the manufacture of carburetted water gas. The specific gravity at 59° F. should be as nearly as possible 1.21, but not less than 1.19 or higher than 1.24.

As regards fractionation, the requirements below 338° F. are the same as for Tar No. 1. Between 338° and 518° F. not less than 12 and not more than 18 per cent of middle oils should be distilled; and between 518° and 572° F. not less than 6 per cent and not more than 10 per cent of heavy oils should be yielded.

In the naphthalene, phenol and free carbon tests, the distillate should remain clear for half an hour at 100° F.; the middle oils should not yield more than 2 per cent phenols by volume; and the weight of free carbon should not be less than 12 or more than 22 per cent.

Tar Surfacing Methods—Either of these tars may be used, but if the heavier grade is employed the surface is always allowed to become well warmed by the sun's rays before application. Where hand methods are employed flexible pipes are used to convey the tar from the boiler to the road. As an alternative to these pipes, which are manipulated by hand, 3-gal. pouring cans, with the orifice 1½ in. in diameter and the spout leading direct from the can bottom, are utilized.

As a general rule, in the case of roads tar-treated for the first time, the amount used is one gallon to every 5 or 7 sq.yd. Gritting, if necessary to allow traffic to pass, is delayed as long as possible, and the material used is stone chippings, crushed gravel, coarse sand, or other material free from dust, which must pass a ¼-in. mesh.

On heavily trafficked roads a second coat is applied, either over the whole surface or from 9 to 12 ft. in the road center to the extent of one gallon of tar per 8 to 10 sq.yd. This is done two to three months after the first application.

Two or more samples of the tar used are kept in quart tin cans and labelled, showing the locality of

application as well as the specification. The Roads Department has arranged with the National Physical Laboratory to submit a selection of samples to chemical and physical tests for the benefit of road engineers.

Careful records are kept of the road condition in the various seasons, both before and after tarring, and such records show the quality of the tar used, the area covered, the state of the weather during tarring operations, time occupied in these operations, number of men employed and full details of material and labor costs

Surfacing with Tar Macadam—Before laying a tar-macadam surface, trial trenches are opened at intervals of 450 ft., extending from the road haunch to the center and on alternate sides of the road, so as to ascertain the thickness of the old crust and the state of the foundation.

The thickness of surface coating after consolidation by rolling is as near 3 in. as possible; if a coat thicker than 3 in. is to be laid, the material is applied in two separate coats.

In the case of naturally hard subsoils, not materially softened by infiltration of surface water, the total thickness of the road crust including foundation, if any, is not less than 6 in. after consolidation by rolling. If the subsoil is hard enough to form a good foundation in itself, this thickness is reduced to 4 in. If a clay or other yielding subsoil is located, the thickness exceeds 11 in.

As a rule the crossfall on the finished surface is about 1 in 32. If the crust is not sufficiently thick at the crown to enable this crossfall to be obtained with a new coating of the above thickness, then the old surface is left intact and unscarified, and the new coat made as thick as necessary. If the crust is sufficiently thick the regulation of the crossfall is obtained by scarifying the surface and removing material from the crown to the sides previous to the application of the new coat. The material so loosened is screened and any material finer than ½ in. is discarded.

The broken stone or slag used for aggregate is made up of 60 per cent 2 in. standard gage; 30 per cent 1½ in. standard gage; and 10 per cent ¾- to ½-in. size stone for filling voids during rolling operations.

In the case of two-coated work the sub-crust consists of 2-in. standard gage stone, and the wearing surface 1½-in. standard gage stone; 10 per cent of ¾-in. to ½-in. size stone is then used for void-filling.

The stone is thoroughly dried before coating and, if Tar No. 1 is used, especially in hot weather, the tarred material is allowed to stand long enough for the tarred stone surfaces to become partially hardened and "tacky." If Tar No. 2 is employed, the macadam is laid soon after tarring, and preferably when the road is quite dry and in warm sunny weather.

The amount of tar used per ton of stone, varies from 9 to 12 gal., according to the stone sizes, the grade of tar and the method of mixing.

In most cases a 10-ton roller is employed to finish off the work of an 8-ton roller since less rolling is required than in the case of water-bound macadam.

It has been found advisable to apply a coating of tar to the macadam surface after several weeks' passage of traffic, to the extent of one gallon of tar per 6 sq.yd. This tar is usually No. 2 and is sprayed on at a temperature of 270° F.

Surfacing with Pitch-Grouted Macadam—As in the case of tar-macadam surfacing, the road is opened up every 450 ft. to ascertain the thickness of the old crust and the state of the foundation.

The thickness of the pitch-grouted macadam coat is usually 2 in. on very lightly trafficked roads, and from 2½ to 3 in. on others for single pitch-grouting, and from 4 to 4½ in. for double pitch-grouting.

The thickness of the road crust is made the same as for tar-macadam roads, i.e., 6 in., 4 in. and 11 in. under similar conditions. The cross-fall and the methods of obtaining it are also the same as for tar-macadam roads.

The material for pitch-grouting is broken to 1½ in. standard gage. In addition to this, 10 per cent of chippings of the same stone, varying from ⅜ to ¾ in. is used for closing after grouting with the melted pitch. The pitch employed usually complies with the Roads Department specification as follows, the viscosity being modified to suit climatic and local conditions by varying the quantity of tar oils:

Specification for Pitch—The pitch is obtained of the required consistency by running it off from tar stills in which the distillation of tar has been stopped at a point at which the residual pitch will give a penetration of 70 when tested at 77° F. on a standard penetrometer. Harder pitch is softened or cut back so as to secure this penetration by the addition of tar oils which are preferably a filtered green or anthracene oil, wholly derived from tar produced by carbonization of bituminous coal or from such tar mixed with not more than 25 per cent of its volume of tar produced in the manufacture of carburetted water gas.

The specific gravity of these oils at 68° F. is between 1.065 and 1.085, and they are free from solid matter such as naphthalene and anthracene after standing for half an hour at 68° F.

These tar oils must be commercially free from light oils and water, and must yield at:

(a) Below 338° F. not more than 1 per cent light oils and water.

(b) Below 518° F. not more than 30 per cent middle oils.

(c) Below 626° F. not less than 95 per cent heavy oils, middle oils, and light oils and water, if any.

The pitch is not poured unless the stones are quite dry, which is affected by tarpaulin protection or by the employment of portable blowers. When the material is spread and levelled, it is rolled down dry without chippings until the stones present a mosaic surface.

The quantity of pitch required to grout a single coating is about 1¼ gal. per square yard for a consolidated thickness of 2 in., 1½ gal. for 2½ in., and 2 gal. for 3 in.

In melting the pitch, boilers of from 2 to 3 tons capacity are charged with pitch and about one-half of the proper proportion of tar oils. The fire is kept bright until the pitch reaches a temperature of 300° F. after four or five hours, the other half of the tar oils is then added and the mixture thoroughly stirred. During this heating the firedoors are kept closed. After stirring the doors are opened and the mixture allowed to fall to 250° or 270° F. If bad weather interferes, the fire-door is left open, the damper closed and the mixture allowed to fall to 200° F., at which temperature it is maintained at a consumption of about 7 lb. coke per hour. The boiler is always kept airtight during the melting of the pitch.

The sand used, which is clean and sharp is heated to

400° F. Mixture, in equal parts of sand and pitch, is effected in a separate vessel called a "dandy," and poured into pouring cans of 2 to 3 gal. capacity. During the whole time the matrix (sand and pitch) is continually stirred.

Final rolling is begun immediately after pouring and pushed forward before the matrix has had time to set. The 10 per cent of graded chippings is spread partly before and partly during rollings. Traffic is allowed to pass as soon as the surface has cooled to the normal temperature.

Where the traffic is heavy enough to demand double pitch-grouting, the bottom layer is made the thicker and consists of large stones, the two layers being rolled down and grouted separately. The stone for the bottom layer is graded from 2 in. to 3 in. standard gage, and no chippings are used for finishing the rolling of the bottom coat. The stone for the top layer is 1½-in. gage, and is finished with chippings graded from ½ to ¼ in.

So as to provide a key for the top layer the pitch is poured until about ½ in. of the stones is left exposed. The pitch used for double pitch-grouting is 3¼ gal. per square yard, with a thickness of 4 in., and 3½ gal. for 4½ in., though these quantities are sometimes varied for different materials.

Filtered Well Water Recommended for Memphis, Tenn.

After Iron and Carbonic Acid Removed Well Water Is Softer, Cooler and Produced Cheaper Than Filtered Mississippi

WELL water freed from carbonic acid gas and iron by aerators and filters rather than filtered Mississippi River water is the recommendation of Fuller & McClintock, consulting engineers to the Board of Water Commissioners of Memphis, Tenn. The well supply is good for 75 m.g.d. and will meet the demands for the next 30 years. The city now uses 13 m.g.d., derived principally from the Auction Ave. Station, which is 30 years old and near the end of its useful life. Costs are high, the service is becoming more and more unreliable, and dangerous pollution by leakage from sewers constantly menaces the supply. Though the artesian water is soft, free from bacteria, clear, cool and palatable, it contains 90 to 130 p.p.m. of CO_2 and an iron content varying from 0.2 to 6.0 p.p.m. The CO_2 takes up iron from the pipes, making storage, needed for fire protection, impracticable, unless the iron and CO_2 are removed.

FUTURE WATER REQUIREMENTS OF MEMPHIS

Year	Estimated Population	—Rates of Consumption m.g.d.— Ave. Day	Max. Day	Max Hour	Max Day Including Fire Draft
1920	162,351	13	20	27	36
1930	203,000	18	27	37	44
1940	249,000	24	36	50	55
1950	299,000	31	47	65	67

It is proposed to sink 24 wells having capacities of 1 m.g.d. each and install an 18-m.g.d. aeration and filter plant. The principal reasons given in the report for choosing the artesian supply rather than river water are as follows:

The water would be much harder than the artesian supply and also appreciably warmer in summer. Filtered river water would be free of iron and free carbonic acid in quantities which would seriously corrode iron. It would be far cheaper to treat the artesian supply by aeration and filtration to remove iron and carbonic acid than to remove the silt and bacteria from the river water.

A satisfactory intake in the Mississippi River from which to obtain a city water supply is more difficult and expensive to obtain under local conditions than at New Orleans or St. Louis. To establish such an intake in the vicinity of the bridges where the channel is stable would be objectionable on account of the city sewage, which could be removed only at great expense by intercepting sewers. To locate an intake twenty miles or more north of the city where the channel and banks are stable would be prohibitively expensive.

The only safe and permanent location for an intake pier, which could be built at reasonable cost, is opposite Poplar St., 1,500 ft. from the Arkansas shore, in deep water, in order to guard against trouble from deposits. From such an intake a tunnel would be built to a reservoir and filtration works at a site, 20 acres in area, located in the general neighborhood of Quinby Bayou and Winchester Ave. For a complete river water project of a rated capacity of 24 m.g.d. estimates for construction costs are $5,080,000, and the average annual cost would be $549,400.

This river supply investment is nearly double that required for a first class modern artesian water development of equal capacity, including aeration and filtration works, 10-m.g.d. storage reservoir, complete new pumping station and all necessary piping connections and extensions to satisfy the insurance authorities. The annual cost, including capital charges, depreciation, operation and maintenance, for a river water supply is about $200,000 in excess of the corresponding annual costs for a complete artesian development.

Treatment—The carbonic acid content is greatly reduced by the air-lift method of pumping water from the wells, about 80 per cent being removed. However, it has been proved conclusively by experiment and by observation of air-lift installations in various parts of the city that when iron is present the water becomes permanently milky in appearance on storage. To prevent corrosion in street mains and consequent increase in iron content, the carbonic acid should be reduced to 10 p.p.m. or less, which result can be obtained by additional aeration through nozzles, coke beds or other devices and by the application of small quantities of quick lime. The iron can be removed readily and completely by passing the water through rapid sand filters at normal rates for mechanical filters and can be completely removed from fully aerated water by such means only.

Air-Lift—Air lifts are best for removing the well water and delivering it through the collecting conduit to the proposed treatment plant at Dunlap St. Electrically-operated deep well pumps are somewhat more expensive and do not show the advantage which the air lifts possess in removing 80 per cent of the CO_2. Air for lifting the water and delivering it to Dunlap St. will be furnished by four compressors, two for regular service and two for reserve, each having a capacity of 2,700 cu.ft. of free air per minute. The compressors would be of the horizontal, cross compound, high-duty type, designed for a maximum pressure of 80 pounds.

Secondary Water Motor Pumps—For lifting the well water 20 ft. to the aerating and filtration works it is proposed to install centrifugal pumps operated by water motors attached to the high-service pipe system, this being the cheapest arrangement. In the event of a very severe conflagration it is possible to by-pass the filter works by shutting down these pumps, but this would not be necessary with any fire such as Memphis has ever yet experienced.

High-Lift Pumps—The best arrangement would be to provide two 15-m.g.d. crank-and-fly wheel engines and three 15-m.g.d. turbine-driven centrifugal pumps, the two former being capable of supplying the secondary pumps and 95 per cent of the water used by the city until 1930. The centrifugal pumps would be used during peak rates of pumpage and when the reciprocating pumping engines are being repaired.

Other types of pumping equipment considered and rejected as inadvisable were electrically-driven pumps not only for lifting water from the wells but also for delivering

water at Dunlap St. from the storage reservoir into the distribution system. No economy was found in electric pumping equipment, regardless of whether power be purchased or generated at the Dunlap station. We are particularly adverse to recommending electricity where there is no stand-by source of power quickly available in case the primary current should be shut off. In the case of this waterworks plant, there is no opportunity for storage of pressure water, and no interruption in the full necessary pumpage at the Dunlap St. high service pumps can be tolerated.

Wells—Eighteen wells at 1 m.g.d. each are required for service and five are required for reserve to permit of repairs. The best spacing, considering relative costs of conduit and extra head caused by interference is 500 ft. The economic size, considering the relation between the first cost of wells and fuel cost of overcoming friction in well casing, is 12 in. in diameter. The average submergence is 70 per cent; operating air pressure at well, 73 lb. and station pressure 78 pounds.

Air—The estimated free air requirement is 300 cu.ft. per min. per m.g.d., or 0.43 cu.ft. per gallon. This is conservative as compared with the Rix formula, which applied to our condition gives 0.28 cu.ft. per gallon.

Spillway of Elephant Butte Dam Completed

THOUGH the Elephant Butte Dam, Texas, was about completed in 1916, the construction of the spillway was postponed until the height of the stored water was such that it could be used to advantage in excavating the spillway hydraulickally. The accompanying photograph taken recently by L. R. Fiock, assistant engineer, U. S. Reclamation Service, Rio Grande Project, shows the spillway in its relation to the main dam.

In arriving at the final design, after consideration was given to curved channels and a series of check weirs, a straight channel was decided upon as best fitting the geological formation and the high velocities which would result down the steep slope from the dam to the river. The section adopted has a width of 50 ft., is from 20 to 25 ft. deep, and has an estimated capacity of 30,000 sec.-ft. The upper or curved sections of the walls, which act as turning walls, are of gravity type, while the straight section is designed with cantilever backfilled walls.

Concrete was placed from a chuting tower 135 ft. high. Approximately 36,000 yd. of material was excavated and 7,785 cu.yd. of plain and reinforced concrete placed.

The design and construction were carried out under the direction of L. M. Lawson, project manager, Rio Grande Project, U. S. Reclamation Service.

Comparative Strength of Air-Dried and Kiln-Dried Wood

FROM 150,000 comparative strength tests of kiln-dried and air-dried wood of 28 species the engineers of the Forest Products Laboratory conclude that there is no difference in strength. The ordinary fallacy that kiln drying produces stronger wood than air drying is usually the result of failure to consider differences in moisture content. The moisture content of wood on leaving the kiln is generally from 2 to 6 per cent lower than that of thoroughly air-dried stock. Since wood rapidly increases in strength with loss of moisture, higher strength values may be obtained from kiln-dried than from air-dried wood. Such a difference in strength has no significance since in use a piece of wood will come to practically the same moisture condition whether it is kiln-dried or air-dried.

The appearance of the dried wood is not a reliable criterion of the effect the drying process has had upon its strength. The strength properties may be seriously injured without visible damage to the wood. Also, it has been found that the same kiln-drying process can not be applied with equal success to all species. To insure uninjured kiln-dried material, a knowledge of the correct kiln conditions to use with stock of a given species, grade and thickness, and a record showing that no more severe treatment has been employed, are necessary.

Steel Powder as a Concrete Content

In 1920 the Queensland Railway Department undertook a series of experiments looking toward the discovery of a formula for obtaining an impermeable concrete with which to reinforce concrete reservoirs. The results of these experiments were recently explained in a conference at Brisbane, in which it was stated that the use of a steel powder not only rendered the mortar or concrete more impermeable but added to the resistance and hardness of the mix. It is recommended for use in concrete placed in either fresh or sea water because the metal seems to fix the cement and cut down the chemical action of the water. The sand used in the mix should be chosen with the greatest care. Half as much steel dust, which replaces part of the sand content, is used as is cement in any particular mixture. Care must be exercised in the mixing, and the consistency should be, according to the bulletin describing the experiments, "semi-liquid."

ELEPHANT BUTTE DAM WITH RECENTLY COMPLETED SPILLWAY

Bending Moments in Pins or Shafts Determined Graphically

Effect of Forces in Different Planes Expressed by Composite Moment Diagram—Maximum Movement Found by Inspection

By A. M. Winslow
University of Washington, Seattle

FOR a pin connecting structural members or machine parts and supporting several non-parallel forces, the customary method of finding the bending moment by numerical computation is rather long and tedious. The following graphical method is usually much shorter, particularly in cases where the value of the bending moment is required at more than one point or where the point of maximum moment cannot be determined readily by inspection.

Graphics of Parallel Forces—The graphic method will be explained by considering first the simpler case of parallel forces, for which the well-known graphical construction will be given here in order to make clear the extension of this method to the more complicated case of non-parallel forces. In Fig. 1, *rv* represents to scale the axis of a horizontal member with the set of vertical forces V_1, V_2, V_3, V_4, V_5 applied as shown. In the force diagram the forces are laid off in succession on a line *be*. According to the usual notation, the length *bc*

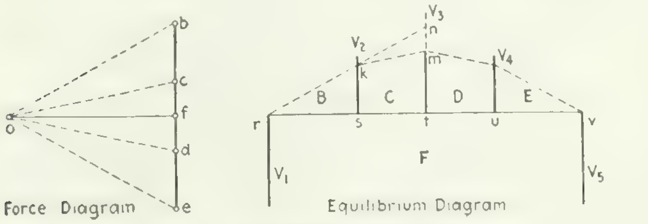


FIG. 1 NORMAL SOLUTION

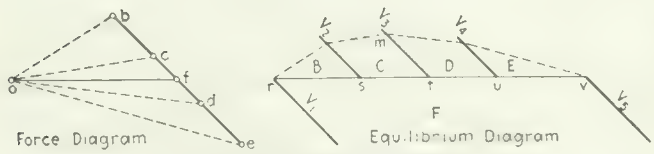


FIG. 2 MODIFIED SOLUTION

FIGS. 1, 2. MOMENT DIAGRAMS FOR PARALLEL FORCES

represents to scale the force included between the large letters B and C in the equilibrium diagram. Next, from *f*, the point between the two end forces, *fo* is drawn parallel to *rv*. From *o*, any convenient point in *fo*, the lines *ob*, *oc*, *od*, *oe* are drawn. Then, in the equilibrium diagram, starting at *r* on the axis, *rk* is drawn parallel to *ob*, *km* parallel to *oc*, and so on. In this last construction it will be noticed that the line in the space B is parallel to *ob*, in the space C parallel to *oc*, etc.

At any point *t* the bending moment M_t is, by computation,

$$M_t = V_1 \times (tr) - V_2 \times (ts)$$

From similar triangles *nrt* and *bof*,

$$\frac{(tn)}{(fb)} = \frac{(tr)}{(fo)}$$

$$(fb) \times (tr) = (tn) \times (fo)$$

$$V_1 \times (tr) = (tn) \times (fo)$$

Likewise, from similar triangles *nkm* and *boc* it can be shown that $V_2 \times (ts) = (mn) \times (fo)$

Therefore,

$$M_t = (tn) \times (fo) - (mn) \times (fo)$$
$$= (tm) \times (fo)$$

Expressed in general terms, in Fig. 1 the bending moment at any point *t* is equal to the product of the intercept *tm* multiplied by *fo*. The former, *tm*, represents a length in inches and should be measured by the same scale as the length of the member *rv*, while *fo* represents a force in pounds and should be measured by the same force scale as *bc*.

Before proceeding to the more complicated case of non-parallel forces, a modification of the method of

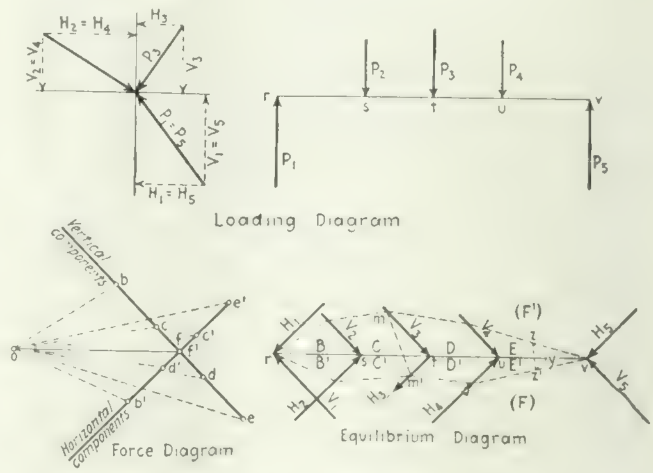


FIG. 3. COMPOSITE DIAGRAM FOR PIN SUBJECTED TO FORCES IN DIFFERENT PLANES

Fig. 1 will be explained. In Fig. 2 assume the same horizontal member *rv* and the same *vertical* forces V_1, V_2, V_3, V_4, V_5 as in Fig. 1. In Fig. 2, however, instead of representing these vertical forces in their true direction, let them be drawn parallel to each other, but inclined at an angle to the axis, as shown. Now draw the force diagram and complete the equilibrium diagram in the same manner as in the preceding figure, noting that *fo* is drawn parallel to *rv*. Then, by precisely the same reasoning as before, it may be shown that, in Fig. 2,

$$V_1 \times (tr) - V_2 \times (ts) = (tm) \times (fo)$$

In other words, in Fig. 2, the product of the intercept *tm* multiplied by *fo* gives the value of the bending moment at the point *t* for parallel forces *perpendicular to the axis*.

Non-Parallel Forces—The above preliminary explanation will make clear the principles involved in the graphical solution of the general case of non-parallel forces perpendicular to the axis, which will now be considered. To make the explanation brief, a simple case of symmetrical loading will be assumed. In Fig. 3, the loading diagram shows the axis of a pin *rv* with perpendicular forces P_1, P_2, P_3, P_4, P_5, the directions of these forces being shown at the left of the figure. Resolve graphically each force *P* into vertical and horizontal components, *V* and *H*. Then, in the equilibrium diagram draw the axis *rv* to scale and indicate the directions of the vertical components parallel to each other, but inclined to the axis at an angle of about 45 deg., similar to Fig. 2. Indicate the directions of the horizontal components at right angles to the vertical components.

Draw the force diagram, starting at the intersection *f, f'* to lay off the *V* and the *H* components, so that the point *f, f'* will be between the two end forces in each case. Draw *fo* parallel to *rv*, and complete the

force diagram and the equilibrium diagram for both the V and H forces, in the same manner as in Fig. 2.

Then, in the equilibrium diagram of Fig. 3, since the intercepts tm and tm' are at right angles, mm' is the resultant intercept, and the value of the bending moment at the point t is

$$M_t = (mm') \times (fo)$$

It can now also be quickly determined whether the maximum bending moment occurs at t or at s. Moreover, if the value of the bending moment is required at any intermediate point y in the span, draw the intercepts yz and yz'; then

$$M_y = (zz') \times (fo)$$

In certain cases this graphical process can be shortened somewhat. For example, where the loading is symmetrical about the middle of the span, as in Fig. 3, it is of course necessary to draw the equilibrium diagram for only one-half of the span. Also the multiplication $(mm') \times (fo)$ may be simplified by a suitable choice of the length of fo. This choice of fo may be conveniently made as follows in cases of pins of moderate length. A principle is involved regarding the scales of mm' and fo. As noted previously, any intercept mm' should regularly be measured by the same scale of length as rv, while fo is measured by the force scale of the force diagram. In the product $(mm') \times (fo)$, however, the result will obviously be the same if these scales are interchanged, that is, if mm' is measured by the force scale and fo is measured by the scale of rv. With pins of moderate length, it is usually convenient to draw the span length rv full-size and also make the actual length of fo one inch. Then, interchanging the scales as just noted, if the intercept mm' is measured by the force scale in pounds, the scale reading is directly the value of the bending moment in inch-pounds.

Suspended Ceiling Specifications Suggested

IN ORDER to co-ordinate the practice of design of suspended ceilings of metal lath, the Associated Metal Lath Manufacturers have issued the following specifications for that type of construction.

Hanger—The vertical member which carries the steel framework.

The minimum size for hangers shall be No. 8 galvanized wire 1 3/16-in. flats or 7/32-in. round mild steel rods. The wire is to be attached by twisting three times—flats attached by bolting with [illegible] bolts—rods by twisting twice, or by right angle bends and wiring. They shall be spaced not to exceed 4 ft. centers in either direction.

Runner Channel—The heaviest horizontal member.

Runner channels are to be not less than 1½-in. channels with a minimum of 0.442 lb. per lin.ft. They shall be spaced not to exceed 4 ft. on centers.

Furring Channel—The smallest horizontal member, to which the lath is attached.

Furring channels shall be not less than ¾-in. channels iwth a minimum weight of 0.276 lb. per lin.ft., attached to runner channels by at least three loops of No. 16 galvanized wire at each crossing. They shall be set on various centers, depending upon the lath to be used. A maximum of 11¾ in. centers shall be used for 3-lb. flat lath, 15¾-in. centers maximum for 3.4 lb. flat lath, 19-in. centers maximum for 3 lb. rib lath.

Metal Lath—The plastering base and reinforcement.

Metal lath shall weigh not less than 3 lb. per square yard. Metal lath shall be attached to the furring channels by No. 18 gage annealed galvanized lather's wire, every 6 in. along the furring channels.

Laminated Floor Tested for Influence of End Joints of Plank

By E. O. Ericson
Cumberland, Md.

IN THE construction of a laminated plank floor for a tire factory building recently, the question arose to what extent the floor is weakened by the end joints if individual plank do not run across the full span between girders. Such a floor consists of strips of wood ranging from 2 x 4 to 2 x 10 or deeper, laid on edge, each strip thoroughly nailed to the preceding one. The top of the floor thus built is smoothed off by adzing and a top floor then laid over it. Common practice in building such floors is to use pieces long enough to reach from girder to girder, which makes the floor rather costly and causes trouble in getting a large number of pieces of the same length, especially where the span is more than 16 ft. It is much more convenient to use random lengths. As no method of calculating the strength of a floor having joints within the span was known, an actual test was made. The results of the test were so satisfactory that all the floors of the building were constructed like the test sample, with plank joints making up as much as one-third the total cross-section.

Spans of 20 ft. and a floor load of 400 lb. per square foot were contemplated. Counting the full cross-section of the floor (under the common practice of using pieces of such length as to reach from girder to girder), a floor thickness of 10 in. was required, at an allowable fiber stress of 1,200 lb. per square inch. Therefore, 2 x 10 planks 20 ft. long would have to be used. In order to reduce cost and expedite the shipping of the lumber, however, it was desired to use random lengths, which would involve joints within the length of a span.

The test was made on a section 2 ft. wide extending over three 20-ft. bays. The material was 2 x 10 long-leaf yellow pine, dressed on four sides, with ¼-in. chamfer on each corner. The lengths ran from 10 to 20 ft., and they were so arranged that every third strip was of the same arrangement as regards joints. The 2-ft. width was made up of fifteen planks, of which five broke joint at the center of the middle span and five near the end of this span, while in the two end spans the three sets of joints came at various positions but not at the middle of the span. The nailing consisted of two 20-penny wire nails vertically one above the other, every 18 in. along the length of a plank.

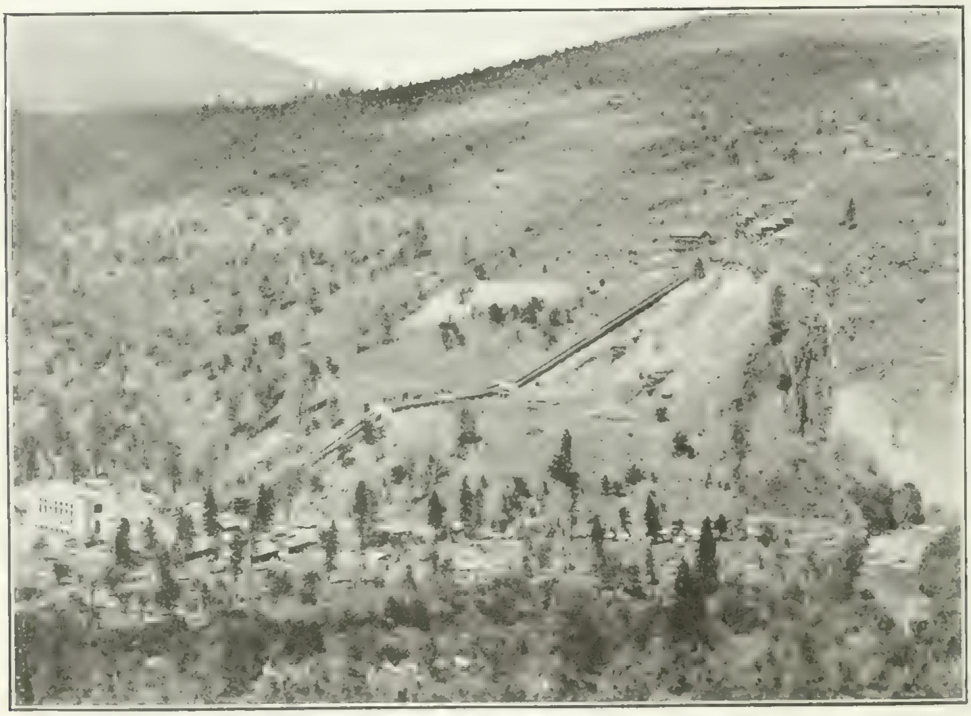
For the test the middle bay was piled with bricks in individual piles, slightly separated to avoid arching as the floor deflected, and as each layer of brick was put down the deflection of the middle section was measured. These deflections amounted to about ⅝ in. at 500 lb. per square foot, 1½ in. at 1,000 lb. per square foot, and 2 5/16 in. at 1,500 lb. per square foot. At a load of 1,587 lb. per square foot a fracture occurred in the sixth board from one side, at the center point of the middle bay. Loading was continued, however, to 1,700 lb., with a total deflection of 2 9/16 in., and this load in two days produced no further deflection.

A working load of 400 lb. per square foot on such a floor would give a factor of safety of 4, according to the test. Since a complete floor has greater strength because of the fact that each section is supported by the section to either side of it and because of the maple top floor, it was decided that the factory floors could be safely built like the test section.

First Pit River Power Project Is Completed

Highest Unit in Continuous River Development Totals 90,000 Hp.—220,000-Volt Power Line 202 Miles Long

A FORMAL opening Sept. 30 marked the completion of Pit River project No. 1, the first large unit in a series of hydro-electric plants being built on the Pit River in northern California by the Pacific Gas & Electric Co. The series of several plants to be built on this stream will use the same water successively in developing a total of about 600,000 hp. Pit No. 1, which stands at the upper end of the series, is notable for the size and head on the reaction wheels installed—45,000 hp. units under a 454-ft. head—but a still more remarkable feature is the watershed whose uniformity of stream flow has justified extensive construction designed to handle a flow of 1,800 sec.-ft. without the provision of any artificial storage whatever. A map and profile, together with general descriptions of the Pit River series of plants and the construction of thirty-five miles of railroad to Pit River No. 1, appeared in *Engineering News-Record*, Oct. 13, 1921, p. 604.



GENERAL VIEW ON PIT RIVER NO. 1 PROJECT

Surge chamber not yet completed. Note precipitous drop at right where flume will convey overflow from surge chamber. Tunnel dump shows at left and crusher plant on right at top of penstock.

Pit No. 1 takes its water from Fall River, a tributary of the Pit, only 15 miles long, but which springs full-fledged, as it were, from the lower edge of the Modoc lava beds. These beds of porous formation occupy a wide more or less level plain, seventy-five miles long, in which there are no surface streams. The extent of their stabilizing effect on the runoff, as shown by the uniform flow of Fall River, is such that seasonal variations are almost entirely eliminated. The maximum fluctuation of the river level on record is considerably less than one foot. In the city of Fall River Mills, near the intake, there is a historic island whose surface averages but 1 or 2 ft. above normal water level and which has on it a flourishing garden and orchard surrounding a residence built many years ago with the floor only 3 ft. above water level.

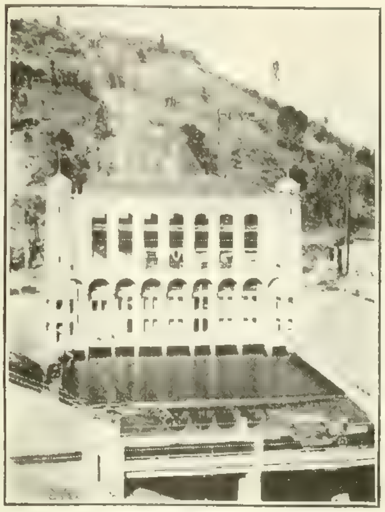
With the exception of the first part of the tunnel work, practically the entire project has been built in the year since the completion of the railroad. Prior to that time mud and snow made the main camp almost inaccessible for seven months of the year and all work was done under difficulties. Within the past year, however, the construction forces have included as high as 2,000 men. Rapid progress was made on all parts of the work and construction was completed according to schedule.

During the year the diversion dam in Fall River has been started and finished, the intake canal involving the removal of 80,000 cu.yd. has been excavated and lined with riprap and the 10,111-ft. tunnel has been completed and concreted. On the lower end of the project excavation for the power house foundation was started less than a year ago. Since then the building has been completed, a 1,200 ft. tailrace which involved a 120,000-cu.yd. excavation has been built and lined with riprap, and two 1,375-ft. steel penstocks and a concrete surge chamber have been constructed, not to mention the installation of all electrical equipment, including the outdoor transformer bank and about 150 miles of 220,000-volt steel tower lines. Installation of equipment in the power house was carried on simultaneously with the erection of the structure itself.

Pit No. 1 is a compact project; from the diversion on Fall River to the discharge into Pit River at the end of the tailrace the water travels but little over 2½ miles. Because of irrigated areas above and the necessity for avoiding any change in water levels, the intake dam is chiefly a submerged structure, 600 ft. long, with its crest but little above normal river level. It has three radial gates for emergency use in letting water through the dam. Entrance to the intake canal is at right angles to the stream flow at the west end of the dam and is controlled by three 10 x 20-ft. radial gates. The setting for these gates was combined with a highway across the canal in a single concrete structure with the motors for operating the gates installed on a second level of floor just below the roadway.

The intake canal, 1,200 ft. long, is designed to carry 1,800 sec.-ft. at a velocity of 2.8 ft. per second. To prevent caveins the side walls were lined with masonry from intake to tunnel portal. Materials excavated from the tunnel were crushed to provide rock and sand for the concrete tunnel lining which was placed by the pneumatic process. Crushing plants were installed at both portals of the tunnel. The one on the lower end

also supplied aggregate to make the concrete for the power house. Storage piles of material ready for the power house were made on the steep sidehill below the tunnel portal, whence delivery to the power house mixing plant could be made by gravity as required.

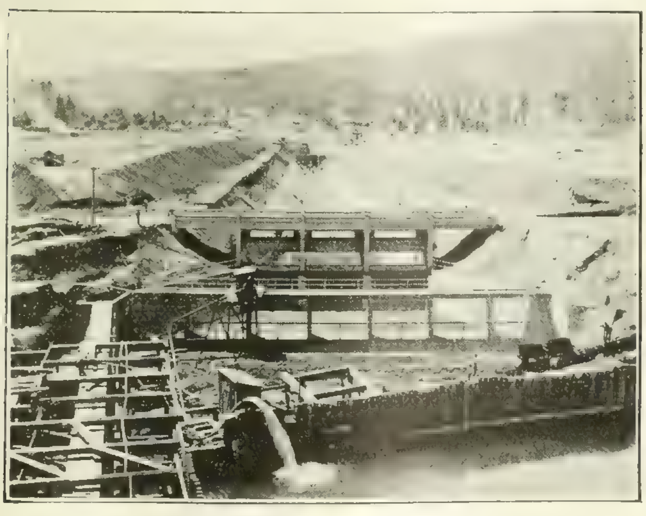


PIT RIVER POWER HOUSE
Turbines discharge into stilling basin whence canal 1,200 ft. long leads into Pit River. Forms not yet removed from circular spillway section on surge chamber at top of penstock line.

The surge chamber is a structure of massive design, 55 ft. high and 60 ft. wide inside, uniting the lower end of the tunnel with the double penstock line. It is designed to spill over the circular top and into a canal which discharges over a precipitous cliff nearby. Each penstock is equipped with a remote control, motor operated, butterfly valve, 10 ft. 9 in. in diameter, located near the surge chamber. Just below these valves at the top of the steep slope are placed 36-in. stand pipes for air venting the penstocks. At their lower ends the penstocks pass beneath the switch house and into the wheel pits via two 15-ft. concrete-lined tunnels.

The two hydraulic units are Allis-Chalmers single runner vertical reaction turbines, rated at 45,000 hp. each, equipped with hydraucone regainers and driving 35,000 kva. generators. The stilling pool just below the power house has been provided with an accurately leveled knife-edge weir 120 ft. long which is to be used in connection with hook gages installed in protected wells alongside for measuring discharges accurately.

In keeping with recent California practice all transformers are placed outdoors on concrete foundations, thus decreasing the size of the structures required, but by means of convenient track connections into the building, the equipment is kept within easy reach of the power-house cranes.



VIEW FROM FALL RIVER DIVERSION DAM TOWARD TUNNEL
Earth barrier in foreground was last of canal excavation to be taken out. Tainter gates located under highway bridge. Canal lined with hand-placed riprap.

Many electrical problems of a pioneering nature had to be worked out in preparation for the use of 220,000 volts on the transmission lines which will lead from Pit No. 1 202 miles to Vacaville, the distribution center not far from San Francisco Bay. The full voltage is not to be employed at the outset. The first operation will be at 110,000 volts over two parallel circuits, one of which will be used as a reserve. Later one of the circuits will be tested out at 175,000 volts, after which the voltage on the other circuit will be raised to 220,000.

The construction of Pit No. 1 has been done by the company's own forces. O. W. Peterson is construction engineer and E. H. Steele in charge of line construction.

The Engineer

From the Winnipeg "Tribune," Sept. 7, 1922

THE fact that the Engineering Institute of Canada is in convention here makes the occasion opportune to pay a little tribute of praise to one of the most essential and one of the least appreciated of the professions.

Study almost any phase of modern life, and at the bottom will be found an engineer. When we learn to recognize the engineer, and value his services at their true worth, the world will make much more rapid progress and at the same time a great profession will come into its own.

Great trains shuttle back and forth across the continent, thundering their contempt for the roadbed that plays a humble but essential part in transportation. Somewhere a long time back an engineer hacked his way through the bush or tramped over the lone prairie, surveying the line. After him came another engineer, blasting and digging and filling until the roadbed was made and the steel laid. Other engineers were creating the machinery that constructed the locomotive and the cars, and they were made from steel. Engineers had found the iron ore, engineers had mined it, engineers had turned it into steel with the aid of chemical engineers and electrical engineers and many others.

We say casually that Canada has 18,000,000 available horsepower in hydro-electric energy. How do we know? Engineers of the hydrographic branch have been ranging the whole Dominion, measuring the flow of rivers, many of them in the almost inaccessible fastnesses of the hinterland. Engineers first surveyed the course of the rivers, and when the time comes when hydro-electric development is possible on any of them, engineers will choose the site, engineers will construct the dams and the power plants and the transmission lines. The development of the hydro-electric power of Manitoba is one of the greatest factors shaping the destiny of this province and its people.

A great bridge costing many millions of dollars is to be erected. Engineering brains must figure the stress and strain on each little strut or girder, even each both in the structure. A highway is planned—engineers must figure gradients and drainage and materials and construction. A great building is to be erected, and engineering accuracy is called to find out what foundations are necessary. A city requires water, and the engineer is the man who finds it and brings it in and distributes it. Does concrete work crumble under the action of alkaline water? Turn to the engineer. What radiation is necessary to heat a space of 200,000 cu.ft.? Ask the engineer. What is the wind stress against a great illuminated sign high in the air? Consult an engineer.

The engineer is the brains of construction and development. The capitalist supplies money, the workingmen supply labor, the management furnishes direction and initiative. The engineer's job is to say what can be done and how it can be done—and he must know, for guesswork is foreign to his nature.

It is a noble profession, and one of the greatest. Let us hope that greater recognition will come to it.

Methods and Cost of Laying Gas Main with New Joint

Deep Bell Joint Packed with Cement and Yarn—Hand Trenching and Backfilling—Large Bell Holes Facilitate Calking

By Jacob D. von Maur
Superintendent of Distribution, Laclede Gaslight Co., St. Louis, Mo.

A TWENTY-FOUR-IN. high-pressure gas main laid recently at St. Louis, Mo., is believed to be the first high-pressure main laid with pipe having the No. 2 or alternative design of bell for cement and combination joints adopted by the American Gas Association in 1913 and revised in 1922. This bell and the standard bell are shown in the accompanying drawing. It will be noted that in the No. 2 bell the depth is much greater, the lead groove is omitted and the bell is tapered so that the lead or cement space is greater at the back. Thus in the 24-in. pipe the bell is 6 in. instead of 5 in. deep and the lead space increases from 0.63 in. to 0.75 in. at the back instead of having a uniform width of 0.63 in. The weight of the new bell is thus 259.5 lb. instead of 235.1 lb. in the standard design. This main is 1,000 ft. long and forms part of the high-pressure belt line which is a distinctive feature of the St. Louis gas distribution system. Of the total length, 900 ft. are laid with pipe having the new joint and 100 ft. with pipe having the old standard bell and spigot joint.

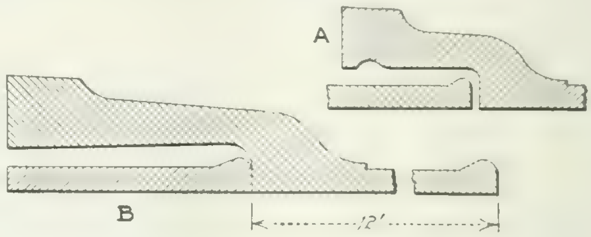
In order that the joint made with the No. 2 bell should be given the best possible test no expense was spared to lay this main as nearly perfect as possible. The bell and spigot were carefully cleaned with wire brushes and each length of pipe was laid on wood blocks set flush with the bottom of the trench, so that the pipe has a bearing on the ground as well as on the blocks. The bell holes were made unusually large so that the calkers had ample room to work comfortably. Jute packing, free from oil, was used in the joints. The first yarn was dipped in water and then thoroughly squeezed so as to leave it just damp. Four strands were first placed in the joint and thoroughly calked with heavy yarning irons driven with hand calking hammers. The pipe was well set by filling and tamping the earth between the joints.

After six lengths of pipe were laid the joints were finished by filling the space between the spigot and bell with neat cement, hand mixed with water in the proportion of 10.5 quarts of cement to 4.5 quarts of water. The proportion of water to cement (45 per cent) is somewhat more than theory calls for, but with weather conditions the hottest of the year this proportion appears to be about right. When the joint was filled to the face of the bell with cement, seven strands of dry yarn were calked in with hand calking irons and driven back by a sledge hammer. This resulted in the excess water being taken up by the yarn and the cement packed in the joint to its maximum density. The portland cement averaged a tensile strength of 292 lb. and 405 lb. at 7 and 28 days respectively.

After the joint was faced with cement it was covered with wet bags which were kept moistened as long as the joint was exposed to the weather. The cement was allowed to set for at least 24 hours before testing the joint. The line was tested in three sections with air at a pressure of 12 lb. per square inch. The gage showed tight, but each joint was then separately tested with soap suds and not the slightest pin-hole leak was discovered. It is believed that this line will remain permanently bottle-tight.

The time actually required with two men to calk each joint was 45 minutes. But their work was more than simply calking the joint. There were live gas connections to be made, holes to be tapped and assistance given in placing the pipes. As a matter of fact the cost of calkers and cement mixer on this job amounted to 30c. per foot, or the total cost of laying and calking, including the cost of live gas connections, was 48c. per foot.

The gang for laying this main was organized on the job. Labor was paid 40c. an hour and was very scarce at this price. The men were mainly miners and railroad men out on strike, together with a sprinkling of farmers, but the miners and railroad men could not stand the strain of working in the sun and most of these men quit after working from two to six days.



JOINTS FOR CAST-IRON GAS MAINS
A; standard bell. B; bell for cement and combination joints.

In excavation, the top 18-in. of the trench was macadam with a very heavy telford base and in places an additional old paving was encountered. Below this was hard dry clay, which expanded 33 per cent in bulk when loosened. Owing to the proximity of double street-car tracks much additional handling of earth was required. The item of digging bell holes was unusually large and amounted to approximately 1.7 cu.yd. per joint. The trench was 6.5 ft. deep and its average width in clay was 3.1 ft. Including the paving, bell holes and connections the total amount of excavation was 946 cu. yd.

With hand labor for work of this kind we can usually estimate an average of 1 cu.yd. per lineal foot of trench, and the total labor cost per foot is equal to one day's pay for a laborer. On this basis the estimate for all labor would be $3.60 per lineal foot of completed work. The actual cost on this job was as follows:

	Total	Per Foot
Excavation, including removal of paving, digging trench, bell holes and excavations for connections and obstructions	$1,283.70	$1.28
Laying pipe, including calking, connections and testing	480.81	0.48
Backfilling, including repaving, hauling dirt to dump and cleaning up	731.66	0.73
Miscellaneous, including construction of valve manhole, bracing, foremen and city inspection	588.24	0.59
Total	$3,084.41	$3.08
Supervision and engineering		0.31
Grand total		$3.39

Where excavating and backfilling machinery can be used the costs can be lowered. Conditions are not always favorable for their use but the high price of

labor will gradually force the greater use of these mechanical agencies. It is interesting to note that the cost of laying, backfilling and cleaning up amounted to nearly as much as the cost of excavation. Tamping in 6-in. layers is very expensive work.

As an experiment, several joints were made by adding 10 per cent of iron filings and sal-ammoniac to the cement. This was done at the suggestion of C. Winter, of Robert W. Hunt & Co., who conducted the cement tests. These joints also proved to be tight. A few lengths of pipe with standard bell were used, with lead joints calked by hand calking tools driven with sledge hammers.

Where lead joints are properly made they will give much better results than they are usually given credit for. Many such joints have been condemned when probably the true cause was not due to the calking material used. For this reason, special attention was given to the laying of this main in order to ensure that the pipe was laid in the best possible manner and that all causes which might result in a joint leaking were elminated as far as possible.

With reference to the shovels used for excavation, a number of different designs were used and it was interesting to note that a properly designed shovel would give 20 per cent greater efficiency over many shovels in common use. With labor paid at the rate of $3.60 for nine hours work, this increase in efficiency means 72c. per day per shovel. The importance of using a properly designed shovel is not generally appreciated, but with proper tools a man can not only do more work per day but can do it with less fatigue. This human factor should not be overlooked by the engineer or contractor.

British Road Direction Posts and Warning Signs

ALL-METAL road signs have been made standard in Great Britain. In order to evolve signs which might be generally acceptable, the Minister of Transport requested the County Surveyors' Society to report on the question. The proposals made were then submitted to the more important associations of road users and motor organizations, and were finally accepted at a meeting of the Roads Advisory Committee. The accompanying illustrations show the direction and the place and name signs.

The instructions of the Minister of Transport are that the posts should occupy a dominant position and that in certain cases it may be advisable to re-site existing posts to attain this end. Direction arms, it is stated, should be set at such angles as to ensure that each arm lies along the immediate general direction of the road which it indicates. Other suggestions are:

1. The projection of the direction arms over the roadway should be avoided.

2. In all cases the lower arms should indicate the more important road, and only the arms indicating the same road should be set in the same horizontal plane.

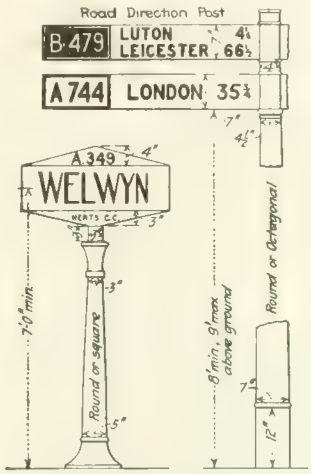
3. Where the text and size of lettering upon the arms of an existing post are otherwise suitable, the route number may be conveniently secured to the end of the direction arm by means of a sleeve connector and set screws.

4. An indication shall be given on the post of the Highway Authority responsible for its maintenance.

5. In all but exceptional cases the arm should be lettered on *both sides*, the nearest village being given first, then the nearest important town, followed by the terminal town where necessary. The mileage should be given in figures only, immediately following the place to which it refers, the lowest fraction being a quarter.

6. Wherever possible, the direction post should be placed in such a position as to be visible to traffic from all converging roads for a distance of at least a hundred yards.

For warning signs and notices, the Ministry recommends on top of a 9-ft. post, a red triangular "danger" sign. The special danger to be avoided is indicated by a symbol, together with a clear and simple title in letters 2 in. high, upon a vertical plate 12 in. wide and 21 in. long fastened to the post below the red triangle. The list of dangers is: "School," "Level crossing," "Cross-roads," "Corner," "Double Corner," "Steep Hill." Cast-iron plates are recommended with letters and details in relief. Flat enamelled sheet iron is liable to damage and defacement by stones. In towns and suburban areas, where street lighting arrangements permit, the illumination of road signs is desirable. At special danger points the red triangle, together with the appropriate symbol should be enlarged to 1½ times the standard size, and lighted.



TYPES OF ALL-METAL ROAD SIGNS IN GREAT BRITAIN

The Ministry recommends that the color of the supporting posts and the field of the sign should be plain white; the color used to denote the name of the highway authority on the sign being optional.

Hard-Surface Roads Should Be at Least 18 Feet Wide

A minimum width of 18 ft. for hard-surface roads is recommended by the U. S. Bureau of Public Roads. The maximum width of truck body generally permitted is 8 ft. and 5½ ft. is the ordinary clearance width of automodrive with the wheels closer than 1½ ft. to the edge biles. At an average speed of 30 miles an hour it is of the pavement, says the bureau. For trucks at an unreasonable to expect the driver of an automobile to average speed of 15 miles an hour, this distance should not be less than 1¾ ft. on account of the great width of the rear wheel. Three feet seems to be a minimum safe clearance between bodies. Inasmuch as a certain amount of truck traffic is to be expected on all main country roads, the minimum width of surface should be 18 ft. to provide these clearances when an automobile meets a truck.

Where the frequency with which trucks pass each other becomes a big factor, as in the neighborhood of large cities, the minimum width of pavement should be 20 ft. to provide a clearance of 3½ ft. and a safe distance of wheels from edge of pavement.

Drainage Ditches for Rio Grande Irrigation Project

Reclamation of Lands Spoiled by Seepage and Alkali from Excess Irrigation—Cost of Contract and Force Work

By L. M. Lawson
Project Manager, U. S. Reclamation Service, El Paso, Tex.

EXTENSIVE land drainage works to carry off seepage water which threatened to render useless a large area of irrigated land by waterlogging and alkali accumulation have been carried out with satisfactory results on the Rio Grande irrigation project of the U. S. Reclamation Service. Plans for this drainage work were described in *Engineering News-Record* of Sept. 18, 1919, p. 543. The present article relates to the results obtained.

Stated briefly, 70 per cent of this project, comprising a gross area of 200,000 acres located in New Mexico, Texas and Mexico, was seeped or in danger of becoming waterlogged in 1917. The cause of this condition was the over-application of irrigation water to lands of the long narrow valley after completion of the Elephant Butte storage dam. Before storage was available the normal flow of the Rio Grande was so erratic and intermittent that long dry periods were experienced and the necessity for drainage was not so apparent. With improvement in irrigation facilities and large available water supply the rise of the ground water was accelerated and for a time the entire irrigated area was threatened with destruction through seepage.

FIG. 1. EXCAVATING DRAINAGE DITCH ON RIO GRANDE IRRIGATION PROJECT

Plans for relief, made in 1917 by a board of engineers, covered the construction of approximately 346 miles of open drains involving the excavation of approximately 17,700,000 cu.yd. By Jan. 1, 1922, about 222 miles or 70 per cent of the entire system had been constructed. Records of seeped and drained areas show that 64 per cent of the total area is now drained and protected, compared with 70 per cent seeped before the construction of drains had been undertaken.

Construction work on a drainage ditch by a dragline excavator is shown in Fig. 1, and Fig. 2 shows a lateral irrigation flume over a ditch. Fig. 3 shows the construction of a double-barrel concrete pipe culvert which is typical of road and canal crossings of the ditches.

Government forces built 206 miles of these drainage ditches, requiring 10,421,708 cu.yd.; 15.7 miles, with 850,341 cu.yd., were built by contract. The total and unit costs of excavation were as follows:

FIG. 2. FLUME CARRYING IRRIGATION LATERAL OVER DRAINAGE DITCH

		Unit Cost	
	Total Cost	Per Mile	Per Cu.Yd.
Government	$890,220	$4,321	8.55c.
Contract	99,031	6,307	11.69c.

A number of interesting features are presented by this work, in addition to the cost and the mechanical means of accomplishment. The valleys of the Rio Grande below Elephant Butte dam and within the limits of the Rio Grande irrigation project, are composed largely of sand accumulations from side arroyos or washes. The fine silt from the upper river has generally formed laminations with these sand deposits in relatively thin layers. Practically all ditches are excavated through the upper silt and reach into the sand strata where underground water movement is facilitated.

The first drainage construction was accomplished in irrigated areas where a high water table was yearly

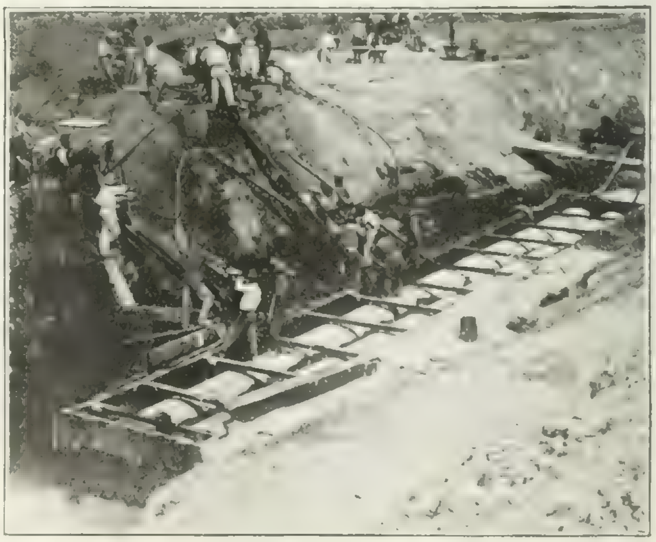


FIG. 3. CULVERT CARRYING DRAINAGE UNDER ROADS AND IRRIGATION CANALS

reducing the crop yield. The first discharges of drains were necessarily high, but later were reduced to flows affected largely by the time and amount of irrigation. Drains located near the river, which is in reality the main canal of the project, have an average discharge of 2.25 sec.-ft. per lineal mile. Those located near the foot-hills or mesa, which receive their flow from irrigation supply, average a discharge of 1 sec.-ft. per lineal mile. The drains first excavated in seeped and waterlogged areas reach a maximum discharge very rapidly.

During the period of high-water table, previous to the construction of deep channel outlets, a large area of project land was subject to accumulations of alkali because of evaporation and capillary action. The salt content of the Rio Grande water at Elephant Butte reservoir is approximately 40 parts in 100,000. The average in drainage canals is 191 parts, with a minimum of 80 and a maximum of 435. These canals discharge into the river at various points throughout the project length. A reasonable minimum of salt content in the irrigation supply for the lower lands is

FIG. 4—EFFECT OF DRAINAGE OF IRRIGATED LAND
Above; accumulation of seepage water. Below; results of drainage, two years later.

maintained by dilution with river supply direct from the dam.

At the Leasburg diversion dam, 60 miles below Elephant Butte dam, the salt content of the Rio Grande irrigation supply averages 45 parts in 100,000. At the Mesilla dam, 80 miles below Elephant Butte, 55 parts. As the International diversion dam, 120 miles below Elephant Butte, the average is 70 parts. During the period of non-irrigation when no flow is released from Elephant Butte dam, and the water at El Paso is composed entirely of discharge from drains or seepage, the salt content is 140 parts per 100,000.

A characteristic of the Rio Grande before storage was accomplished was the rapid increase in salt content as the flow diminished. This alkaline condition was so severe at times of normal low-water flow that the use of river water for boiler or irrigation purposes was prohibitive. As the river flow increased with the spring floods from melting snows in the upper drainage area of the river, the percentage of salt content was decreased. Drainage canals show the opposite condition, an increase in discharge registering an increase in salt content. Based on the analysis of discharge of drainage canals, over 500,000 tons of alkali have been removed from the project lands. Analysis of the drainage water shows the drain discharge to contain over 1,000 tons of alkali in solution in 24 hours.

Although the drainage ditches lower the water table and largely remove the opportunity for further accumulations of alkali by holding the water table sufficiently below the line of action of capillary attraction, they do not accomplish the removal of the salt accumulations without individual reclamation work on the part of the landowners. The deep main drains furnish an outlet for underground water accumulations, but deep plowing and flooding of alkali land are required to remove salt accumulations. Inducement to the property owners to perform such work is offered by delivering water for flooding purposes at a very nominal rate.

Considerable success has been obtained in these leaching processes, and some areas which were so highly impregnated with salt as to be incapacitated from producing crop yields have within short periods been reclaimed and made productive. With further use of this practice the remaining salt areas will regain their original fertility. The salt content of the drainage discharge will then be reduced to such a minimum as to make this water available for irrigation without the dilution now necessary.

New Refuse Destructor at Rochdale, England

Mixed refuse, screened to remove "fine dust," is incinerated in a new destructor at Rochdale, England, and the resulting heat is used to produce power for all works' purposes, driving the refuse elevators, the screens, the ash and clinker aërial tramway, and also the electric light plant for the entire installation. The destructor is a four-cell, top-feed, continuous-fire Heenan & Froude unit, with a capacity of 450 long or 500 short tons per week of six working days, or some 80 short tons a day. The gases of combustion pass through a Babcock & Wilcox boiler with 2,197 sq.ft. heating surface, which supplies steam under 140 lb. pressure to a 100-kw. turbo alternator. On arriving at the works, the "dry ashbin refuse," as the London *Surveyor* styles it, is "tipped" into specially constructed covered hoppers from which bucket elevators lift the refuse to the "vibratory screens." The screenings are discharged into covered hoppers and the remainder of the refuse onto destructor charging floor. The "fine dust" from the screens and the clinker (and ash?) from the destructors are moved by "an aërial ropeway" to a dump at the rear of the destructor. The "ropeway" displaces a 9,900-lb. motor truck and two horses and carts formerly used for moving this material. The cost of the plant described, *The Surveyor* states, will be under the £19,500 loan ($95,000 at normal exchange) authorized for the purpose. The scheme was carried out by J. Ardern, cleansing superintendent of Rochdale.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Largest Storage Reservoirs in United States

Sir—There was published in *Engineering News-Record* on May 11, 1922, p. 799, a table of the larger reservoirs in the United States in the year 1920, compiled by me for the Committee on Water Supply of Engineering Council. Since then we have been indebted to numerous correspondents for additions and corrections. These have been embodied in the accompanying abbreviation and extension of the original table, which is divided into four parts. Part A includes all of the 38 reservoirs holding over 50 billion gallons each. Corrections to the rest of the table (which is not reprinted)

TABLE II—RESERVOIRS FOR WATER SUPPLY COMPARED WITH ALL RESERVOIRS LISTED

Size Billion Gallons	All: Number	All: Capacity Billion Gallons	Water Supply: Number	Water Supply: Capacity Billion Gallons	Per Cent of Total: Number	Per Cent of Total: Capacity
Over 400	2	1,288	0	0	0	0
Over 200	6	2,498	0	0		
Over 100	13	3,501	1	132		
Over 50	38	5,252	2	195	5.25	3.73
Over 20	75	6,307	7	348	9.35	5.50
Over 10	122	6,982	14	441	11.45	6.32
Over 4	208	7,831	30	544	14.50	7.95

are shown in Parts B and C of the revised table. These contain data for additional reservoirs now reported, and corrected data where there are important changes. It also shows revised figures for capacities of two reservoirs, one of which is reported to be much reduced in capacity by silting and the other not capable of being filled to its flow line because of the condition of the dam.

It is of interest to note that of 208 reservoirs in the revised

TABLE III—SUMMARY OF ALL 208 RESERVOIRS BY SIZE

Reservoirs Between Stated Limits, Billion Gallons	Number of Reservoirs Reported of this size	Combined Capacity of Reservoirs of This Class Billions Gallons
Over 400	2	1,288
200 to 400	4	1,210
100 to 200	7	1,003
50 to 100	25	1,751
20 to 50	37	1,055
10 to 20	47	675
4 to 10	76	849

table with capacities of 4 billion gallons and over, and with an aggregate capacity of 7,831 billion gallons, 30 reservoirs holding 544 billions are used for public water supply. (See Part D of Table I for detailed list, and Table II for comparative summary. For another summary covering all 208 reservoirs, see Table III.) In number the public water-supply reservoirs are about one-seventh of the total, but they

[Note: The information below refers to tabular matter herein, particularly to Table I in the column opposite.—Editor.]

Capacities include only the available capacity ordinarily and easily used and do not include water below the outlet and not available; nor water held above the flow-line by flash-boards unless the flash-boards are a part of the regular equipment and are normally used each year; nor temporary storage at times of high flood.

The information was first secured and verified by a well informed hydraulic engineer in each state selected for this purpose by the council. Figures for several states from which returns were not received have been supplied from any other source believed by the committee to be trustworthy.

As Engineering Council was abolished the work of this committee was terminated while it was still in an incomplete state, and this table represents this particular work as far as it had been carried.

The second edition differs from the first by embodying all the additions and corrections received since the table was first published.

represent only 8 per cent of the aggregate capacity. No doubt the average cost per unit of capacity of the reservoirs used for municipal supply has been much greater than the reservoirs built for power and irrigation and the total investment in reservoirs of this class is therefore greater than would be indicated by these figures.

New York City, Sept. 24. ALLEN HAZEN.

TABLE I—LARGEST STORAGE RESERVOIRS IN THE UNITED STATES IN 1920

(Second Edition, Revised to Sept. 9, 1922. First Edition Published in *Engineering News-Record*, May 11, 1922.)

Name of Reservoir	Year Reservoir Began to Fill	Area Acres	Cap. Billion Gal.	Depth of Water Ft. Max.	Depth of Water Ft. Aver.	Used for
Part A:	38 Reservoirs in Excess of 50 Billion Gallons Capacity					
Elephant Butte, N. M.	1915	40,080	863	193	66	Irr
Roosevelt, Ariz.	1908	16,832	425	225	78	Ir
Pathfinder, Wyo.	1909	22,700	349	184	47	Irr
L. Winnibagoshish, Minn.	1884	103,040	338		10	Nav
Jackson Lake, Wyo.	1916	25,530	276	41	33	Irr
Leech Lake, Minn.	1884	149,760	247		5	Nav
Moosehead Lake, Me.		74,900	177		7.3	Pow
Ripogenus, Me.	1916	28,800	157		22	Pow
Clear L. Klamath, Cal.		25,000	150	24	18	Irr
Shoshone, Wyo.	1909	6,604	149	233	69	Irr
Ashokan, N. Y.	1913	8,180	132	190	50	W.S.
Twin Lakes, Me.	....	....	123	...	..	Pow
Hebgen, Mont.	1915	13,000	115	81	29	Pow
Medina, Tex.	1913		98	156		Irr
Big Meadows, Cal.	....	15,500	96	...	20	Pow.
Bridgewater, N. C.	1919	6,510	94		44	Pow
Lahontan, Nev.	1914	12,000	94	112	24	Irr
Arrowrock, Ida.	1915	2,860	91	247	98	Irr
Sevier Bridge, Utah	1908	10,120	82		26	Irr
Strawberry, Utah	....	8,370	81	61	30	Irr.
Sebago Lake, Me.	....	28,672	77	...	8.2	Pow
Salmon, Ida.	1911	3,500	74	120	65	Irr.
Aziscohos, Me.	1913		71	60		Pow
Lake Kachess, Wash.		4,800	68	53	44	Irr
Belle Fourche, S. D.	1910	8,010	66	100	25	Irr
Magic, Ida.	1911	3,800	65	...	52.5	Irr
Mooselookmaguntic L., Me.		16,608	64		11.9	Pow
Spednic Lake, Me.		14,618	64		13.5	Pow
Wachusett, Mass.	1905	4,200	63	150	46	W.S.
Sawyer Lake, Me.		6,720	60		27.3	Pow
Deer Flat, Ida.	1908	9,835	58	58	18	Irr
Salmon River, Ida.	1911	3,500	58		53	Irr
Pine River, Minn.	1886	562	58		3	Nav
Blewett Falls, N. C.	1912	2,500	57		74	Pow
Warm Spring, Ore.	1919	4,200	55		43	
Buenavista Lake, Cal.	1890	25,000	55	15	7	
Lake Winnepesaukee, N. H.	1850	45,400	52		4	Pow
Lake Keechelus, Wash.	..	2,550	50	66	60	
Part B: Additional Reservoirs Reported						
Sanchez, Colo.			34			Irr
Nelson Res., Mont.		4,560	22	53	19	Irr
Holter, Mont.	1918		20	100		Pow
Lower Otay, Cal.	1919		19			W.S.
Hauser Lake, Mont.	1911	...	15	65	..	Pow
Canyon Ferry, Mont.	1898	4,750	13	39	9	Pow
Madison Lake, Mont.	1906	4,250	12	44	9	Pow
Part C: Revised List of Reservoirs where important changes in data are reported.						
Sherburn Lake, Mont.		1,735	22	69	38	Irr
East Park, Cal.	1911	1,850	17	88	28	Irr.
Lake McMillan, N. M.	1895	7,860	15	25	6	
Stanley Lake, Colo.	1910		16	108		Irr
Cold Spring, Ore.	1908	1,500	16	90	33	Irr
Bumping Lake, Wash.		1,350	11	36	25	
Fort Worth, Tex.	1914		8	36		W.S.
Lake Clealum, Wash.		2,260	6.8	11	9	
Willow Creek, Mont.		1,050	5.4	65	16	Irr
Conconully, Wash.	1909	460	4.7	55	31	Irr
Part D: Reservoirs Used For Water Supply						
Ashokan, N. Y.	1913	8,180	132	190	50	W.S.
Wachusett, Mass.	1905	4,200	63	150	46	W.S.
Croton, N. Y.	1906	3,360	45	157	41	W.S.
Kensico, N. Y.	1916	2,218	38	155	52	W.S.
Cheesman, Col.	1901	874	26	222	68	W.S.
Crystal Springs, Cal.	1888	1,500	23		48	W.S.
Haiwee, Cal.	1911	2,100	21	60	30	W.S.
Lower Otay, Cal.	1919	.	19			
Croton Falls, N. Y.	1910	1,600	15	100	29	W.S.
Morena, Cal.	1911	1,370	15	142	34	W.S.
Tomhannock, N. Y.			12			W.S.
Johnstown, Pa.	1911	900	12	80	42	W.S.
Carmel, N. Y.	1895	998	10	55	31	W.S.
Cross River	1908	850	10	106	36	W.S.
Nepaug, Conn.	1916	851	9.560	97	33	W.S.
Boonton, N. J.	1904	900	8.600	100	25	W.S.
Decatur Dam, Ill.	1920	3,000	8.000		7	W.S.
Fort Worth, Tex.	1914		8.00	36		W.S.
Sudbury, Mass.	1896	1,220	7.900		21	W.S.
Amawalk, N. Y.	1897	600	7.680		20	W.S.
San Fernando, Cal.	1914	410	7.500		56	W.S.
Titicus, N. Y.	1894	707	7.167	105	31	W.S.
San Andreas, Cal.	1874	549	6.500	90	36	W.S.
Pueblo, Col.	1908	818	6.000	30	22	W.S.
Sodom, N. Y.	1890	575	4.883	72	26	W.S.
Hemlock, Conn.	1915	500	4.500	80	28	W.S.
San Leandro, Cal.	1875	335	4.323	100	40	W.S.
Calaveras, Cal.	1918		4.200			
Bog Brook, N. Y.	1890	410	4.145	54	31	W.S.
Middle Branch, N. Y.	1878	432	4.000		54	W.S.

Asphyxiation by Gas in a Sewer Manhole

Sir—At the convention of the American Society of Sanitary Engineers held last month near Sandusky, Ohio, mention was made of a case of asphyxiation due to gas collected in a sewer manhole. Inquiry by the writer brought out the following facts: The accident (in Jacksonville, Fla.) occurred to two plumbers working in a manhole on a 12-in. intercepting sewer on a separate system. The sewer is over a mile long, delivering into a pump chamber, with an inverted siphon upstream from the pumps.

The city workmen have found that the manholes on the lower portion of the sewer all collect a gas which is non-inflammable, odorless and evidently heavier than air. The gas also collects in the storm-water drains and a contractor's laborer who entered one of these manholes was overcome and confined to a hospital for several weeks.

Before entering a manhole the test is now made with a lantern and at no time has any combustible gas been found in these manholes.

My information has been received from John Fowler, building inspector at Jacksonville.

Although this appears to be an unusual case, recording it in your columns may be the means of saving lives.

New York City. R. A. MacGregor.
Office of Commissioner of
Public Works, Borough of Manhattan.

The Effect of Alkali on Concrete

Sir—Much literature has been published upon this subject, ending with an article in *Engineering News-Record*, July 13, 1922, on the disintegration of brickwork and concrete in Glenn County, in California.

The writer's responsibility for the construction of the cantonment for the garrison at Basrah in Mesopotamia has caused him to apply the results of previous experience to eliminate this trouble.

The soil here is similarly alkaline to that described by the writer of the above-named article, except that the predominating salt is calcium sulphate.

The crux of the whole question seems to be whether or not capillarity, followed by evaporation of the ground water, can take place in the structure.

Few investigations can be traced, which have been published, as to this phase of the problem, since Richard L. Humphrey stated, in a discussion before the American Society of Civil Engineers (Vol. LXXII, 1910, page 599) "Generally it" (i. e. disintegration) "is found where the brick or stone is quite porous, and has a high absorption. In such cases the disintegration occurs at the ground line, or at that point above it which marks the limit of capillarity action, where the water evaporates."

This confirms the writer's observations that where the damp-proof course, in an ordinary building, is efficient, it not only prevents damage above itself but is equally effective in preventing deterioration below ground, especially if the coating can be made to extend down the sides of the foundation, to such a depth below the actual ground surface that evaporation cannot take place.

The action appears to be that the alkaline ground waters rise by capillarity into the foundations and walls, until at some level (generally about two feet above the ground, in this hot dry climate) all the moisture has been evaporated, and the salts left behind. This process is, of course, continuous and cumulative.

If the water is prevented from rising, there will be no concentration of salts, increasing year after year, destroying the building.

It will probably be found that in the cases illustrated in the article in your July 13 number, there is no effective damp-proof course in the walls, or behind the concrete abutment (placed before the back-filling was commenced).

Local experience is, that if all movement of ground water into, and subsequently out of, the structure is prevented, the trouble is reduced to negligible proportions, and that the water-proofing of all surfaces exposed to evaporation is of greater importance than an improvement in the concrete or brickwork itself. H. C. Lott,
Deputy Director of the R. E. Services.
Basrah, Mesopotamia, Aug. 28.

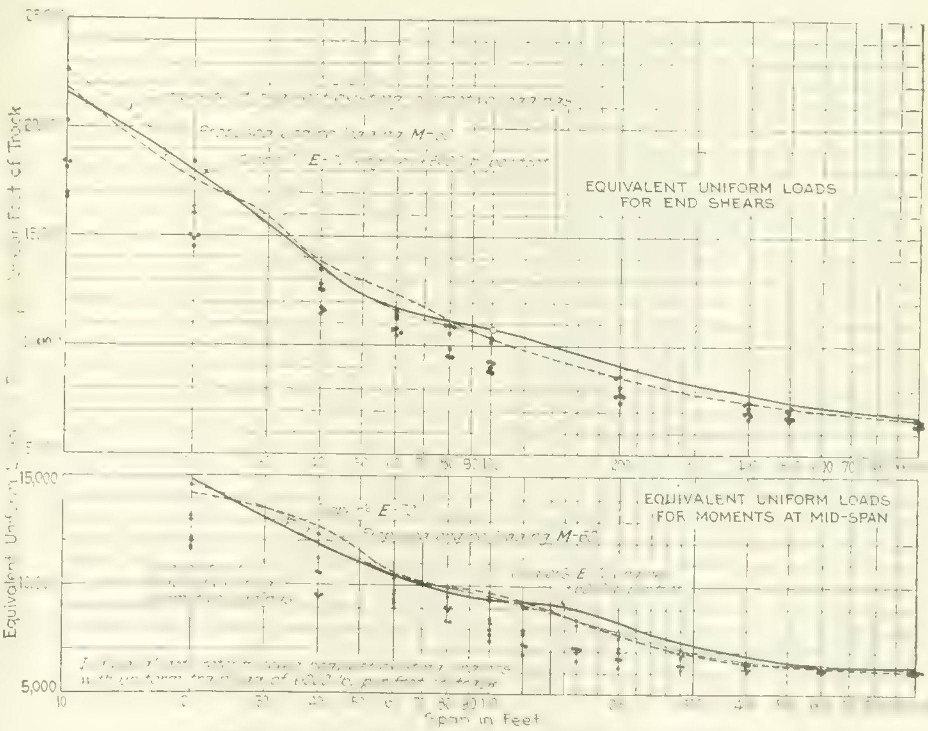
Cooper's Loading Fitted to Modern Railway Bridge Traffic

Sir—I have read with great interest your editorial "Bridge Loading," in the Sept. 14 issue, page 421.

I cannot agree with your view that the Cooper loading is no longer safe to use without arbitrary adjustments for each individual case. If properly applied with unbiased judgment, the Cooper loading can be brought into harmony with actual modern loads as well as any other loading. This may be appreciated at once by an examination of the attached diagram, which is self-explanatory. The entire question is not as complex as it would appear. The apparent complexity lies in the variety of actual engines and in the fact that engine weights have grown faster than car weights.

Cooper's loading is sufficiently elastic to be adjustable to the change in both of these elements.

New York, Sept. 15. O. H. Ammann,
Hudson River Bridge Corp.



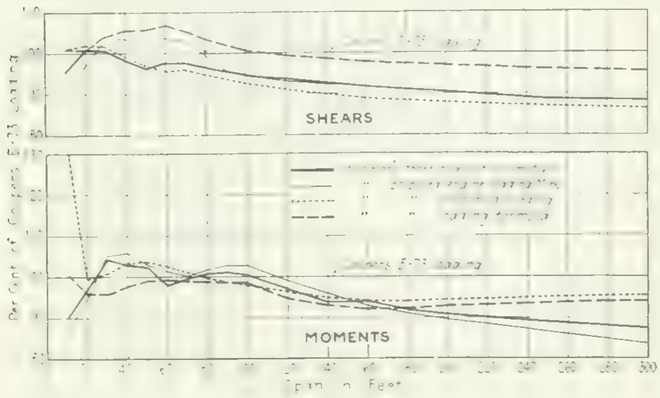
COMPARISON OF RAILWAY BRIDGE LOADINGS
Proposed loading M60, modified Cooper loading (E72 engines followed by 6,000 lb. per ft.); seven heaviest existing engines followed by 6,000 lb. per ft.

Cooper's Loading Is Adequate

Sir—There are at least two sides or viewpoints to every question. *Engineering News-Record* has published two editorials and one article rather highly commending the loading proposed by Steinman. Definite statement has been made that the Cooper system is outgrown, that it is deficient, and that a new system is necessary. It would seem rather hasty action has been taken. It is doubtful whether, in fact, there are two sides to the question of loading to be used in the design of railway bridges. The entire discussion centers around an accurate mathematical comparison of existing engines with design loads.

Steinman has taken existing heavy locomotives and prepared a diagram showing the composite of the maximum effect of these locomotives on bridge structures. Steinman's proposed loading is in the form of a Mallet engine, made to produce the same effect on bridge structures as the composite effect of existing locomotives. Undoubtedly Cooper did the same thing, when he proposed his loading system in 1894. His engine is of the Consolidation type; however, it is to be noted that Cooper's engine is double-headed, whereas Steinman's is not.

The fact that any bridge structure examined for a particular engine does not give uniform stresses means nothing. The same thing will happen whether Steinman's or Cooper's loading is used as the basis. These loadings are nothing but a composite of existing loads. In this connection it is to be noted that what may be called the peak point, that is, the maximum effect of an engine on a bridge structure, occurs at different span lengths. The maximum effect for the Atlantic engine is on short spans, the maximum effect for the Pacific, Consolidation, Mikado, Santa Fé



COOPER AND STEINMAN LOADINGS COMPARED

and Mallet engines is on successively longer spans. Therefore, when bridges are designed for a loading like Cooper's, which gives the composite effect for existing engines, and later compared for an actual engine, there will be a wide variation in stresses. This is true whether the design loading used is Cooper's, Steinman's or any other loading based on the composite of actual engines, and is nothing but what is to be expected.

The Cooper loading provides for an equality between the effect of the hauling engine and the following train load. This equality is not maintained in the Steinman loading, apparently for the reason that Steinman chooses to assume that a following train load of 6,000 lb. per foot of track is the maximum. Such is not the case. Maximum locomotives have been selected, but not maximum cars. Actual cars now in operation have an average weight considerably in excess of 8,000 lb. per lineal foot of track.

For some unknown reason, Steinman's principal loading is designated "M 60." It may be in order to compare it to E 60. But the M 60 is not comparable to the E 60 loading; it is, in a sense, however, comparable to E 73.

Referring to the original statement that this entire matter is simply an accurate presentation of actual facts, if the same maximum actual engines used by Steinman are selected, then it is a fact that the Cooper E 73 loading represents the composite effect of the actual engines more nearly than Steinman's M 60, both for shears and moments, as shown by the adjoining diagram.

Steinman's paper, therefore, seems to prove that the Cooper system of loading is entirely satisfactory, and is to be retained, particularly as it is shown that the proposed loading does not more nearly represent actual loads than the Cooper loading. Further, the Cooper system is used as a measure for rating existing bridges; existing records cannot be changed, from the standpoint of either money value or time, to the new yardstick. Certainly, the proposition to use one system of loading in design and another in rating is untenable, as this would mean that all new structures must be calculated for two systems of loads.

In conclusion, so far as the safety of traffic is concerned, a span is a span, whether long or short; long-span bridges are few in number, and the vast majority of existing spans are less than 120 ft. in length. P. G. LANG, JR.

Engineer of Bridges, Baltimore & Ohio R. R.

Baltimore, Sept. 18.

To Mix Good Concrete

Sir—Having followed the development of concrete for a number of years, I have been surprised by the slowness of improvement in specifications and methods of mixing. Recently revised reference books recognize the theory of a good mixture, and tell what to get, but give nothing new as to how to get it.

For a long time it was puzzling to see the wide discrepancy between the strength of the units and the safe loading strength of the finished product. Microscopic tests seemed to throw some light on this matter, showing voids and unhydrated cement as a reason for loss of efficiency. Perfect concrete can be made in the laboratory, in small quantities. Perfect concrete should be waterproof and have the density and strength of the aggregate. Laboratory methods cannot prevail in the field, however, and I evolved a theory to get a better mixture with available plant and methods.

Water being hard, it must be broken either with heat or friction. Dough mixed by unskilled hands is apt to be lumpy. The skillful housewife mixes hers rather thin, and then works in additional flour, kneading it with her hands, until the right consistency is reached. The same principle applies to mixing concrete, if the material is proportioned right, with an excess of sand and cement, rather than a deficiency, and will cost no more on an average than prevailing methods.

The theory has been tested on two jobs, with the consent of contractor and architect, and met approval in each case. One was foundations, basement walls, floor slabs and beams and columns in a court house in South Dakota. The water was strongly alkaline with some magnesia, and a small percentage of cement was added to partly offset these. Tests covering a period of six months after completion showed concrete of unusual density and strength, with no cracks or voids visible. The architect, who has built state capitols and court houses as well as business blocks, stated that it was the best concrete he had seen. The second job was a storeroom and loading platform in St. Paul, Minn. Although the gravel was rather poor, results were good here, as was proved when we had to cut through the walls for some changes in the plumbing plans.

The method is: Place sand, cement and water for full batch in mixer, in the order named. Mix as for grout. Then place the coarse aggregate in mixer, which will knead lumps out in getting to the bottom, and also coat each particle with the grout. Have water to 70 deg. F. or warmer, or mix longer.

Turn until thoroughly mixed.

On the jobs above mentioned the time in the mixer has been approximately the same as for the usual method of turning dry and then introducing water, and the results have seemed better, but might be better still with longer turning. BUTLER SMITH.

Superior, Wis., Sept. 1.

NEWS OF THE WEEK

New York, October 5, 1922

New Traffic Survey Starts in Connecticut

State and Federal Government Join in Most Comprehensive Program Ever Attempted

Washington Correspondence

Under a co-operative agreement the U. S. Bureau of Public Roads and the Connecticut State Highway Department have undertaken the most comprehensive survey of highway traffic ever attempted, supplementing last year's survey. The survey is of an intensive character and will continue for a period of 12 months so that the seasonal variations in traffic may be studied and recorded. The principal purposes of the survey are as follows:

To determine the total traffic density, type of traffic, and seasonal, daily and hourly variations; gross truck-loads, net commodity loads and overloads; the net tonnage movement and character of freight by motor-truck, and average length of haul of motor-truck shipments, with regard to commodities, capacities, and production areas; and the relation of motor transport to other methods of transportation.

Data are sought which will make possible a more intelligent allocation of construction and maintenance funds.

Dr. J. Gordon McKay has resigned as a member of the faculty of the University of Wisconsin to undertake this work. A similar survey is to be made in California. Another will be made in a typical agricultural state, another in a state where both agriculture and manufacturing are highly developed, and another in a southern state.

Stone Producers Deny Guilt

Attorneys for the Bedford stone organizations in Indiana and affiliated companies and individuals in Indianapolis, Bedford and the stone producing district of the state, named as defendants in an anti-trust injunction suit brought by U. S. Lesh, Attorney General of Indiana, in the Superior Court in Indianapolis March 24, have filed a general answer denying guilt. Judge Moll of the Superior Court overruled on Sept. 5 demurrers filed in the case and ordered the defendants to submit answers. The answer averred that the defendants had not committed any acts in violation of the law or in restraint of trade or commerce.

Sues City for Engineer's Death

Suit for $15,000 has been brought against the city of Phoenix, Ariz., by the administrator of the estate of Hiram Phillips, the consulting engineer of St. Louis, Mo., who was killed Dec. 22, 1921, when the automobile in which he was making an inspection trip was overturned. At the time Mr. Phillips was inspecting the Verde river water-supply system for Phoenix.

Operators and Miners Seek Plan to Fix Coal Wages

Unable to agree among themselves as to a plan for negotiating future wage scales, the bituminous coal operators have entered the conferences with the miners' union as individuals. The mine workers, on the other hand, have announced through John Lewis, president of the United Mine Workers, that they are in unanimous agreement and insist that the operators form a responsible organization with which they can deal.

The miners are hostile toward the fact-finding commission created by national legislation; but the operators are split, some sharing the workers' views and others inclined to await the findings of the President's commission. The conference is now in session at Cleveland.

Antioch Loses New Move in Water Injunction Suit

The city of Antioch, Cal., has been denied permission to file an amended complaint in its endeavor to obtain a permanent injunction to prevent irrigationists from diverting water from the San Joaquin and Sacramento Rivers. The original suit was won by the city in the Superior Court and the decision was reversed in the Supreme Court. A review of the original case was published in *Engineering News-Record* March 24, 1921, p. 513, and decisions of the State Supreme Court subsequently made were reported in the issues of Oct. 27, 1921, p. 697, and April 13, 1922, p. 627, respectively.

The new petition sought to have additional water users defendants in the action and would have involved practically 6,000 irrigationists of the two streams. In denying the new application Judge A. F. St. Sure of the Alameda County Superior Court held that the issue had already been settled in the decision handed down by the State Supreme Court.

U. S. Public Roads Bureau Plans Rural Engineering Research

In the future the rural engineering division of the U. S. Bureau of Public Roads will concentrate its work on research problems. Heretofore the division has found it difficult to relinquish its wide activities in extension work. The point now has been reached, it is believed, where the states and local agencies are sufficiently acquainted with the work and have the facilities to carry forward the educational part of the program.

Increased research is planned on such problems as the flow of water in drainage ditches; drainage by pumping; the effects of alkali waters on concrete; and the use of concrete pipe in connection with reclamation projects.

Brazil Holds International Engineering Congress

Delegates from Many Lands Celebrate National Centennial and Discuss Technical Developments

The International Congress of Engineering held in Rio de Janeiro, Sept. 17-30 was successful, judged either by the papers presented or by the number of official delegates. Representatives were present from all the principal engineering societies of the United States, Canada, Argentina, Belgium, France, Mexico and other countries. Delegates were there also from each of the states of Brazil and from a large number of private organizations.

Preliminary to the opening session a committee of the Brazilian Engineering Club was received by the American Ambassador Extraordinary, Secretary of State Charles Evans Hughes. This committee expressed its appreciation of the initiative and the work of certain Americans with regard to the congress and the co-operation that had been extended to the commercial attaché to the Brazilian Embassy in Washington, Sr. Sebastiao Sampaio, through which it was possible to hold the meetings in connection with the exposition.

American Engineers Praised

The earlier work of American engineers in Brazil was eulogized, special mention being accorded to Greenough, who, by installing the first electric-traction system in Rio and in South America, was instrumental to a large degree in having similar systems adopted in conservative Europe; to Corthell, former president of the American Society of Civil Engineers, who solved the problems of the shifting sand-bars at the entrance to Rio Grande harbor, and of Pearson, victim of the Lusitania sinking, to whom the inhabitants of Rio and Sao Paulo owe their light and power system.

A point of particular interest to American engineers is the fact that in the Engineering Club of Rio is a hall of fame where are placed the busts of prominent engineers as a token of the esteem in which the engineering profession is held in Brazil. In this hall are the busts of Rodriguez Alves, a former president and of their last emperor, Dom Pedro II, both of whom had displayed unusual interest in matters pertaining to engineering.

The sessions of the congress were opened with an address by Getulio das Neves, president ad interim of the Engineering Club of Rio de Janeiro, who was followed by Calvin W. Rice speaking for the American Society of Mechanical Engineers and other American engineering bodies represented by him. The keynote of the congress was struck in the address by Verne Leroy Havens, editor of *Ingeniería Internacional*, representative

(Continued on page 5[illegible]1)

Demonstrate Better Town Roads at State Fair

Low-Cost Oiled Cinder Section Laid as Demonstration on Midway at Trenton, N. J.

In the attendance of tens of thousands of voters from townships in every county of New Jersey at the Interstate Fair, now being held at Trenton, Thomas J. Wasser, state highway engineer, has seen an opportunity of spreading the doctrine of better township roads. For the first time in its history the state fair, this year, has a good

SIGN AT DEMONSTRATION ROAD

roads exhibit and a demonstration section of low-cost oiled cinder road.

While New Jersey is active in the development of its state highway system under the Federal-Aid Highway Act, one of the greatest needs today is believed to be the improvement of roads in the minor political subdivisions of the state. The purpose of the highway exhibit, therefore, is aimed primarily at residents of the smaller townships, where plain earth roads prevail. The New Jersey State Highway Department is endeavoring to get the townships interested—to the extent of raising adequate funds—in town-road improvements and the type of surfacing advocated consists of a 6-in. thickness of cinders, laid in two layers, and surface-treated with a coal asphalt oil. The type is the same as that described by F. H. Shepherd and E. E. Butterfield, engineers in the Office of the President of the Borough of Queens, New York City, in *Engineering News-Record* of Sept. 22, 1921, p. 477. This type of surfacing can be put down, it

DRILLING CORES FROM PAVEMENT

is estimated, for a 9-ft. width at a cost of $5,300, or for a 16-ft. width, at $9,400 per mile.

Under New Jersey's state-aid legislation the maximum amount of state money which may be allocated for town-road construction in any one county is $25,000. Additional sums must be raised locally. In financing these township roads with state aid the town must supply at least 25 per cent of the funds, the state furnishing the remaining 75 per cent. There are, in the state, 232 townships with 13,700 miles of town roads. For the improvement of this mileage local interest must be awakened and it was for this reason that the state fair at Trenton seemed to offer an excellent opportunity for promotional work among the farmers.

The State Highway Department, therefore, selected a location along the Midway of the fair and constructed a 500-ft. section of oiled-cinder surface 16 ft. wide. Printed signboards at the roadside and an overhead banner call the attention of passers-by to the demonstration road and direct them for further information to the State Highway Commission's booth and exhibit.

The construction of this type of oiled-cinder surfacing is comparatively simple. It involves merely the shaping of the existing surface and the application of two layers of cinders, each of which is rolled with a 10-ton roller and sprinkled with water to form a 6-in. compacted thickness. A 55-per cent asphalt oil is then applied, cold, at the rate of ½ gal. per sq.yd. by a pressure distributor. The railroads in New Jersey, it is predicted, can furnish a plentiful supply of cinders.

In addition to the demonstration road, the State Highway Commission's exhibit includes a number of maps and photographs of road construction of all types and in various stages of completion. There are also samples of stone, sand and gravel, laboratory testing equipment, cores cut from concrete pavements, and a core-drilling machine mounted on a motor truck operated for the instruction of visitors to the fair.

As a result of this educational campaign a state-wide program of town-road improvement is expected.

Geological Survey Approves Texas Conservation Program

The program of the Texas Conservation Association organized at Waco, Aug. 16, after the conference of engineers called by Governor Neff in Austin, Aug. 6 (See *Engineering News-Record*, Aug. 17, 1922, p. 288) has been approved by the United States Geological Survey according to Homer D. Wade, secretary of the association.

Tunnel Driving Progress on the Hetch Hetchy Project

Of the 18 miles of tunnel now under construction on the mountain division of the Hetch Hetchy project which is to supply water and power for the city of San Francisco, 76,110 ft., or about 84 per cent, had been been driven on Sept. 15. The accompanying table indicates the present rate of progress as shown by heading advances during June, as an indication of the current rate.

Plant and materials are being assembled at Priest Portal and at Big Creek shaft with which to place the concrete lining. At Priest crushers and screens have been installed and practically all the tunnel muck, which is now very hard granite and diorite, is being worked up into crushed rock and fines. The storage piles there on July 10 contained about 28,000 cu.yd. At Big Creek shaft a total of 13,000 cu.yd. of materials have been stored. Plans have been worked out for a new adaptation of the Web & Cox gun whereby concrete will be mixed in the tunnel at the point where the gun is at work, the materials coming in dry in batches suited to the mixer capacity.

The first concrete lining is expected to be placed through the Big Creek shaft. If the tunnel between Big Creek and Adit 8-9 is holed through about Oct. 1, as is now estimated, concreting is expected to start within thirty days thereafter.

Contract for driving the tunnel is held by the Construction Co. of North America, the lining work being sublet to the Universal Concrete Gun Co.

PROGRESS BY HEADINGS FOR THE MONTH OF JUNE, 1922, HETCH HETCHY TUNNEL

Heading	Tunnel Section	Character of Rock	Holes per Round	Superintendent	Shifts Worked*	Progress, Ft., June	Total Progress Ft., Sept. 15
Intake..........	13 ft. 4 in.	Monolithic granite to..........	45 52	Johnson	60	314	9,870
South Fork East	13 ft. 4 in.	Monolithic granite to	45 52	Peterson	59	313	10,230
South Fork West	13 ft. 4 in.	Granodiorite	38	Peterson	62	363	5,600
Adit 5-6 East...	13 ft. 4 in.	Granodiorite	38	Gallagher	72	459	4,260
Adit 5-6 West	13 ft. 4 in.	Quartzite and Diorite	34	Gallagher	88	434	5,100
Adit 8-9 East...	11 ft. 3 in.	Quartzite, Schists and Slates	25	Criddle	76	461	4,450
Adit 8-9 West...	11 ft. 3 in.	Schists and Slates...	25	Criddle	90	579	4,340
Big Creek East (Shaft)	11 ft. 3 in.	Schists and Slates....	25	Fowler	59	395	6,390
Big Creek West	11 ft. 3 in.	Diorite..............	25	Fowler	59	397	8,060
Priest.....	11 ft. 3 in.	Granite and Diorite..	30	Hickman	81	343	17,810
					706	4.058	76,110

Average feet per shift..........5.74

* Cause of shifts lost were as follows:

South Fork	Water supply 1	1
Heading 5-6......	Power, 2; timbering, 2; Trimming, 1	5
Heading 8-9......	Timbering, 14....................	14
Big Creek........	Broken skip, 2	2
Priest	Engineers checking tunnel, 1; power, 5; Accident, 3.......................... (progress reduced account low voltage in power supply)..........................	9 ..
Total..........................		31

Texas to Have Road Exhibit

The Texas Highway Association will have a complete road show and exhibit at the Waco Cotton Palace Exposition in October. The county engineers of the leading Texas counties are co-operating with the highway association committee composed of R. V. Glen, Ft. Worth, C. A. Clark, Dallas, and Pat Thompson, Arlington, to have models of recent Texas construction on display, thereby making it a most up to date exhibit. There also will be a large collection of highway photographs. The committee promises the most complete display of the kind ever shown in the State of Texas.

Eldridge Becomes Executive Chairman of A.A.A.

Maurice O. Eldridge, who has been director of roads of the American Automobile Association's Good Roads Board for the past three years and in direct charge of all legislative activities of the A. A. A., has been named as executive chairman of the association and has assumed active charge of the association's work throughout the United States. Mr. Eldridge was selected at a meeting of a special committee, named to select an executive chairman, which was held at Cleveland, Ohio, Sept. 20.

The new executive chairman brings to his task a record of 25 years of service in the U. S. Bureau of Public Roads. While assistant director of that bureau he performed much original research and development work on road and transportation problems, and for five or six years previous to associating himself with the A. A. A. he co-operated extensively with the late A. G. Batchelder in good roads programs. A graduate of the scientific school of George Washington University and a civil and highway engineer, Mr. Eldridge has made road problems his life work. He drafted the first federal-aid highway law, introduced by the late Congressman Brownlow of Tennessee, and was active in having the Dunn bill, which proposed to limit federal aid to $12,500 a mile for 1923 and $10,000 per mile thereafter, amended to allow federal aid of $16,500 per mile for 1923 and $15,000 per mile thereafter.

Brazilian Engineering Congress

(*Continued from p. 579*)

of the American Society of Civil Engineers, and other societies and one of the principal organizers of the congress. Mr. Havens' address was on the subject, "Problems and Duties of the Engineer," and brought out the necessity for the engineer to identify himself more broadly with the public affairs of his country.

The several papers that were read were nearly all of a practical nature as it had been specified that this congress result in actual tangible suggestions rather than be a scientific congress devoted to academic discussions.

Titles of papers which will constitute the annals of the congress follow:

"Utilization of Low-Grade Fuels With Seymour Pulverizers;" "Electrical Apparatus for High-Tension Power Transmission," Stephen Q. Hayes; "Economic Possibilities in the Use of Low-Grade Fuels of South and Central America, With Special Reference to Locomotive Requirements," Howard P. Quick; "Some Engineering and Construction Problems of the Panama Canal," S. B. Williamson; "Mammoth Cofferdam for Pier Construction in New York Harbor," Charles W. Staniford; "The Design of Masonry Dams," Edward Wegmann; "Technique of Radio Broadcasting," S. M. Kintner; "High Head Hydro-Electric Development in the Mountains of California," A. A. Northrop; "Long-Distance Telephony in the United States of America," Bancroft Gherardi and H. S. Osborne; "New Electric Furnace for Brass, Bronze and Copper," J. Murray Weed; "Factors Limiting Voltage of Long-Distance Transmission Lines," F. W. Peek, Jr.; "Large High-Voltage Oil Circuit Breakers," E. M. Hewlett; "Impressions of Cotton Textile Mills in the United States," R. L. Pamplona; "Present Status, Electric Furnace for Iron and Steel Industry," John A. Seede; "Concrete Piles and Concrete Piling Construction," Maxwell M. Upson; "Report on Development of the Cachoeria Paulo Affonso," Charles O. Lenz; "Building Mining Cities in South America," H. F. Guggenheim.

The Engineer in Public Life

A. B. ROBERTS

When Fred Kohler was elected Mayor of Cleveland, the Engineering Society of Cleveland was asked for the first time to suggest the names of men to be considered for the position of Director of Public Utilities, an office which, under the charter of Cleveland, is in reality the general manager of the Water Division, the Municipal Electric Light Plant, and the Heating Division. From the list submitted the Mayor picked Arthur Boardman Roberts, one of the directors of the Cleveland Engineering Society, and member of the Withington-Roberts-Wright Co., consulting engineers. Mr. Roberts accepted, and since Jan. 1, the $40,000,000 investment of Cleveland in public utilities has for the first time been under the supervision of a graduate engineer.

A. B. Roberts is 38 years old, was graduated from Case School of Applied Science as B. S. in mechanical engineering in 1907, and received honorary degrees of E.E. in 1914, M.E. in 1915, and C.E. in 1917. The regular work of training a young engineer during summers and when first out of school took him from Wyoming to Chesapeake Bay on various construction jobs. From 1908 to 1911 he was consulting engineer for the Standard Welding Co. and from 1911 to 1913, chief engineer of the 17 plants of the American Fork & Hoe Co.

In 1913 he went into private practice and was general manager of the firm which supervised the new plant of the Upson Nut Co., the Rubay Co., the Jordon Motor Car Co., the Shelby (Ohio) Municipal Light Co., Ohio Forge Co., and the American ship-building extensions at Cleveland, Lorain, and Chicago.

On Sept. 22, 1917, after entering the military service, Mr. Roberts reported for duty at Sandy Hook and until Jan. 28, 1919 he was in charge of the engineering design and construction of the Aberdeen Proving Grounds, built at a cost of approximately $12,000,000. He held a commission as major when discharged from the army. Beginning in 1919 he resumed connections with his private firm which engages in every line of construction except bridges. He resigned this year to become Director of Public Utilities in Cleveland.

Move Made to Dismiss Suit Against Water Power Act

Government Would Dismiss Petition of New York State Seeking to Restrain Permit Issuances

Washington Correspondence

Motion to dismiss the petition filed by the State of New York in the U. S. Supreme Court seeking to bring suit for an injunction against the Federal Power Commission to restrain the latter from issuing preliminary permits and licenses within the state has been filed by Solicitor General James M. Beck.

It is expected that the federal government's motion will be heard by the Supreme Court during the first month of its fall session, and that if dismissal be denied that Attorney General Charles D. Newton, of the State of New York, will apply for an advanced hearing of the state's petition. Without an advanced hearing, the case would not be reached on the ordinary docket for nearly two years.

The New York petition seeks to test the constitutionality of the water power act. The supporting brief filed by Attorney General Newton last May sets forth the claim that the Federal Power Commission is exercising authority which rightfully is reserved to the state; that it assumes jurisdiction over all streams other than brooklets, and that it is depriving the state of revenue. The license granted the Niagara Falls Power Co. and the preliminary permit granted the Lower Niagara River Power Co. accompany the petition as exhibits of the authority exercised by the commission.

In the petition to dismiss, Solicitor General Beck declares that the petition does not join essential parties as defendants; that it does not present any concrete question; that it does not present a controversy within the original jurisdiction of the Supreme Court; that it does not set forth any cause of action against the defendants—who are Secretaries Weeks, Fall and Wallace and Attorney General Daugherty; that the bill of complaint is without equity and that no concrete loss is established.

The government's motion sets forth the claim that if New York State has suffered any loss or injury because of the license issued the Niagara Falls Power Co. or the preliminary permit granted the Lower Niagara River Power Co., these corporations should have been made defendants to the petition.

Solicitor General Beck also recites various court decisions in support of his contention that the water power act is constitutional and that the Federal Power Commission is proceeding in a lawfully regulated manner.

Discuss Change in Rule of Road

The change in the rule of the road in eastern Canada is in confusion. New Brunswick was to change from left to right last spring at the suggestion of the New Brunswick Automobile Association and a bill to this effect was passed in the legislature. At that time it was thought that Nova Scotia and Prince Edward Island would follow the lead of New Brunswick, but opposition to the plan has arisen, and these provinces have not yet agreed to the change.

Engineering Societies

Calendar

Annual Meetings

AMERICAN PUBLIC HEALTH ASSOCIATION, New York. Annual Convention, Cleveland, Oct. 16-19.

The Municipal Engineers of the City of New York at its regular monthly meeting Sept. 27 was addressed by William W. Mills, deputy commissioner of the Department of Plant and Structures of the city of New York on the activities of his department, especially with respect to the municipal ferry service.

The Kansas City Chapter, A. A. E., held its first annual outing at the Ivanhoe Country Club, near Kansas City, on Sept. 16. More than fifty prizes, donated by various Kansas City business houses, were awarded to the winners of the athletic and guessing contests. A basket lunch was served followed by moonlight dancing to radio music, which was furnished by the broadcasting station of the *Kansas City Star*. This feature was highly successful.

Personal Notes

WESTON E. FULLER has withdrawn from the partnership of Hazen, Whipple & Fuller, consulting hydraulic and sanitary engineers, New York, to become professor of civil engineering at Swarthmore College. That firm will revert to the name of Hazen & Whipple, by which it was known during the period from 1904 to 1914.

L. W. KING, assistant county engineer of Cameron County, Texas, has resigned and has been appointed city manager of Brownsville, Texas, succeeding GEORGE GRUPE, resigned.

B. G. SLINING has returned to the Illinois Traction System, Peoria, Ill., as construction engineer, to become identified with an extensive program of power plant and transmission line construction in Illinois, Missouri and Kansas. Mr. Slining was construction engineer with this company in 1916 and 1917, leaving to take charge of the construction of the Standard Oil Co. coal-mining and power developments in Macoupin County, Ill.

CHARLES E. FRASER has tendered his resignation as president of the New York Harbor Dry Dock Co., Inc., in order to devote more effort to the gĕneral contracting business of Fraser, Brace & Co. George C. Clarke, formerly vice-president, has been elected president, and N. J. Kayser, works manager, has been elected vice-president. Messrs. Clarke and Kayser have been in charge of the operation of the dry dock since the inception of the project three years ago. Mr. Fraser will remain a director of the company.

A. H. DIMOCK, former city engineer of Seattle, has opened offices in the Central Building, Seattle, where he will engage in municipal, hydraulic, hydro-electric, water-works and sanitary engineering. Mr. Dimock was connected with the city engineering department for 25 years, and since 1911 had been city engineer.

FULLER & BEARD, engineers, St. Louis, Mo., has reorganized owing to the withdrawal of A. H. Beard. The firm is now known as the W. A. Fuller Co., W. A. Fuller, who has been actively engaged in engineering work for thirty years, continuing as the head of the company. A. H. Beard has opened his own engineering offices.

FRANK OSLER, for the past year supervising, management and construction engineer for Rose Polytechnic Institute, Terre Haute, Indiana, on the new layout of buildings, has become associated with O. C. Herdrich & Co. as consulting industrial management engineer.

J. H. BRILLHART, consulting engineer of Dallas, has taken over the management of the structural steel department of the Helm Mechanical Co., Ft. Worth. Mr. Brillhart is a past president of the Texas Section, Am. Soc. C.E.

FRANK A. MCARTHUR, city engineer of Guelph, Ont., has tendered his resignation to go into business for himself, having established the McArthur Engineering Construction Co.

A. W. SWAYZE, assistant to E. V. Buchanan, general manager of the Public Utilities Department at London, Ont., has resigned to become engineer with the Putherbough Construction Co. of London, Ont.

GEORGE C. WINCHEL, formerly chief engineer of the Industrial Engineering Co. of Akron, Ohio, and JOHN C. PAYNE, former city engineer of Akron, have opened offices at 600 Second National Bldg., Akron, Ohio. They will handle general industrial plant engineering in addition to their present civil engineering practice. Several well-known Akron engineers will be associated with this firm.

GEORGE ACKER, who has been for nearly five years inspector of material with the Submarine Boat Corp. of Port Newark, N. J., has been appointed engineering inspector for the New York & New Jersey Interstate Bridge and Tunnel Commission on the vehicle tunnel under the Hudson River.

R. V. DAVIDSON, recently engineer for the Northern Texas Traction Co., Ft. Worth, on the surveys for the Ft. Worth-Lake Worth Interurban is now office engineer under R. V. Glenn, consulting engineer, Tarrant County, Tex., Highway Dept.

A. B. DEAN, former maintenance engineer of Walla Walla County, Wash., is to be retained as deputy county engineer according to recent advices. Mr. Dean will replace Earl Kennedy who recently resigned.

J. GUITON MORGAN has been appointed by the state highway department to be bridge engineer for Palo Pinto County, Tex.

J. W. BEARDSLEY, civil engineer of New York, has left Spokane for Marble, Stevens County, Wash., to take charge of the Marble irrigation project. It is expected that plans and specifications will be ready about Dec. 1.

J. M. FELKNOR has been selected by the supervisors of Colusa County, Calif., to supervise the construction of approximately 50 miles of highway. Funds are available from a bond issue recently authorized.

R. E. YOUNGS, of Livingston, has been appointed county engineer of Liberty County, Tex.

FRANK C. TOLLES, formerly superintendent of public works for Akron, Ohio, announces his association with the firm of Swigart and Ehrman, of that city, for the general practice of engineering.

Obituary

C. C. THOMPSON, former city engineer of Phoenix, Ariz., was killed by lightning recently while in the Harqua Hala mountains running the division line between Yavapai and Maricopa counties in that state.

EDGAR B. TYLER, of Decatur, Ill., vice-president and member of the board of directors of the Mississippi Valley Structural Steel Co., died Sept. 27 in St. Louis, Mo.

CHARLES B. FALLEY, captain, Corps of Engineers, U. S. Army, died at the army base hospital, Fort Sam Houston, Tex., Sept. 22, 1922, following an operation. Capt. Falley was assigned to the Second Engineers and was serving as assistant to the engineer of the eighth corps area.

WILLIAM H. SCHMIDT, a civil engineer having offices in New York City, died Sept. 29 at his summer home at Bay Shore, Long Island, after an illness of two years. Mr. Schmidt was second vice-president of the Commonwealth Bank and a trustee of the Citizens Savings Bank. He as a graduate of Cornell University and had been connected with the United Engineering & Contracting Co., which helped build the Pennsylvania tubes under Manhattan Island, and had done work for that company in Cuba.

RICHARD B. ANGUS, Canadian financier and director of the Canadian Pacific Ry., died, after a protracted illness, Sept. 17 at Senneville, Que., in his ninety-second year. He was a native of Scotland and came to Canada in 1857 taking a position on the staff of the Bank of Montreal. In 1869 he became general manager. Ten years later he turned his attention to railway enterprises and was one of the first promoters of the Canadian Pacific Ry. With him in the original syndicate was George Stephen, later Lord Mount Stephen, and Donald A. Smith, later Lord Strathcona. In 1910, at the age of eighty, Mr. Angus became president of the Bank of Montreal, from which office he resigned in 1913. He was prominently identified with many other industrial and commercial enterprises. He is survived by three sons and four daughters.

From the Manufacturer's Point of View

Need More Mechanical Plant at American Ports

This is View of G. E. Titcomb, Returned from Five Months' Inspection of European Parts

IN COMPARISON with European practice docks at American ports are underequipped with cargo-handling machinery. This is one of the main impressions brought back from a five months' trip abroad by George E. Titcomb, New York manager for the McMyler Interstate Co. of Cleveland, manufacturer of a wide variety of ship and locomotive cranes, car dumpers, buckets, and other material-handling plant. His opinion, as expressed during a recent interview with *Engineering News-Record's* representative, is based upon a study of conditions not only at English seaports but also at those in Holland, Germany, France, and Spain. For general industrial and construction use, however, the locomotive crane figures more prominently in America than in Europe.

Mr. Titcomb's trip was devoted primarily to a study of cargo cranes and coal- and ore-handling machinery with a view to securing data applicable to the solution of American port problems and to the improvement in design of material-handling machinery. Plans of European port organization, he pointed out, necessitate methods and equipment different from those employed in the United States. In the London port area, for example, a large percentage of the incoming freight from vessels is delivered to lighters for distribution to the quays.

One of the conditions favoring adequate mechanical equipment of British ports, Mr. Titcomb emphasized, is the policy of putting back into improvements and maintenance the bulk of the revenue received. In other words, the funds coming from the shipping interests do not go into the city treasury, but are set apart for the particular use of the Port Authority, as contrasted with the situation in New York where rentals from piers revert to other municipal uses. In the case of the Port of London, the directors, in whose hands is placed the entire operation, are elected by the interests, both shipping and railway, that pay the dues. Under this scheme of operation the importance of adequate cargo-handling facilities is fully appreciated and proper equipment is installed.

While in general Mr. Titcomb noted a similarity in the type of cranes employed in American and European practice, there was one notable exception. This was an English type of horizontal luffing cane with balanced boom, so designed as to require a comparatively small motor for luffing and insuring flexibility of control. In this type of crane the load travels horizontally in spite of upward or downward movements of the boom. Mr. Titcomb was very favorably impressed with the design and operation of this type of crane. In the opinion of English stevedores operating cranes of this type 50 per cent more freight can be handled from steamer to quay than with the ordinary type of revolving gantry crane. With a 3-ton load the luffing cranes have a lifting speed of 150 ft. per minute; luffing, 180 ft. per minute; slewing, 1½ r.p.m.; and travel 100 ft. per minutes.

Both in England and on the Continent a definite trend toward the wider use of mechanical equipment for cargo handling was noted. In the erection of every new terminal great stress is being placed upon the adequacy of freight-handling machinery. This is particularly the case at the new Holland-American line piers in Rotterdam.

Engineers Discuss Plan to Reduce Asphalt Varieties

Patterson Favors Uniformity—Forrest Gives Views on Penetration and Other Tests

IN LAST week's issue, (p. 539) there appeared an article presenting arguments from the manufacturer's point of view on the desirability of having fewer different grades of asphalt for road and paving work. As a result of *Engineering News-Record's* invitation for comment on this general subject the following discussion has been received:

IRVING W. PATTERSON
Chief Engineer, State Highway Department, Providence, R. I.

I believe that the point of view of the asphalt manufacturers, as explained in the article in the Sept. 28 issue of *Engineering News-Record*, is very well taken. I have felt for a long time that there is needless variation in asphalt specifications. I am of the opinion that specifications for asphalt should be more nearly standardized than they are today.

C. N. FORREST
Manager, Technical Dept., Barber Asphalt Co., Maurer, N. J.

I have read with interest the article on "Too Many Grades of Asphalt" which appears in *Engineering News-Record* of Sept. 28, under the new department, "From the Manufacturer's Point of View."

The ostensible purpose of this article is to encourage greater uniformity in specifications for paving asphalt as to penetration (consistency), so that a few appropriate standards may be established and the procedure of the manufactures thus simplified. While the consistency of a paving asphalt is an important characteristic it is not so vital as to require adjustment within narrow or unusual limits, and even less than the 7 standard grades of consistency proposed would in my opinion suffice for all practical purposes.

It will be noted that the penetration standards proposed in the article overlap and as this is also undesirable the following classification is offered.

Asphalt Macadam (Penetration Method)	130 to 150
Asphalt Macadam (Mixing Method)	100 to 125
Asphaltic Concrete, Sheet Asphalt	50 to 60; 35 to 45; 25 to 30

It is conceded that the limit of accuracy of the penetration test is "not more than four points between maximum and minimum."

In the writer's experience, there is no reason to vary the consistency of the asphalt for use in asphalt macadam on account of climatic conditions. If the grading of the mineral aggregate in use does not produce the desired results with asphalt of the consistency provided in the above schedule, then it, and not the asphalt, should be changed, because the grading is probably too fine and a harder or softer asphalt will not correct such a difficulty.

Three different consistencies of asphalt are sufficient for any variations in climate or traffic, practically the world over, for asphaltic concrete or sheet asphalt.

While the writer is in sympathy with the movement to reduce the number of different consistencies of asphalt which may be specified he does not concede that "the keynote test for asphalt quality is that of penetration" nor that the specifications on all other characteristics of asphalt can be advantageously reduced to stereotype form. The penetration of asphalt is an adjustable characteristic and denotes only a degree of hardness regardless of any other physical or chemical characteristics which may be inherent in the substance or imparted to it by manipulation in the process of production.

The original sources of supply of paving asphalt as well as the processes employed in its production are various. Consequently, it is not all alike even though it may all be of the same penetration or series of penetrations.

Standardization of a limited number of grades of asphalt as to penetration would be of considerable advantage to the manufacturer without any disadvantages to the highway engineer or the public at large, and this should be done, but as penetration is not a criterion of quality, it does not necessarily follow that all of the other features of the specifications for asphalt may also be unified either as to the kind of tests or the limits of the results thereof, without disadvantage to the consumer.

In the writer's opinion this latter should not be done.

Business Notes

HERBERT C. FOLLINGER, manager of the Chicago office of the Chain Belt Co., died of pneumonia at his home in Chicago on Sept. 27. He had been ill but a few days. Mr. Follinger was 38 years of age, and was born at Fort Wayne, Ind. In 1902 he was graduated from the Chicago Manual Training School, now part of the University of Chicago, and entered the employ of the Otis Elevator Co. He became associated with the Chain Belt Co. in 1914, and in 1916 was appointed district manager for the Chicago territory.

F. S. PEARSON ENGINEERING CORP., New York City, has reestablished its department for industrial management and technical auditing of industries and public utilities.

Equipment and Materials

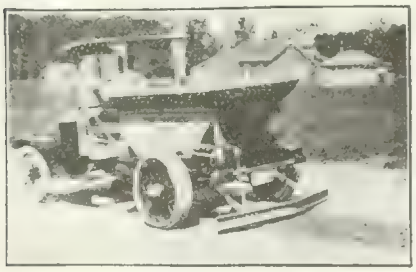
Shovel Patents Valid

By decision of Judge Buffiington in the Circuit Court of Appeals, Third Circuit, the Surbaugh patent, U. S. No. 1,212,582 on hand shovels is held to be valid. The patent covers the two-prong or double-frog type of coal shovel or scoop controlled by the Pittsburgh Shovel Co., under the trade names "Coal Bluff" and "Pacemaker."

Road Maintenance Truck

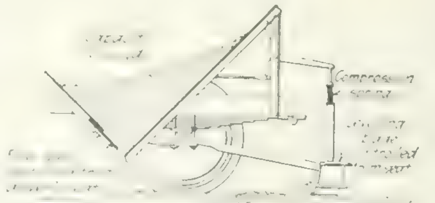
For highway maintenance work a truck with hopper body and adjustable scraper, known as the "Patrol," has just been placed on the market by the Greenville Manufacturing Co., Greenville, Ohio.

The truck holds 2 cu.yd. (3 tons) of gravel or stone and is constructed with a long narrow sliding gate extending entirely across the lower extremity of



the front sloping side of the body. This gate can be opened 1, 2, 3, or up to 6 in., creating a long slot which permits an even flow of material across the roadway the full width of the body. An adjustable scraper or levelling blade attached to the rear axle and also controlled from the driver's seat, further spreads the material and levels it over chuck holes, ruts, etc.

One side only of the gate opening can be used permitting the filling of chuck and mud holes on either side of the road without spreading material over the entire surface. The truck has also been used as a power unit for

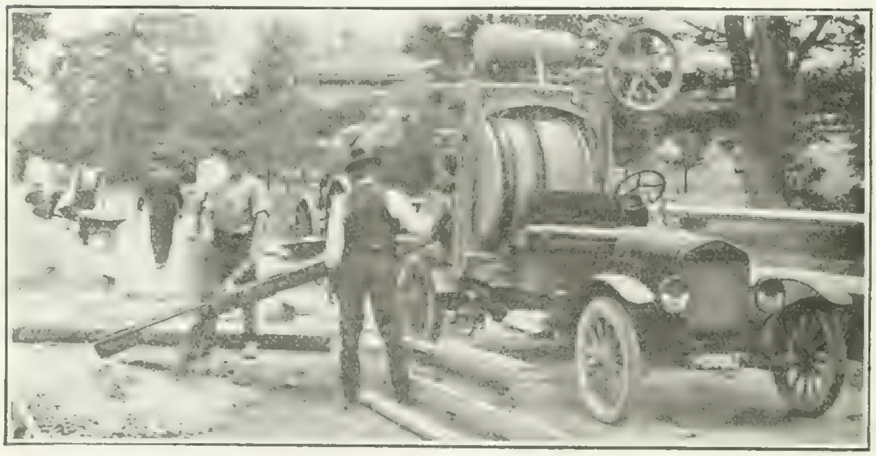


pulling light road graders and other machines.

The machine has a speed of from 12 to 15 miles per hour and is built on a standard Ford truck chassis. The front half is entirely of Ford design and the rear half is of 3½-ton truck construction with wheels, axle, springs, etc., to correspond. The "Patrol" sells for $1,350 f.o.b. Greenville, Ohio.

Concrete Mixer Combined With Ford Truck

For the purpose of obtaining mobility on comparatively small concreting jobs, such as building foundations, sidewalks,



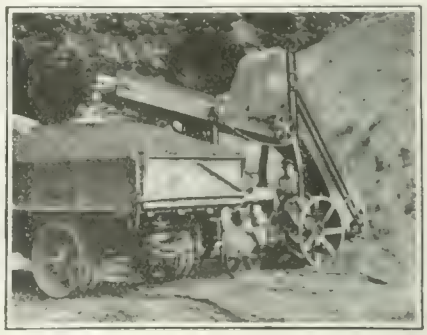
curbs and gutters, the Milwaukee Concrete Mixer Co. has adapted one of its 7-cu. ft. mixers to a 1-ton Ford truck. The mixer is operated through pin-wheel drive from the 20-hp. engine of the truck. Levers are all within range of the driver or from a position on the ground. By removing four clamps the mixing mechanism can be removed and the "Mixermobile" converted into a one-ton truck.

Power-Driven Elevating Loader Mounted on Tractor

A portable elevating loader in which mobility is secured by mounting on a Fordson tractor, which serves also as the power plant, has been put on the market by the Specialty Engineering Co., Philadelphia. The loader consists of three main parts: the frame, the elevator and the conveyor. The general arrangement is shown in the accompanying photograph. Steel buckets are operated by endless chains and work on rollers which are claimed to be a distinctive feature. The conveying mechanism is of conventional endless-belt type and moves the material forward beyond the front end of the tractor where it is dumped into trucks or wagons. The frame consists of four uprights attached to the tractor.

Power is taken from the shaft of the tractor through a sprocket wheel which, by means of a chain drive, operates a sprocket on the loader. The loader weighs approximately 5,500 lb., 80 per cent of which is carried on the rear axle. In operation the loader backs into the material to be handled, trucks being spotted in front of the machine. In moving from one job to another the elevator is raised so that it has the same clearance as the tractor.

The photograph shows the equipment loading anthracite river coal at Reading, Pa., this is a very fine material and resembles sand. The machine is designed, however, for

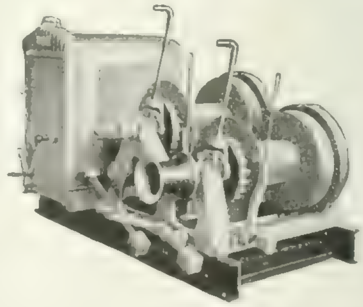


handling any kind of loose material such as sand, coal, gravel, earth, and stone.

The loader has an overall length of 11 ft. 3 in. and the point of discharge of the belt conveyor is 8 ft. 6 in. above the ground. The buckets are 8 x 16 in. and are equipped with steel digging edges riveted in the corners. The belt conveyor is of rubber, 18 in. wide. The loader may be attached to a standard Fordson tractor without the necessity of drilling holes or making any other alterations.

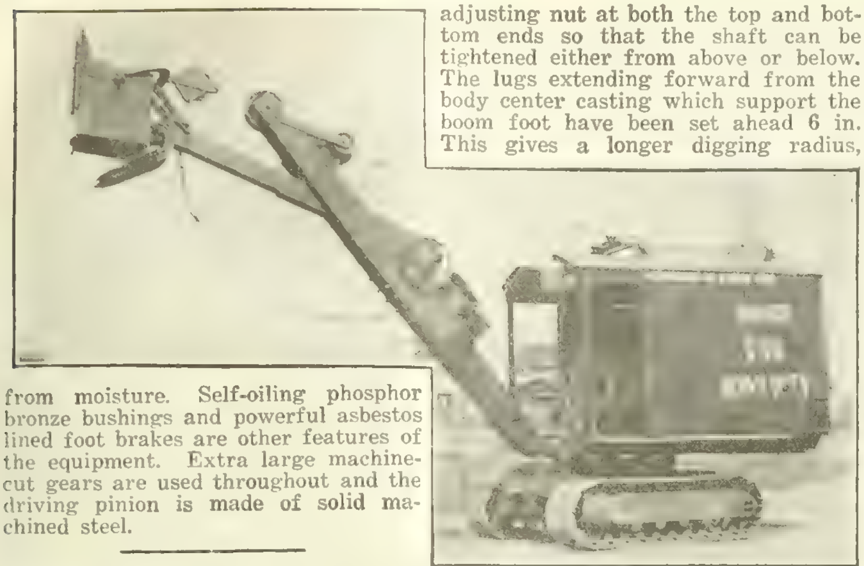
Double-Drum Hoist With Multiple Cylinder Gasoline Engine

Several advantages are claimed by the O. K. Clutch & Machinery Co., Columbia, Pa., for its double-drum hoist equipped with four-cylinder, 15-hp. gasoline engine. The design of the engine is similar to that of a motor truck, but is adapted to meet the heavier demands of hoisting. This machine, it is claimed, is considerably lighter than the ordinary single-cylinder stationary-engine type of hoist,



takes up less space and can be moved more readily. Repairs, when necessary, can be made in almost any automobile garage. These hoists are manufactured in three sizes, 8, 12 and 15 hp., have hoisting speeds from 125 to 150 ft. per minute, and will lift 1,500, 2,200 and 2,800 lb. respectively. In comparison with a steam-operated hoist it is pointed out that no time is lost in firing a boiler.

The asbestos-lined, cone friction drums, the manufacturers state, require no adjustment and will not swell



from moisture. Self-oiling phosphor bronze bushings and powerful asbestos lined foot brakes are other features of the equipment. Extra large machine-cut gears are used throughout and the driving pinion is made of solid machined steel.

Bascule Bridge Litigation Settled

The dispute between the city of Seattle and the Strauss Bascule Bridge Co., which resulted in a suit for $350,000 by the latter against the city for alleged infringement of patents in the construction of the three bridges across the Lake Washington canal, has been settled out of court and the construction of the Spokane St. bridge across the Duwamish Waterway is now expected to proceed. On the terms of settlement the company will furnish the city with complete plans for the Spokane St. bridge, which the city may use or not. For these plans, the company will receive $50,000, and if they are adopted an additional sum of $25,000.

Improvements Made in New ¾-Yd. Revolving Shovel

Announcement is made by the Osgood Co., Marion, Ohio, of a new ¾-yd. heavy duty revolving steam shovel similar to the Osgood 18, which it is to replace. A complete redesign of the continuous tread mountings has produced an all-gear propelling drive, increased the bearing surface of the treads on the ground and simplifying construction.

The driving and idler tumblers have been made round to reduce vibration when traveling and produce smoother action of the tread belts. The drivers have teeth on the sides which contact with the guiding flanges of the tread links for driving the belts. This eliminates tooth pockets in the face of the treads and the trouble and inconvenience of these pockets becoming clogged. With the tread links overlapping as they do an unbroken bearing surface is provided.

Improvements have been made in the steam cylinder steering mechanism which is controlled by a single lever in the cab. The steering clutches have jaws of the self-cleaning type.

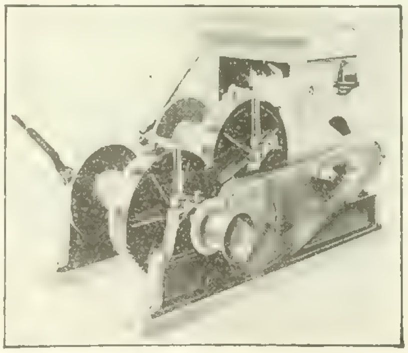
The wheels on the traction machine have been increased to 36 in. in diameter and the rims strengthened. The rear or driving wheels have been increased in width to 20 in. and fitted with the usual bolted-on diagonal cleats. The front or steering wheels have 16 in. face and bushed with bronze for the axle.

The vertical center shaft carries an adjusting nut at both the top and bottom ends so that the shaft can be tightened either from above or below. The lugs extending forward from the body center casting which support the boom foot have been set ahead 6 in. This gives a longer digging radius, wider cut at floor level, longer dump and better cleanup.

The new design retains such features of the Osgood 18 model as: Submerged tube type boiler; horizontal, long-stroke, hoisting engines; double-gear shipper shaft; large centering gudgeon around center shaft; and swinging mechanism with all adjustments above deck.

Silent Chain Drives Gasoline Hoist

Gasoline hoists made by the Clyde Iron Works are now equipped with silent chain drive connecting the motor



and friction drums. The hoisting drums and motor with all accessories are mounted on a single bed plate making a self-contained unit. The hoists are made with one, two or three drums.

Publications from the Construction Industry

Trailers and Tractors—General Motors Truck Co., Pontiac, Mich., and the Detroit Trailer Co., Detroit, Mich., have issued, jointly, a 32-p. illustrated booklet entitled "Modern Freight Transportation," which gives details regarding the two types of highway transport unit and illustrates their use, together, in hauling gravel, lumber and other construction materials in addition to general merchandise. It is claimed by the two companies that this is the first instance of a truck manufacturer and a trailer manufacturer co-operating in the publication of a joint catalog for the trucking public. Tractors are illustrated in 5, 10, and 15-ton capacities. One of their features is a two-range transmission by means of which maximum pulling power is developed only when needed in starting the load and running on poor roads, making possible the use of a relatively small and economical motor. This transmission, it is pointed out, delivers a much wider range of gear reductions than is possible in a four-speed transmission. The portion of the booklet devoted to trailers and semi-trailers illustrates a wide variety of types, ranging from 15 tons' capacity downward. In addition to the various standard forms of semi-trailer, there are special types among which may be noted a 15-ton drop frame trailer for carrying transformers, electric generators, and cable reels. A special 20-ton, four-wheel "Big Devil" model is designed particularly for heavy tonnages of structural steel. Trailers with both open and inclosed bodies are shown, sometimes in trains of three units. A feature of the Detroit four-wheel trailers is a patented swivel draw-head, compelling the trailer to follow the true line of the truck. For municipal work, such as the handling of garbage and refuse, a gravity drop frame, dump-body type, with capacities from 2 to 7 tons, is illustrated. At the end of the booklet is a large chart giving detailed operating costs per 100 miles for five representative truck-trailer combinations.

Swing Hammer Pulverizers—Jeffrey Manufacturing Co., Columbus, Ohio, describes and illustrates three types of swing-hammer pulverizers in a 42-p. catalog just issued. These machines operate on the principle of reducing material by striking it while in suspension, as opposed to the attrition mill which masses or rolls the substance between two hard surfaces. In the Jeffrey pulverizers the material is fed into the top of the machine and in falling comes in contact with rapidly revolving hammers which drive it against breaker plates from which it rebounds again into the path of the hammer. Three types of machine are manufactured, one for general purposes, a second for breakdown machines and fine grinding, and the third for grinding limestone and similar rock. The Type A plant is adapted to crushing rock for road construction.

Aids to Traffic Control—American Gas Accumulator Co., Elizabeth, N. J., has issued a 14-p. pamphlet entitled "Traffic Engineering," by G. G. Kelcey, illustrating, both in text and diagrams, methods of handling traffic at street intersections and preventing accidents. Several cases of typical traffic situations at intersections are discussed and the advantages of rotary traffic are emphasized. The company manufactures a small marine-type "lighthouse," designated as the flushing traffic beacon for use at highway intersections to regulate the passage of vehicles. It is an independent unit requiring no wiring as acetylene light is used.

Nailing Base for Floors — Paul Mende, Inc., New York City, has issued a 4-p. folder describing Nalecode, a compound of powdered fibrous minerals which, when mixed with portland cement, sand and water, makes a plastic mortar that sets. Nails or screws may be driven into it.

Business Side of Construction

Facts and Events that Affect Cost and Volume

September Contracts Show Higher Average Weekly Rate Than Preceding Month

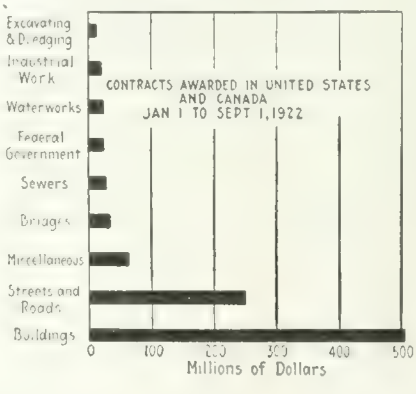
Awards Aggregated $138,648,000 in Four Issues of September Against $160,130,000 in Five August Issues

Contracts awarded on important engineering projects, as announced in the four September issues of *Engineering News-Record*, aggregated $138,648,000 as against $160,130,000 reported in the five August issues. This represents an average weekly rate of $34,662,000 as compared with $32,026,000 for August. Contracts awarded in Canada totaled $7,833,000 leaving $130,815,000 as representing contracts let on important engineering construction in the United States. The rate for September, 1921, was $24,694,000 per week, which is over 40 per cent lower than this year.

The minimum costs observed in Construction News, on each class of construction, are as follows: water-works, $15,000; other public works, $25,000; industrial construction, $40,000, and commercial buildings, $150,000.

The weekly average for commercial buildings during September totaled $14,670,000, which compares very closely with $14,702,000, the weekly rate for August. Likewise, streets and roads attained an average of $7,221,000 during September, with the rate for August at $7,407,000 per week.

Although lettings in the Middle Atlantic States, on all classes of construction, exceeded those in the Middle West, during September, the slow swing in the construction of new buildings from the New York-New Jersey district to that part of the Middle West centered in Chicago is indicated in reports to the Housing Division of the Department of Commerce. The East, however, continues its lead in the construction of apartment houses and dwellings. There is no indication, thus far, according to reports received by the Division, of the effect of increasing prices of construction materials upon future contracts. The general tendency of building materials prices continues upward as shown by the Department index number of 172.4 for August as against 169.6 for July. The *Engineering News-Record* Construction Cost Index Number for July was 169.7; August, 173.4; September, 185.0 and is now 188.6.



Large contracts awarded in all classes of construction from Jan. 1 to Sept. 1, 1922, totaled over $1,059,000,000, as reported by the *News-Record*. Buildings comprised the bulk of the total money value. Streets and roads came next followed by "Miscellaneous" construction, with public works last. The accompanying chart shows the proportions in which contracts were awarded according to classifications, during the eight months.

Residential building in twenty-seven states in the eight months aggregated $887,251,700, according to F. W. Dodge statistics. The New York district was the heaviest, $314,387,200, followed in order by the Chicago, Philadelphia, Pittsburgh, Boston and Minneapolis districts. The last district reported only $17,819,000.

Engineering News-Record Construction Cost Index Number

October, 1922	188.60
September, 1922	185.00
October, 1921	182.57
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is 3.6 points higher than last month, due to advances in prices of steel and cement. Steel is now $2.00@$2.25, Pittsburgh mill. Lumber and cement advanced generally. The average rate for common labor remains at 45c. Thus, general construction cost is only 3 per cent higher than one year ago and 31 per cent under the peak; it is 88.6 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
September, 1922	**129**
August, 1922	154
September, 1921	114
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 129 for the month of September, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 129 for September, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA IN SEPTEMBER, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Waterworks	$1,358,000	$99,000	$460,000	$556,000	$338,000	$850,000	$245,000	$3,906,000
Sewers	....	780,000	121,000	1,957,000	377,000	38,000	67,000	3,340,000
Bridges	80,000	200,000	1,655,000	566,000	321,000	175,000	35,000	3,032,000
Excavating and dredging	25,000	61,000	61,000	220,000	326,000	127,000	56,000	876,000
Streets and roads	835,000	5,556,000	6,503,000	7,057,000	5,104,000	3,268,000	561,000	28,884,000
Industrial Works	4,020,000	4,381,000	363,000	6,210,000	380,000	225,000	3,000,000	18,579,000
Buildings	7,293,000	21,128,000	1,693,000	15,207,000	9,420,000	1,160,000	2,780,000	58,681,000
Federal Government Works	103,000	3,118,000	1,321,000	60,000	1,180,000	1,887,000		7,669,000
Miscellaneous	3,025,000	6,010,000	119,000	2,700,000	626,000	112,000	1,089,000	13,681,000
Total	$16,739,000	$41,333,000	$12,296,000	$34,533,000	$18,072,000	$7,842,000	$7,833,000	$138,648,000

Coal Output Hampered by Lack of Cars and Poor Transportation

"Normal production of anthracite is being retarded by the same conditions that hamper the soft-coal industry—lack of cars and poor transportation," states *Coal Age*, reviewing conditions in the current coal market. The report continues: "There also is a dearth of labor. The effect of the car shortage is only just now being felt. During the last four days of September the supply began to be "spotty," incurring delays at collieries located on the Lehigh Valley, Erie and D. L. & W. lines. Deliveries are slow, some loads destined to New York Tidewater on Sept. 11, 12 and 13 not having been received three weeks later and side-tracks being congested with coal awaiting pulling.

"The anthracite price situation is confusing. Retailers have received independent quotations ranging $9.15@$13 and even higher and are loath to pass this on to their trade. The $8.50 price recommended by the Pennsylvania commission did not hold water and the commission now urges that, pending further investigation and adjustment, operators refrain from charging prices exceeding those established in 1920 by the Fair Practice Committee, which prices ranged up to $12.50, averaging around $10.50.

"With 25 per cent of their motive power out of commission the railroads of the country are now attempting to handle the peak of the year's business. There are no signs that the crest has been reached. Traffic men believe that business will be offered the railroads in increasing amounts more rapidly than its locomotives can be repaired."

Labor Rates and Conditions Throughout the Country

The return to work of several hundred thousand coal miners, railroad shopment and textile workers, together with a general increase in employment during the month, marks the beginning of a temporary upward trend in labor costs. The most important wage increases occurred in the metals, textile and construction industries.

Despite the wage increases and the fact that general business progress is being greatly hindered by freight congestion, industrial conditions throughout the country, show marked improvement from week to week.

As wages become more and more sensitive to price fluctuations, labor problems of a local character begin to appear. For instance, advances in the common labor rates in Philadelphia and Baltimore are offset by adjustments in the schedules in Cincinnati, Kansas City, Pittsburgh and St. Louis, resulting in a common labor rate for the entire country of 45c. per hr., exactly the same as the average for September. This average rate, however, applies to unskilled, non-union, common labor only, and does not include the semi-skilled.

Local industrial conditions as reported by *News-Record* correspondents are given as follows:

Atlanta—Situation somewhat upset, owing to strike conditions and heavy demand for materials and men. Building going ahead despite trouble.

Baltimore—Skilled building trades mechanics in sufficient numbers; scarcity of common laborers.

Birmingham—No change in labor rates or conditions since 20 per cent advance in steel mills. Stocks of all materials piling up, owing to lack of cars.

Cincinnati—Shortage of bricklayers, carpenters, hodcarriers and common laborers. Supply of structural ironworkers and hoisting engineers, normal.

Denver—Labor, all classes, 100 per cent employed. Some trouble reported due to car shortage, principally in the cement industry.

Detroit—Labor rates and conditions unchanged during month. Supply and demand in all trades about normal.

Kansas City—Plenty of all classes of building trades mechanics except carpenters. Hoisting engineers, one drum, receive $1 per hr., two drums, $1.25. Hodcarriers paid 75c.@80c. as against 80c. per hr. and pile drivers, $1 as compared with 85c@$1 per hr., formerly. Structural ironworkers reduced to $1 as against $1.07½. Common labor rates range from 40c.@65c. per hr. as compared with a minimum of 60c., last month.

Cleveland—Hoisting engineers advanced to $1.1 per hr., from $1.04.

Montreal—Plenty of common laborers but scarcity of bricklayers. Ample supply of other trades.

New York—Shortage of building trades mechanics in all parts of Metropolitan District. Unusually large amount of brick construction under way for this season of the year, resulting in an equally unusual demand for bricklayers, hodcarriers, etc. Labor costs increasing in certain skilled lines, particularly the finishing trades.

Pittsburgh—Scarcity of bricklayers, carpenters and common laborers. Other trades plentiful. Hodcarriers raised to 90c. as against 80c. per hr. but common labor rate at maximum of 50c. as compared with 50c.@60c. per hr., last month.

St. Louis—Foremen bricklayers receive $1.62½ per hr. Scarcity of mechanics; paying as high as $1.37½. Carpenters have withdrawn from Building Trades Division of A. F. of L.; threaten strike over jurisdictonal dispute. Union common laborers receive 57½c. as compared with 30c.@40c. for non-union. Rate for concrete men, 69c.; finishers, $1 per hr.

San Francisco—Plenty of work for all classes of building trades mechanics; seasonal rains not having begun, as yet.

Philadelphia—Scarcity of bricklayers. Sufficient work for all trades.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$0.70	$0.30	....	$0.65	$0.30@.35
Baltimore	1.25	.80	+.87½@.90	+.60@.75	+$0.75	1.00	+.35@.40
Birmingham	1.00	.75	.50@1.00	.15@.25	......	1.00	.15@.20
Boston	.90	.90	.90	.60	.90	.90	.35
Cincinnati	1.25	.95	.95	.72½	.....	.95	.35
Chicago	1.10	1.00	1.10	......	1.10	1.05	.72½
Cleveland	1.25	1.04@1.10	+1.10	.60	.91	1.10	.57½
Dallas	1.00	1.00	1.00	.60	1.00	1.00	.25
Denver	1.25	1.00	1.00	.75@.81¼	1.00	1.03⅛	.35@.50
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.07½	1.00	1.00@1.25	−.75@.80	+1.00	−1.00	.40@.65
Los Angeles	1.25	1.00	1.00	1.12½	87½	1.00	.56¼@.62½
Minneapolis	1.00	.80	.80	.65	....	.80	.35@.50
Montreal	[illegible]	.65	.50	.35	.50	.55	.30@.35
New Orleans	1.00	.85	.90	.50	.80	1.00	.35@.40
New York	1.25	1.12½	1.25	87½	1.00	1.12½	.44@.60
Pittsburgh	1.30	1.12½	1.00	+.90	1.00	1.00	.50
St. Louis	1.25	—1.10	1.12½	.85	+1.12	+1.1[illegible]	.30@.40
San Francisco	1.12½	1.00	1.00	.75	1.00	1.12½	.47½@.50
Seattle	1.00	.80	.90	.70	1.00	.80@.90	.50@.60
Philadelphia	+1.25	.90	.90	.75@90	1.00	[illegible]@1.00	+.35@.40

Extensive Concrete Paving Work in South and West

Within the next year Houston, Tex., will spend $2,000,000 on new pavements. The first of these contracts has been delayed because of a difference of $20,000 in a $160,000 job. A paving company bid $20,000 under all others on a proposal to use a rock asphalt that had never been laid in Houston before.

In the first seven months of 1922 a total of 136 concrete-paving contracts have been made in the state of Washington, according to the Portland Cement Association. Of these jobs twenty-six were state and county projects and 110 were city street-paving jobs. The former totaled 926,172 sq.yd. and the latter 850,197 sq.yd. or a grand total for both classes of 1,776,369 sq.yd. This is 84 per cent of the total yardage contracted in the state of Washington during the entire twelve months preceding.

Some idea of the average cost per mile of concrete paving work in the South, may be gained from the following record of contracts awarded for road work, totaling $3,500,000, in two months.

During April, the North Carolina Highway Commission let six highway projects and one bridge project. The total length of this work was 51.43 miles, and the cost, exclusive of the usual 10 per cent for engineering and contingencies, was $1,031,140. Of this mileage, 19.67 miles were of standard hard-surface construction, i.e. plain or reinforced concrete or some asphaltic type on a 5-in. concrete base. The average cost per mile for roads of this type with 18-ft. pavements, including clearing, grading, draining, reinforced concrete structures, was $33,059.

On 22.89 miles of standard earth, sand-clay, topsoil, and one-course gravel construction the cost per mile averaged $8,272, including clearing, grading, draining, reinforced concrete structures, etc. On 8.87 miles of two-course gravel and waterbound macadam the cost was $15,500 per mile.

During May the Commission let 15 highway projects and one bridge project. The total mileage involved was 142.54, and the cost, exclusive of the usual 10 per cent for engineering and contingencies, amounted to $2,532,709. Of this mileage, 62.75 miles were of standard hard-surface construction, with widths about equally divided between 16 and 18 ft.; the average cost per mile $31,176.

Finance Briefs

Stock market prices broke sharply during week due to uncertainty of Near East situation. No important upward movement since peak, Sept. 11. Buyers cautious.

Bond Market showed substantial recoveries at close of week. Municipals quiet; fair demand for new issues. Liberty bonds below par, first time in six months. Declines in railroad and industrial obligations. Foreign securities affected by news of Turkish advance. Public utilities show greatest improvement of week.

Foreign Exchange affected by Near East situation. Sterling dropped sharply during week to $4.36¾, lowest since Mar. 28. French, Italian, German and other continental rates lower.

Money Market steady for time loans, bidding 4¾ per cent on maturities from ninety days to six months. Call money, 4½@5 per cent as against 3½@6 per cent, last week.

Railroad Shops Getting Back to Normal Basis

Restoration of normal conditions in the railroad shops continues rapidly and the Association of Railway Executives reports that 372,000 men, approximately 88 per cent of the normal force, are now at work.

Nineteen roads having a mileage of 54,056 miles, or 23 per cent of the total mileage of the country, are reported to have settled on the basis of the so-called Willard-Jewell compromise negotiated at Chicago and reported in *Engineering News-Record* of Sept. 21, p. 492. Several roads are still in conference with the shopmen's union.

Monthly Prices of Construction Materials

Ups and Downs of the Market

No reports received this month from Boston, Dallas and Los Angeles.

Pig Iron—Despite stiff advances during month, pig-iron prices show tendency to soften. No. 2 foundry, avering $33@$35; basic about $34 and bessemer at a maximum of $35 per ton, valley base. Coke production gaining with prices slightly lower.

Railway Supplies—Standard rails, $43 as against $40 per ton, f.o.b. mill, effective Oct. 1. Bessemer rails were $45, one year ago; openhearth, $47. Light rails, spikes and track bolts higher at Pittsburgh mills. Douglas fir railway ties up in San Francisco; red oak, in St. Louis.

Pipe—Discounts reduced 5½ points on black and galvanized wrought-iron pipe since recent change on Pittsburgh basing card of Aug. 23. Recent pig-iron shortage reflected in advances in cast-iron pipe of $3 in Birmingham and $2 per ton in Chicago. Recent softening of pig-iron market has not yet affected pipe. Sewer pipe higher in Pittsburgh, Birmingham, St. Louis, Cincinnati and Atlanta; clay drain tile up $5 per 1,000 lin.ft. in New York, due to car shortage, labor and fuel situations.

Roads and Paving Materials—Mexican asphalt up $1 in bulk, f.o.b. Minneapolis and Baltimore; down $1 per ton in Atlanta. Package asphalt, Mexican, $18 as against $18.50, and bulk, $15.50 as compared with $16.50 f.o.b. Maurer, N. J., one month ago. Paving stone up 10c. in Atlanta; down 25c. per sq.yd. in St. Louis. Wood blocks cheaper in Philadelphia, St. Louis and New Orleans; up in Cincinnati and Kansas City. Demand heavy in Philadelphia; light in New Orleans.

Sand, Gravel and Crushed Stone—Sand advanced 5c. per cu.yd. in Philadelphia, 10c. in St. Louis and 20c. in Atlanta. Gravel up 10c. in Philadelphia and 15c. in Atlanta and St. Louis. Cincinnati reports drop in sand and gravel. Crushed stone higher in Philadelphia and St. Louis; down in Baltimore Cincinnati and Montreal. Fluctuations in this group due to local labor and transportation conditions.

Lime—Hydrated finishing lime up $6 in Baltimore, with slight rise in Atlanta; down $2 in St. Louis and $1 per ton in Cincinnati. Hydrated common, up $2.75 in Baltimore; down $3 per ton in St. Louis, with slight drop in Cincinnati. Lump finishing lime advanced 25c. per bbl. in Atlanta. Common lump dropped $1.75 per ton in Cincinnati and rose 5c. per bbl. (180-lb. net) in Atlanta. Advances due to fuel difficulties.

Cement—Mill advances of 25c. per bbl. at Hudson, N. Y., and Northampton, Pa. Other mill advances anticipated, owing to car situation. Mill rise reflected in following advances; f.o.b., Atlanta, 4c.; New Orleans, 10c.; St. Louis, 15c.; New York, 25c.; Birmingham, 30c. and Baltimore, 40c. per bbl.

Structural Steel—Shapes and bars up 10c. at Pittsburgh mill and in New York warehouses, during month; stiff advances at Birmingham. Demand for structurals light; $2@$2.15 quoted, with occasional small lots at $2.25 per 100 lb., f.o.b. Pittsburgh. Shortage of steel bars. Few mills taking on new steel business except on indefinite delivery basis. Rivets quoted at $3 as against $2.65 per 100 lb., f.o.b. mill; rise reflected in advances in San Francisco and St. Louis warehouses.

Steel Sheets—Blue annealed, base size, up 15c.; galvanized, 25c. per 100 lb. at mill; no change in black during month. Blue annealed advanced 16c., black and galvanized, 30c., in New York warehouses; both black and galvanized higher in San Francisco.

Brick and Hollow Tile—Common brick quoted at $15@$17 as against $18@$20 per M. alongside dock, New York. Price tendency downward, despite large amount of brick construction under way in New York City at present time. Brick down $2 per M. in Kansas City. Other cities show rising tendencies. New Orleans advanced $2.75; Cincinnati, $2; Atlanta, $1 and Birmingham, 50c. per M., during month. Hollow tile up in New York, St. Louis, Cincinnati, Detroit and Birmingham; down in Kansas City, Denver and Montreal.

Lumber—Market stronger, with no sign of slackening in demand. Car shortage holding up mill shipments. Yellow pine up $3 in New York; Douglas fir, $2 per M. ft. b.m. in San Francisco. Advances ranging from $1 to $5 per M. ft. in pine, fir, hemlock and spruce in Baltimore, Cincinnati, Seattle, St. Louis and Atlanta. Birmingham reports drop of $4 per M ft. in 1-in and 8-in. yellow pine.

Scrap—Rise of $1@$3 per gross ton in iron and steel scrap in New York; stiff advances in St. Louis during month. Demand due to pig-iron shortage.

Explosives—Average drop of 2c. per lb. throughout country on 40@60 per cent gelatin dynamite.

Linseed Oil—Quotations unchanged in New York during month; down 2c. per gal. in Chicago. Prices fairly stable despite scarcity of spot oil.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	**$30 55**	$24.50
Northern Basic	**32.27**	22.52
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	**34.27**	23.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	**36 27**	30.26
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	**27.50**	20.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25 @ 2.75 sil.)	**36 64**	22 76
Virginia No. 2 (silicon 2.25 @ 2.75)	**37 17**	28 74
Basic	**34 00**	20.75
Gray Forge	**33 00**	21.75
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	**32 00**	22 70
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	**31 50**	26.66
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	**35 00**	22.96
Basic	**32 50**	21.96
Bessemer	**33.00**	21.96

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	**$43 00**	$45 00		**$43 00**
Standard openhearth rails	**43 00**	47 00	**$43 00**	**43 00**
Light rails, 8 to 10 lb.	**45 00**	45 00	**1 80***	**43 00**
Light rails, 12 to 14 lb.	**45 00**	45.00	**1.80***	**43 00**
Light rails, 25 to 45 lb.	**45 00**	40.00	**1.80***	**43 00**
Rerolled Rails	**26 @ 29**	....	.....	....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	**$1 40**	**$1.55**
Chicago, Hardwood and Red Oak	**1 25**	**1 40**
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco...... Green Douglas Fir	.92	**1 19**
San Francisco, Empty Cell Creosoted, Douglas Fir	**1.93**	2.39
St. Louis, Red Oak*	**1 30**	**1 60**
St. Louis (creosoted) (zinc treated)	**1 65**	**2 00**

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, 9/16-in. and larger	**$2 75@2 85**	$3.00	$2.55	$[illegible]	**$4 45**	**$3 29**
Track bolts	**3 75@4 50**	4.00	3.65	[illegible]	**5 45**	**4 29**
Standard section angle bars	2.40	2.75	2.40	[illegible]	**4.10**	[illegible]

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
BUTT WELD					
1 to 3	68	56½	¾ to 1½	**34**	**19**
LAP WELD					
2	61	49½	2	**29**	**15**
2½ to 6	65	33½	2½ to 4	**32½**	**19**
2 to 8	62	49½	4½ to 6	**32½**	**19**
9 to 12	61	48½	7 to 12	**30**	**17**
BUTT WELD, EXTRA STRONG, PLAIN ENDS					
1 to 1½	66	55½	¾ to 1½	**34**	**20**
2 to 3	67	56½			
LAP WELD, EXTRA STRONG, PLAIN ENDS					
2	59	48½	2	**30**	**17**
2½ to 4	63	52½	2½ to 4	**33**	**21**
4½ to 6	62	51½	4½ to 6	**32**	**20**
7 to 8	58	45½	7 to 8	**25**	**13**
9 to 12	52	39½	9 to 12	**20**	**8**

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	60%	62½%	61½%
2½ to 6 in. lap welded	57%	59½%	58½%
	Galvanized New York	**Galvanized Chicago**	**Galvanized St. Louis**
1 to 3 in. butt welded	47%	48½%	51½%
2½ to 6 in. lap welded	44%	45½%	50½%

Malleable fittings, Class B and C, from New York stock sell at list less 10%. Cast iron, standard sizes, *32-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Current	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	**$45 00**	60.30	$50.30	**$52 70**	$44.50	$55.00
6 in. and over	**40 50**	55.30	45 30	**48.70**	.	51.00

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	**$45 00**	$40 00	$40 00	$50 00	. .	$55.00
4	**55 00**	50 00	*40 00*	60 00	$76.50	65 00
5	80 00	80 00	70 00	80.00	97 75	84.00
6	**105 00**	105 00	*70 00*	100.00	127.50	110 00
8	**170 00**	175 00	*170 00*	150 00	212.50	181.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.14	**$0 105**		.	$0 12	$0 12	.....
4	.14	**105**	**$0 10**	$0.0875	12	.15	$0.18
5	.20	**.1575**	**.125**	1225	18	.18	.165
6	.20	**.1575**	**150**	**1600**	18	21	.26
8	.34	**245**	**.225**	**2350**	28	30	.35
10	.51	**3675**	.2925	**3290**	42	.42	.....
12	65	**.4725**	.3825	**.4230**	54	.54	.80
15	1.03†	**.63**	5625	**.7050**	.72	.90	.....
18	1.50†	**875**	.765	**.9870**	1.00	1.32	.....
20	1.80†	**1 05**	1.0125	**1 3160**	1.20	.....	.....
22	2.40†	**1 40**	1 2375	.	1 60	....	.....
24	2 70†	**1 575**	1.4625	**1 6920**	1 80	2 16	2.40
27	4 50†	**2.795**	....	**2 5000**	3 75†	3 00	.....
30	5.00†	**3 096**		**3 1000**	4 75†	3 60	.....
33	6 50†	**4.14**	. .	**3 3500**	5.50†	....	.....
36	7 50†	**4.715**	. . .	**3.6500**	6 00†	....	.....

	3	5	8	12	24	36
Boston	$0 105	$0 1575	$0 245	$0.4725	$1.575	$4.408
Minneapolis	......	. .	.40	.72	2.55	5.66†
Denver	.135*	18*	.27	47	1 70	.....
Seattle	.13		.325	651	2 34†	.....
Los Angeles	.11*	.165*	.275	495	1 65	.....
New Orleans	.106*	159†	27	459	1 755†	.....
Cincinnati	**111***	**1665**	**.259**	**4995**	**1 665**	3.7925†
Atlanta	**10***	**14***	**.225**	**425**	**1 55**	.. ..
Montreal, *delivered*	.68‡	.45†	.70	1 35	4.50†	
Detroit	.102	.153	.238	.459	1 98†	6 15†
Baltimore	.1225	2275	.35	.6870	2.29	5.23
Kansas City, Mo.	.135	.19	.30	.54	2 16	
Philadelphia	114	171	.266	.513	1.71†	3.895†

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Current	One Year Ago
New York, 45% asphalt......(at terminal)	$0.05½	$0.05
New York, 65% asphalt......(at terminal)	.05½	.05
New York, binder............(at terminal)	.06¼	.06
New York, flux..............(at terminal)	.06	.05½
New York, liquid asphalt....(at terminal)	.06½	.06½
St. Louis, 22@25% asphalt (*f.o.b. Wood River, Ill.*)	*.03½*	*.01½**
Chicago, 40-50% asphalt	.05¼	.05
Chicago, 60-70% asphalt	.05½	.05½
Dallas, 40-50% asphalt	.10	.10
Dallas, 60-70% asphalt	.13	.13
Dallas, 75-90% asphalt	.15	.15
San Francisco, binder, per ton	13.00†	15.00

* Freight $21.75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT [illegible] bulk in carload lots, f.o.b. points listed:

	[illegible]	Bulk
New York [illegible]	[illegible]	$14.00
Boston [illegible]	[illegible]	[illegible]
Chicago [illegible]	[illegible]	[illegible]
San Francisco [illegible]	[illegible]	13.00
Dallas [illegible]	[illegible]	27.00
Seattle [illegible]	[illegible]	13.00†
Denver [illegible]	40.50	
Minneapolis *f.o.b. Twin Cities (Mexican)*	33 50	**29 00**
St. Louis [illegible]	[illegible]	[illegible]
Baltimore [illegible]	[illegible]	**15 00**
Los Angeles [illegible]	[illegible]	15.00
Montreal [illegible]	[illegible]	[illegible]
Atlanta [illegible]	[illegible]	[illegible]
Detroit [illegible]	[illegible]	19.50
Cincinnati (*Mexican*)	22.50	19.50
Maurer, N. J. [illegible]	[illegible]	[illegible]
Maurer, N. J. (*Mexican*)	*18.00*	*15.50*
Philadelphia [illegible]	[illegible]	[illegible]
Kansas City, *petroleum*	28 83	22 83

*Freight to San Francisco, 80c. per ton.

† f.o.b. Richmond, Cal.

NOTE [illegible] from 4 to 5 drums [illegible] $1 [illegible]

PAVING STONE—

New York [illegible]	5-in granite, 28-29 [illegible]	$135.00 per M
Chicago	About 4x8x4 dressed	**3 35** sq.yd.
	About 4x8x4 common	**3 10** sq.yd.
San Francisco	Basalt block, 4x7x8	70 00 per M
Boston	5-in. granite	no report
Atlanta	Granite	**2 10** sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	[illegible] per M
Baltimore	Granite	2.00 sq.yd.
Montreal *delivered*	Granite	100 00 per M
New Orleans	Granite 4 x 8 x 4	3 25 sq.yd.
Cincinnati	Granite	3.84@4 sq.yd.
St. Louis	4x8x4 dressed	[illegible] sq.yd.
	4x8x4 common	*2 90* sq.yd.
Kansas City	No. Granite	3.95 sq.yd.
Philadelphia	Granite	128 00 per M.

FLAGGING—

New York	Bronx, 5 ft	$0 30@35 sq.ft.
	Manhattan, 4 ft.	.26 sq.ft.
	Queens, 5 ft.	.26 sq.ft.
	6x20-in. cross-walk	1 00 lin.ft.
Chicago	18 in. wide	.99 lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c.@85c. for 5x16 in.; 88c. for 5x18 in., in cargo lots. 5x18 in., 72c. per lin.ft. delivered in St. Louis. 6x18 in., Chicago, $2 per lin.ft.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2 09
New York [illegible]	3	16	2.29
New York [illegible]	4	16	2.57
Boston	3½	16	2.32
Chicago	4	16	3.00@3 25
Chicago	3½	16	2 [illegible]
St. Louis	3½	16	*2.00*
St. Louis	4	16	*2.00*
Seattle	4	16	Off market
Minneapolis	3½	16	2 09
Atlanta	3½	16	2 30
New Orleans	3	16	*1 70*
New Orleans	3	16	*1 95*
New Orleans	4	16	2.25
Dallas	4	18	3 90
Baltimore	3	16	3 44
Montreal	4	16	4 50
Detroit	3	16	2 84
Detroit	4	16	3.00
Cincinnati	4	16	**2 35**
Kansas City	4	16	**3 25**
Philadelphia	[illegible]	[illegible]	[illegible]

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for [illegible] as follows, per cu.yd.:

	Gravel				Sand	
	1½ In.		¾ In.			
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
New York	$1 75	$2 00	$1 75	$2 00	$1 [illegible]	$1 [illegible]
Denver	[illegible]	2 00	[illegible]	1 80	[illegible]	1 60
Chicago	2 00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
St. Louis	**1 40**	1 55	**1 45**	1 40	**1 20**	1 [illegible]
Seattle	1 00	1 50	[illegible]	[illegible]	1 [illegible]	1 50
Dallas	2 25	3 00	2 25	[illegible]	2 25	[illegible]
Minneapolis	1 75	2 00	1 75		[illegible] 00	1 60
Cincinnati	1.50	2 [illegible]	[illegible]	2 [illegible]	[illegible]	1 75
San Francisco	2 25	2 25	2 25	2 [illegible]	1 50	1 50
Boston		2 65		[illegible]		2 00
New Orleans	2 85	2 85	2 [illegible]		1 [illegible]	1 [illegible]
Los Angeles [illegible]	1 50‡	1 [illegible]	1 [illegible]	1.[illegible]	1 [illegible]	1.20
Atlanta, per ton	**2 00**	2 13	**2 00**	2.13	**1 35**	1.35
Detroit	2 00	2 00	2 00	2 [illegible]	2 [illegible]	2 00
Baltimore, per ton	1 40	1 40	1 60	1.60	[illegible]	2 40
Montreal, per ton	1 25	1.25	1 50	1.25	1.25	1.25
Birmingham, per ton (Crushed slag used instead of gravel)					*1.20*	1 37
Philadelphia	**1 70**		**1 75**		**1 65**	
Kansas City, per ton	2 00‡		2 [illegible]‡	..	[illegible]	...

* Fine white sand: Pacific, $5 per ton; Ottawa, $6.

[illegible]

† At pit.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, as follows, per cu.yd.:

	1½ In.		¾ In.	
	Current	One Year Ago	Current	One Year Ago
New York	$1 65	$1 80@1 90	$1 75	$1 80@1 90
Chicago	1 60	1 75	1 60	1.75
St. Louis *delivered*	**2 10**	1 65*	**2 20**	1.65*
Dallas	1 65	2 80	1 65	2.80
San Francisco	2.25	2.25	2 25	2.50
Boston, [illegible]		3 00*		3 00*
Minneapolis, *at plant*	2 00	2 00	2 25	2 25
Kansas City	2.00	1.50	2.50	1.50
Denver	3 50		3 50	
Seattle, [illegible]	3 00	3 00	3 00	3.00
Atlanta	1.90*	2 25*	1 90*	2 25*
Cincinnati *delivered*	1 55*	2 68	*1.55**	2.06‡
Los Angeles	1.75*	1 60*	1 55*	1 70*
Detroit	1.90*	1 90*	1 90*	1 90*
Baltimore	*1 [illegible]*	1 75*	*1 [illegible]*	1 65*
Montreal	1.50*	2.00*	*1 90**	2.10*
Birmingham *delivered*	3.20	3 20	3.10	3 10
Philadelphia	**1 75***		**1 60***	
Pittsburgh	2.85		2.85	
Cleveland	3.00*		3.00*	

* Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1 [illegible]	$1 30	$2 00	$1 30
Steubenville District	1.40	1 40	2.00	1 40
Ironton District	1 40	1 40	2.00	1 40
East Canaan, Conn.	1 25	1 35	4 00	1 [illegible]
Easton, Catasaqua, Pa.	1.00	1 00	2.00	0.90
Birmingham, Ala.	*0.75*	0 75	0 75	0.25
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1 25
Cleveland, Ohio	1.20	1 20		1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2 00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$15 80@$16.17	$13.10	$3 63*	$2.75@$3.14*
Chicago	18 00			1.40†
St. Louis	*21 00*	*17.00*	2 40†	2.25†
Boston				
Dallas	25 00		....	2 50†
Cincinnati	*14.80*	[illegible]	....	*10.75‡*
San Francisco	22 00	16 00		1.75†
Minneapolis	29 00	22.00 (white)	1.70†	1.40†
Denver	24 00		..	2 70†
Detroit	18 00	16 00		17.00‡
Seattle *paper sacks*	24 00		2 80†	
Los Angeles	30 00	30 00	3 00*	3.00*
Baltimore	**21 00**	**15 75**		12.00‡
Montreal	21 00	21 00	15 00‡	11.00‡
Atlanta	**23 00**	15 00	**2 25†**	**1 80†**
New Orleans		17 25	2 40†	
Philadelphia	15 00	14 00	12.50‡	11.50‡
Kansas City	25 60	24 00	2 34†	2 [illegible]†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton. Refund of 10c. per bbl. Minneapolis quotes brown [illegible] lump lime, Kelly Is. white is $1.70, Sheboygan $1.55. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2 80	$2 80
Kansas City (Ft. Scott)	**1 75**	1 60
Atlanta (Magnolia)	11 00 [illegible]	11.00
Cincinnati (Utica)	*1 [illegible]*	1.77
Boston (Rosendale) per bag		0 95@1.05
St. Louis (Carney)	*1.87*	

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b points listed [illegible]

	Current	One Month Ago	One Year Ago
New York, del. by truck	**$2 60@2 75**	$2 60	$2 50
New York, alongside dock to dealers	2 55	2.30	2.10
Jersey City	2 73	2.73	2.60
Boston			2 61
Chicago	2.20	2.20	1 97
Pittsburgh	2 24	2.24	2 02
Cleveland	2 46	2 46	2 28
Detroit	2 48	2 48	2 51
Indianapolis	2 41	2 31	2 23
Toledo	2 53	2 53	2 31
Milwaukee	2 37	2 37	2 19
Duluth	2 14	2 14	1 95
Peoria	2 41	2 41	2 14
Cedar Rapids	2.48	2 48	2 28
Davenport	2 43	2 43	2 22
St. Louis	**2 35**	2 20	2 [illegible]
San Francisco	2 71	2 71	2 84
New Orleans	**3 30**	3 20	3 [illegible]
Minneapolis	[illegible]	2 39	2 26
Denver	2 [illegible]	2 85	3 10
Seattle	[illegible]	2 90	3 10
Dallas	2 25	2 25	2 55
Atlanta	**2 54**	2 50	2 69
Cincinnati	2 59	2.59	2 37
Los Angeles	3 30	3.30	3 31
Baltimore, del. by truck	**2 90**	2 50	2 88
Birmingham	**2 40**	2.10	2 85
Kansas City	2 85	2 85	2 80
Montreal	2 78	2.78	2 75
Philadelphia	2.41	2 41	
St. Paul	2 39	2.39	2.26

NOTE—Bags 10c. each. 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind	$1 [illegible]	[illegible]	$2 35
Universal, Pa.	2 00	La Salle, Ind.	2.35
Steelton, Minn	1 95	[illegible], N. Y.	**2 35**
Fordwick, Va.	[illegible]	Leeds, Ala	**2 10**
Mitchell, Ind	2 35	Hannibal, Mo.	**2 00**
[illegible], Pa.	2 10	Lehigh Valley District	**2 25**

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	Dallas	San Francisco
032	22	$0 74	$0 95	$0 86	$1 15	$1 20
049	28	94	1 23	1 11	1 46	1 55
068	35	1 14	1 48	1 35	1 80	1 89
093	45	1 46	1 91	1 73	2 30	2 43
126	57	1 80	2 35	2 13	2 86	3 00
153	68	2 14	2 81	2 54	3.40	...
180	78	2 46	3 22	2 92	3 93	.....
245	103	3 24	4 25	3 85	5 15	
287	119	3 75	4 90	4 45	5.96	6.31
336	138	4 35	5 69	5 16	7 32	.....
395	160	5 04	6 60	5 98	8 00	.....
PAVING						
036P	17	$0 56	$0 72	$0 66	$0.88	.....
053P	24	79	1 02	93	1 24	.....
072P	31	99	1 29	1 18	1 57	.....
097P	40	1 28	1 67	1 52	2 02	.....
049R	24	79	1 02	93	1 24	....
067R	31	99	1 29	1 18	1 57	....
089R	40	1 28	1 67	1 52	2 02	.

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200 and 300-ft lengths Galvanized is about 15 higher Size of roll carried in New York warehouses, 48 in wide x 150 ft long, or 600 sq ft

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St Louis	San Francisco	Dallas
27Dia.	2.3	$22 00	$23 25	$23 00	$20 78	$25 50
26 "	2 5	22 00	24 75	25 00	21 43	27 56
25 "	3.0	22 00	27 25	27 00		30 71
24 "	3 4	24 00	29 25	29 50	24 28	33 16
22 "	4 33	27 00	33 75			35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St Louis	Dallas	San Francisco
¾ and larger	$2 00@2 25	$2 20	$3 04	$2 92½	2 70	$3 50	$3 00
⅝	2 05@2 30	2 20	3 09	2 97½	2 75	3 55	3 05
½	2 10@2 35	2 25	3 14	3 02½	2 80	3 60	3 10
⅜	2 25@2 50	2 25	3 19	3 17½	2 95	3 75	3 25
¼	2 50@2 75	2 30	3 54	3 42½	3 20	4 00	3.50

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	$2 10	$2 55	$3 25	⅜	$2 35	$2 80	$3 50
⅝ in	2 15	2 60	3 30	¼	2 60	3 05	3 75
½	2 20	2 65	3 35				

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	$18@20 20	$21.30@23.50	$18.40@19.40	$42 00†	$50 00†
New York (at dock)...	15@17	18@20	15@15 50		
Chicago	11 00	11 00	11 00	34 00	42 00
St. Louis, salmon.	14 00	14 00	17 00	35 00	35 50
Denver, salmon ..	12 00	12 00	14 00	.....	...
Dallas	10 90	10 30	12 72	no market	
San Francisco	15 00	15 00	18 00	....	.
Los Angeles (del.).....	15 00	15 00	15 50	(not used)	
Boston (del.)	.....	.	17 00	44.00†	53 00†
Minneapolis (del.)....	18@19	18@19	17 00	.....	43 00
Kansas City	14 50	16 50	14 50	....	.....
Seattle	14 00	14 00	14 00	44 00	
Cincinnati	17 00	15 00	18 50	41 00	36.50
Montreal	16 00	16 00	16 00	..	68 00
Detroit (del.)	16.50	16 50	17 00	36 50 39	50@41
Baltimore (del.)	20 00	20 00	20 00	36 00‡	.. ..
Atlanta	12 00	11 00	10 00	39.00	.....
New Orleans	15 75	13 00	14 00	.....	... .
Birmingham	12 50	12 00	11 50	......	.
Philadelphia	19@24	17.50@18.50	16.50@17.50	38.00	46.00
Pittsburgh (del.)	16.00	16 00		. ..	
Cleveland	16 00	16.00			

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current on Trucks*	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12.	$0 1230	$0.11370	$0 0808	$0 115	$0 092	$0 108	. .
6x12x12...	1844	15160	1112		115	156	....
8x12x12...	2305	20210	1516	18	160	244	$0 2147
10x12x12...			1879	.	185	..	2653
12x12x12...		....	.2147		220	. ..	3448

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	..		. .
Minneapolis (f.o.b. cars)	$0 08	$0 13125	$0 23
Minneapolis (delivered)	09	.14675	.245
Cincinnati	1093	1861	....
Kansas City	.083	1455	.270
Denver	.065	123	.188
Seattle (delivered)	11	25	.36
Los Angeles factory	.095	.176	.22
New Orleans	.12	.23	.36
Detroit (delivered)	.09	175	.260
Montreal	.08	.15	.29
Baltimore	.14	.25	.39
Atlanta	.0776	.1453	......
Dallas	115	. ..	......
Birmingham	.11	18	......
Pittsburgh (del.)	.068	.128	.179
Cleveland	.08	164	

* San Francisco, Philadelphia, Atlanta, New York and Chicago quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. m罒, Pittsburg and Birmingham together with quotations per 100 lb. from warehouses at place named.

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in. .	2.00@2 25	$2 40	$3.14	$4.20	$3.00	$2 92½	$3.25
Channel, 3 to 15 in. .	2 00@2 25	2 40	3 14	4 20	3.00	2.92½	3.25
Angles, 3 to 6 in., ¼ in thick	2 00@2 25	2 40	3 14	4 20	3.00	2 92½	3.25
Tees, 3 in. and larger. .	2.00@2 25	2 40	3 14	4 20	3.05	2 92½	3.25
Plates	2 00@2.25	2 40	3 14	4 20	3.00	2.92½	3.40

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse: New York Current	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$3.00	$3.85	$4.40	$3.35	$3 60	$4.50	$6.00
CONE HEAD BOILER							
¾ in. and larger	3.10	3.95	4.50	3.45	3.70	4 60	6.15
⅝ and 11/16	3.25	4.11	4.65	3.60	3.70	4.75	6.30
½ and 9/16	3.50	4.35	4 90	3 85	3 70	5 00	6.55

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.60@2 75	$3 10	$4 00	$5 00	$3.60	$4 95
Cut	....	5 50	5.65	7.75	6.00	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square, f.o.b., as follows:

	New York: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.
No 1 grade....	$2 10	$2.55	$3.00	$1 90	$2 55	$2 80
No. 2 grade....	1.85	2.15	2 55	1 70	2 00	2.40

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.50 per package (sufficient to cover 50 sq.ft.) in carloads; $5.75 in smaller quantities, in Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia. l.c.l., $5.90

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft.	$2 00
Tar pitch (in 400-lb. bbl.), per 100 lb.	1 65
Asphalt roofing (in barrels), per ton, f.o.b. plant*	40.50
Asphalt felt (light), per ton, f.o.b. plant*	64.50
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3,00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2 50@$2.75	4.10	$4.00	$4.35	$4 19
No. 12	2.60@2 85	4.15	4.05	4.40	4 24
No. 14	2 70@2.90	4.20	4.10	4.45	4 29
No. 16	2 90@3.20	4.30	4.20	4.55	4 39
Black					
*Nos. 18 and 20...	3.20@3.35	4.65	....	5 70	4 70
*Nos. 22 and 24...	3.25@3.40	4.70	4 70	5 75	4 75
*No. 26	3.30@3.45	4.75	4.75	5 80	4 80
*No. 28	3.35@3.50	4.85	4.85	5.90	4 90
Galvanized					
No. 10	3.35@3.75	4.85	4.85	....	4.90
No. 12	3.45@3 85	4.95	4.95	5.85	5 00
No. 14	3.45@3 85	4.95	4.95	5 85	5.00
Nos. 17 to 21	3.75@4 15	5.10	....	6 15	5 30
Nos. 22 and 24....	3.90@4 30	5.40	5.40	6 30	5.45
*Nos. 25 and 26...	4.05@4.45	5.55	5.55	6 45	5.60
*No. 28	4.35@4.75	5.85	5.95	6 75	5.90

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Current	One Year Ago	Chicago: Current	One Year Ago
Raw in barrel (5 bbl. lots)...	$0.91	$0 76	$0 97	$0.87

WHITE AND RED LEAD—Base price in cents per pound

	Red				White	
	Current		1 Year Ago		Current	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	12 75	14 25	12 25	13 75	12 75	12 25
25 and 50-lb. kegs	13 00	14 50	12 50	14 00	13 00	12 50
12½-lb. keg	13 25	14 75	12 75	14 25	13 25	12 75
[illegible]	15 75	17 25	15 25	16 75	15 75	15 25
1-lb. cans	17 75	19 25	17 25	18 75	17 75	17 25

LUMBER

Prices wholesale to dealers in carload lots [illegible]

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers, at yards. To contractors, $2 per M ft. additional.

	6-8 and 12 Ft	10-16-18 and 20 Ft	22 and 24 Ft	25 to 32 Ft.
3x3 and 4	$30 00	$33 00	$33 00	$35 00
3x6 and 8	30 00	33 00	33 00	36 00
4x4-6 and 8	30 00	33 00	34 00	37 00
3x10 and 12	30 00	35 00	34 00	38 00
3x14	34 00	35 00	36 00	38 00
4x10 and 12	30 00	33 00	34 00	37 00
4x14	34 00	35 00	36 00	38 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$32 00	$35 00	$37 00
6x14	34 00	37 00	39 00
8x10	32 00	35 00	37 00
8x14	34 00	37 00	39 00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine

	New York		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x 4 to 8x8	$47 00	*$48 00	$45 00	$47 00
3x10 to 10x10	50 00	51 00	48 00	50 00
3x12 to 12x12	54 00	55 00	51 00	53 00
3x14 to 14x14	60 00	61 00	56 00	58 00
3x16 to 16x16	67 00	68 00	60 00	62 00
3x18 to 18x18	80 00	81 00	67 00	69 00
4x20 to 20x20	90 00	91 00	77 00	79 00

*Wholesale price to dealers, to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	...				.	
Seattle	..	$24 50		.	.....	$24 50
New Orleans	$30 00		...	.	$35 00	
Baltimore	58 00	.. .	.....	.	70 00	.
Cincinnati	40 00		....		45 00	
Montreal	50.00	50 00	$35.00	$38 00	78 00	50.00
Los Angeles	.....	44 00	43 00		....	44 00
Denver	.....	38 75	38 75	38 75		[illegible]
Minneapolis	47 00	[illegible]	42 00		49 00	[illegible]
Atlanta	37 00				42 00	.
Dallas	37.50				40 00	
Kansas City	47 00	47 00	47 00	49 50	49 00	
Birmingham	28.00	..			36.00	
Philadelphia	39 00	38.08	45 00	[illegible] 00	48 00	40 00
Detroit	43 75	45 75			51.75	46.75
St. Louis	35 50				39 50	

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston				.	
Seattle	......	$20 00	..	....	$23 50
New Orleans, at mill	$70 00		...	$37 00	
Baltimore	40 00	...		40 00	
Cincinnati	65 00	80.00		37 50	
Montreal	66.00	45.00	$27 00	45.00	45.00
Los Angeles	.....	37.00	36 00	.....	43 00
Denver	.....	32.25	[illegible]	....	33.25
Minneapolis	46.50	40.25	38 25	43.75	40 25
Atlanta	24 00	.....	.	28 00	
Dallas	37.50	30 00	...	40 50	
Kansas City	[illegible] 50	38 50	38.50	[illegible]	40 00
Birmingham	[illegible] 00		...	30 00	
Philadelphia	33.00	38 50	45 00	35 00	38 00
Detroit	45 25	38 50		42 00	41 00
St. Louis	68 00		.	45 00	

Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.
Birmingham—Quotes carload lots, f.o.b. sidings. $2.00 additional per M. ft to contractor.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers prices to contractor on large projects.
St. Louis—Wholesale price to contractors, $12—$14 per M ft. additional.
Seattle—Price to contractor, delivered.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carload lots of 36,000 lb.:

Baltimore	$0 315	Detroit	$0 295
Birmingham	69	Kansas City	.735
Boston	365	New Orleans	515
Buffalo	.265	New York	34
Chicago	34	Pacific Coast (all rail)	1 50†
Cincinnati	295	Philadelphia	325
Cleveland	215	St. Louis	43
Denver	1.275*	St. Paul	595

*Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2 50	$2 35	$2 00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	25%
Patent flattened strand, special and cast steel	25%
Patent flattened strand, iron rope	10%
Plow steel round strand rope	40%
Special steel round strand rope	35%
Cast steel round strand rope	27½%
Round strand iron and iron tiller	10
Galvanized steel rigging and guy rope	12½%
Galvanized iron rigging and guy rope	+7½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¾-in., 8 ft., ¾-in., 6; ⅞-in., 4¼; 1-in., 3⅓; 1½-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston		New Orleans	$0 17¾
New York	$0 17	Los Angeles	.16½
Chicago	19	Seattle	18
Minneapolis	19	St. Louis	17
San Francisco	17	Montreal	30
Atlanta	[illegible]	Detroit	19
Denver	20	Baltimore	17
Cincinnati	17	Kansas City	19
Dallas	29	Birmingham	.20½
Philadelphia	18		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin	
	40%	60%
New York	[illegible]	[illegible]
Boston	.....	.
Kansas City	.2225	.2525
Seattle	.175	.195
Chicago	.2450	.2750
Minneapolis	.2092	.2295
St. Louis	.2425	.2725
Denver	.2025	.2325
Dallas	.29	.375
Los Angeles	.23	.26
Atlanta	.2525	.2825
Baltimore	.1950	.2250
Cincinnati	.2300	.25
Montreal	.195	.235
Birmingham	.19	.21
New Orleans	.2350	.2650
San Francisco	.195	.235
Philadelphia	.24	.27

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$14 50	$11 50	$15 00
Stove plate	1[illegible] 50	12 00	15 00
No. 1 machinery cast	18 00	16 50	21 00
Machine shop turnings	9 00	4 00	10 00
Cast borings	12 00	5 50	11 50
Railroad malleable cast	15 00	12 50	19 00
Re-rolling rails	16 00	13 00	18 00
Relaying rails	28 50	30 00	23 00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
[illegible]	$6 75	$5 50	$8 55
[illegible]	6 30	5 05	8 25
[illegible]	6 15	4 90	8 30

Pittsburgh base in lots of 200 kegs or more $3 25@3.75

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 89 — NEW YORK, OCTOBER 12, 1922 — Number 15

Making Specifications in Societies

EXCEPT for a most unbalanced program, last week's meeting of the American Society for Municipal Improvements was a marked success. Even if it could not have been foreseen that the dozen specification committee reports scheduled for a single session would have been disposed of in an hour and a half it was evident to all that the group of eight or ten papers and reports on sewage treatment listed for Thursday morning would be far too many for even the four hours to which the session was stretched. The perfunctory way in which the specification reports were received and acted on raises the question of procedure common to every specification-making society. How far should the program be cluttered up, the members bored and time wasted in presenting to a convention specifications which have to go to letter ballot for approval. Academically the practice of open meeting presentation is admirable; practically not one specification out of a hundred is ever rejected on the floor and when one is altered the chances are great that the alteration is ill-considered and dangerous.

Why Separate Sewers?

THE abuses to which both sanitary and storm sewers are commonly subjected were so forcibly shown by H. P. Eddy at the A.S.M.I. convention last week as to raise the question whether separate sewers are advisable. The full strength of the case made by Mr. Eddy cannot be presented in our necessarily rather short abstract of his full and able discussion. One thing is certain. If separate sewerage systems are to be continued, municipal authorities must awake to the necessity for rigid safeguards against the various abuses to which they are subjected, especially the prevention of overcharging sanitary sewers by permitted or surreptitious storm-water connections and like connections of house sewers with storm-water drains.

Relating Geology to Engineering Work

IN THE course of the discussion of the paper on "Engineering Geology of the Catskill Water Supply," presented to the American Society of Civil Engineers at its last meeting by Prof. Charles P. Berkey and James F. Sanborn, it transpired that several requests have reached the authors for copies of the paper to supplement courses in geology in technical schools. This indicates that the paper makes further progress along a road already staked out by Professor Berkey in earlier publications; namely, the presentation of geology as a practical tool of the engineer, rather than as an isolated department of science. Geology is not the only subject that suffers at the hands of the engineering undergraduate because of his failure to appreciate its utility. Neither is it the only subject that can be made live and interesting by an instructor with the capacity to interpret its significance in terms of engineering construction. Some teachers have this capacity, and their graduates take away with them a sound fundamental grasp of the subject and its relation to the work they have to do, rather than a confused and fugitive recollection of abstract science and unrelated information. This paper is a noteworthy contribution toward the breathing of life and purpose into one of those collateral subjects which are required of engineering students but which all too often are considered only as hurdles to be overcome in the pursuit of an engineering degree.

Getting Back to Earth

IN THE formulation of agreements between the railroad companies and the new company shopcrafts unions considerable progress is being made toward the elimination of some of the more objectionable inheritances from the régime of government operation. A most gratifying step is the restoration of piece work on some of the roads. So long as fair standards of performance can be established and are maintained, there is no reason why compensation cannot be made proportionate to the work performed. There is every reason, moreover, why such method should do greater justice to both employer and employee than the payment of a uniform wage which inevitably tends toward uniformity of production. Other incentives may be more deep seated and more elemental, but none is more direct or quick acting than that of having increased efficiency and increased industry reflected in the next pay envelope. And if there ever was a time when industry and efficiency are needed in the railway shops of the country it is today.

Prolonging His Reign

SMALL encouragement for the public will be found in the announcement that the United Mine Workers are planning to demand, for another two years, beginning next spring, a continuance of the existing wartime wage scale, together with the establishment of a 6-hr. day and a five-day week with time and a half for overtime. The negotiations between the miners and the operators will be held next January, but the impression prevails that insistence by the miners upon these demands can result only in another struggle such as that recently ended. Already the operators announce their intention of calling a meeting to form a permanent national association "to deal with labor problems." Operators and miners both have demonstrated their incompetence to "deal with labor problems" in any manner that can make for the public welfare and the sooner the government commission recently authorized can be put to work, the better it will be for all concerned. The American people cannot afford to put up with another disturbance like the recent strike. There is no reason,

moreover, why they should be asked to put up with it, and it is incumbent on governmental authority to see that they are not required to put up with it. In commenting on the recent settlement we pointed out that 750,000 coal miners had imposed their will upon the 24,000,000 farmers and wage earners of the United States and that King Lewis had declared his superiority to economic law. At that time we asked whether he was to be merely king for a day. Should he succeed in carrying out his present plans he will have strengthened his grip upon the scepter for at least two years longer.

Major General Sir Henry Thornton

EIGHT years ago last February *Engineering News* recorded the appointment of Henry W. Thornton, general superintendent of the Long Island R.R., as general manager of the Great Eastern Ry., the largest system in the British Isles. Now, Major General Sir Henry Thornton is returning to this side of the ocean to head the reorganized Canadian National Railway system. He took with him to England an engineering training in an American university and an experience of twenty years in the engineering and operating departments of the Pennsylvania R.R. He returns full of honors that attest how effectively he has mastered the problems of British railroading and commanded the confidence of the British public. If background is worth anything at all in his new work General Thornton should command a peculiar advantage, combining as he does an intimate knowledge of American railroad practice with a British viewpoint that will be most helpful in directing the national railway system of one of the most loyal dominions of that great empire.

Possibilities in Port Control

THOSE residents of New York City who still feel that the organization of the interstate Port Authority was a usurpation of the city's natural and legal rights would do well to ponder the following nonpartisan sentences from Elihu Root's recent political address before the state Republican convention:

> The harbor of New York is one of the chief assets of our state and of our nation. Nobody can take that asset away merely by making a residence in the vicinity. If the port of New York were to cease to perform its primary function as the gateway of the nation's commerce, and the flow of commerce were to cease, the inhabitants of the city must disperse and go elsewhere in search of food and occupation. The people living in that territory are the keepers of the gate for the nation. They constitute a part of a great national organization of production and trade. Upon the continued and prosperous working of that organization as a whole depend the prosperity and the lives of all the people of the state, which is sovereign over the territory about the Bay of New York where powers have been vested in the people of the city of New York as agents of the state.

If those who regard the harbor as the city's private property can vizualize an extension of this thought by an equally lucid legal mind pleading before a court or Congress or the federal administration, they can readily see how a restricted and mercenary municipal port policy might lead to that federal assumption of port control which has been frequently predicted but which has never been taken seriously by the selfish interests in the city.

Sage Counsel on Business Problems

HEARTENING as a friendly light on a storm-tossed horizon is the counsel of Thomas W. Lamont to the American Bankers' Association at its annual convention in New York last week. Hope and confidence are derived from his analysis of current economic conditions because of its sanity, its fairness, and its freedom from the traditional cant so often invoked on like occasions. Mr. Lamont is a disciple neither of Pollyanna nor of Jeremiah. He sees improvement, but he warns that several obstacles still encumber the road to prosperity.

With regard to labor problems, Mr. Lamont reminds his hearers of the responsibility that rests upon them. He bids them remember that there are still traces of arrogance in employers as well as in employed. The latter he attributes largely to the "boom wages" of the "boom years," which "gave labor the feeling that it must always share in the prosperity, never in the adversity, of business. I deplore that feeling," continued Mr. Lamont," yet I beg to remind you here that that feeling of labor, in so far as it was directed to the improvement of living conditions, to the gaining of a little leisure and of the time to play and be happy, was wholly right and to the advantage of the community. From such men as you such ambitions on the part of labor, moderately and wisely directed, should have every possible encouragement.

"The problem of capital and of labor will never be wholly worked out. People talk as if it were an example in arithmetic, capable of a final solution. It is no such thing. It is a problem of human beings: therefore, of emotions, gropings, longings, and ambitions. We can meet it only little by little, and only then if we put ourselves in the other fellow's shoes and get his viewpoint. . . . It is our responsibility to study more fully than we do today the conditions of labor and to be sure that, by and large, every competent worker (be he in the office or in the field) has an interval in the drudgery of work for that enjoyment of life that will make him a more contented and better citizen. In this matter you and I have a responsibility that we cannot dodge."

In discussing the human problems of industry three viewpoints are commonly taken: That of the Bourbon, who learns nothing and forgets nothing; that of the sentimentalist, blind to fact and experience and taking counsel only of his hopes and ideals; and finally that of the genuine progressive, keenly alive to the lessons of yesterday and determined to apply them to the problems of today in such wise that tomorrow shall see us a little farther along the road to economic efficiency and social justice. This last is the viewpoint so happily set forth by Mr. Lamont in the foregoing extract.

Low prices, caused largely by plentiful crops, do not worry Mr. Lamont, who contends that no country ever went broke on abundance of crops and that in the long run the farmers, like the rest of us, "will fare better on a moderate price scale with small fluctuations." He warns against a tariff policy that forgets the mutual character of trade and reminds us that "he who does not buy, neither shall he sell." Europe he considers to be on the mend, with hope for the future centered not in the formulas of statesmen, economists, or bankers so much as in the hard work and the thrift of the people —coupled with wise and courageous leadership.

This noteworthy summary, so broad in its scope, so sane in its judgments, and so stimulating in its reasoned optimism, deserves a wide circulation. If in this comment we have dwelt upon its expression concerning the relations between employer and employee, it is because of the fundamental quality of those relations, and because of a conviction that if Mr. Lamont succeeds in winning to his viewpoint on that question the influential audience he was addressing, a great work for industrial good-will will have been achieved.

A Professional Obligation

A READER brings to our attention a condition that one might prefer to forget about as something regrettable that cannot well be helped. He complains that the published records of engineering work are sadly incomplete, and that in particular the trials and failures which form part of every record of construction are commonly omitted.

To use his own words: "Any one who has had occasion to search through the records of a particular branch of engineering soon finds that much valuable information is frequently omitted in work described, and that many important works are left without any published records. The information that is published usually covers only the favorable results obtained, and rarely mentions the unfavorable ones. Yet hardly an engineering work is carried through without some unsuccessful attempts being made somewhere; if these were generally recorded and published, not only the engineers directly connected with the work, but also other engineers, might learn to avoid them in the future. As it is, the experience and knowledge gained in these attempts are lost to the engineering profession at large."

These few words carry a strong appeal. We are hopeful enough to believe that every reader will appreciate its force. We believe, moreover, that many an engineer preparing a paper on a piece of work accomplished feels it is his duty to tell a complete story, and that he will omit the most valuable portion of the record if he tells only of the successes. Yet many important engineering occurrences are withheld from record, and quite commonly published descriptions omit valuable experiences that are not flattering to those in charge.

There are readily understandable causes back of this condition. The engineer is not always free to tell all the details, at least the unpleasant details, of a case involving other interests than his own. His clients and his associates in the work, contractors and engineers, architects, even manufacturers who supply material or equipment, have feelings and prejudices—possibly rights—that claim consideration.

Not always do reasons of this kind control, however. The personal pride of the engineer is often the governing factor; to speak plainly, he wishes to present himself only in a favorable light.

The evil may to some degree be a necessary one, the resultant of the multiplicity of human factors that attend engineering work. Yet it is certain that the professional conscience, both individual and collective, will always stand squarely against the tendency to paint in fair colors only and to omit essential but uncomfortable bits of truth. Every individual student of engineering records resents the unfair task imposed on him of having to read between the lines and finding there nothing but white paper. We hope that in the course of time this feeling will crystallize into openly expressed convictions of the whole profession, which will demand more complete recording of engineering experience. In view of the human factors involved one might think that such a hope was futile. But a general professional conviction will hearten the engineer who inclines to tell the full history of an engineering work; and professional approval of his contribution to the knowledge of the art will more than balance the fault-finding and criticism—unless there be almost criminal dereliction and incompetence.

A basic professional obligation is involved in making true records of engineering work.

A Question of Language

TRANSMISSION of thought by drawings is one of the defining characteristics of modern engineering, so important a one, indeed, that the engineer may fairly be described as a man who talks with drawings. Drawing is the language by which he conveys his meaning in very many of his dealings with other men. He has acquired great skill in using this special language, and, as we all know, can apply it with wonderful precision. Yet, if some recent observations mean anything, he often fails to use it clearly, or even intelligibly. During the last few weeks we have been interested to notice that among the many drawings, original and printed, which come to an editorial office there is a significant number whose meaning is obscure, confused, or quite unintelligible.

Thus, to cite a few specific instances, beginning with a mild case: In the drawings of a novel structure now being built, views of detail parts which appeared on several sheets lacked both title and reference lines, leaving the location of these parts to be guessed at, with the result that the user of the drawings, instead of reading them directly, had to solve a riddle. A paper which gave an analysis of some newly studied mechanical actions of great interest to structural men presented its essential facts by various curve diagrams; these diagrams had no adequate legends or captions, and as in addition their ordinate values were not defined they confused more than they informed, and the author of the work largely failed in his effort to transmit the message he intended to deliver. One of the leading investigations of the last few years in the civil engineering field is reported by a short text statement supplemented by a dozen or more diagrams so bare of information as to their meaning, interrelation, or method of derivation that nine out of ten readers of the report are morally sure to get nothing whatever out of it.

Such shortcomings in drawings—and we find that they are disconcertingly numerous—mean simply that gross misuse of language has been committed, a misuse which, if paralleled in ordinary written language, would dishonor and defame its author. Are our ideals too low or too vague where applied to the language of graphic representation to enforce even the mimimum standards that would insure clarity? Or do our schools miss one of their functions, when they insist upon grammatical and effective expression with the pen but ignore corresponding needs in the art of the pencil? This much may be set down as an axiom: Unintelligible use of any language is wasted effort, just as truly in the language of drawing as in any other.

Marking System for Illinois State Roads

Danger and Caution Signs Developed by Tests on 60-Mile Stretch and Covering Several Months—Special Route Marking Through Cities Gives Satisfaction

By Ralph R. Benedict
Assistant Chief Highway Engineer, Springfield, Ill.

TWO requirements of road marking were had principally in mind in developing the system recently adopted for the State of Illinois. They were:

1. To make the highways as safe as possible under present-day traffic conditions.

2. To impart as complete directory information to the traveling public as may be feasible.

Warning and Danger Signs—To accomplish the first purpose, wooden signs, 42 in. wide and 24 in. high, with black letters on a white background, are erected. These signs, which are located 400 ft. each way from every point of potential danger, are carried on 4 x 4-in. creosoted wooden posts, set 15 ft. from the center of the pavement on the right-hand side; the bottom edge of the sign being 4 ft. above the pavement.

On all side roads and cross roads connecting with the improved state roads, the signs read: "Danger—State Road." The word "Danger" is painted red on a white background, the letters being 7 in. high and 4¼ in. wide. The words "State Road" are painted black, the letters being 5 in. high and 2½ in. wide. (Fig. 1.) On the paved roads the signs read: "Look"; "Caution"; or "Danger"; depending upon the location.

"Look" signs are erected where the driver need not slacken speed but should be on his guard.

"Caution" signs are erected where some slacking of speed and a certain degree of care are necessary.

"Danger" signs are used only where there is imminent danger, i.e., where extra precaution must be taken and speed greatly reduced.

The letters in the words "Look" and "Caution" are 7 in. high and are painted black on a white background. The letters in the word "Danger" are the same height as in the words "Look" and "Caution" but are painted red on a white background. Beneath these words, in letters 5 in. high and 2½ in. wide, the nature of the danger is indicated, i.e., "Sharp Curve R" (sharp curve right); "Cross Road"; "Side Road"; "S Curve L" (reverse curve left); "School"; "Narrow Bridge," etc. (Fig. 2).

Where continuous care for a certain distance is necessary because of the frequency of cross roads, curves, narrow bridges, schools, etc., "Caution Zones" have been established. Such zones are marked at each end with a board sign lettered "Caution Zones." (Fig. 3.) These signs have a border of diagonal black and white stripes approximately 2 in. wide. Throughout the caution zone all poles, bridge rails, other stationary objects, and, where necessary, special posts near the feature of potential danger, are painted with diagonal black and white stripes; in this way a great number of confusing separate signs are avoided.

System Carefully Studied—Before the final adoption of this system of warning signs, a 60-mile stretch of road was fitted with signs and studied for a period of several months. This study resulted in a number of minor modifications. At first the signs were so erected that the line of sight of a driver when 200 ft. away was perpendicular to the plane of the sign board. It was found that the painted surface being glossy caused a reflection of the headlights at night so that the lettering could not be read conveniently, until the driver had approached to within 50 ft. of the sign. On the other hand, the very fact that this reflection occurred made the sign very conspicuous at distances even as great as one-half mile under favorable conditions. In order, however, that the legend might be more readily deciphered at greater distances, the sign boards are now set normal to the center line of the road. At this angle the signs are still very conspicuous at distances of 1,000 ft. or more; and the lettering may be read at night at distances of from 50 to 100 ft.

Direction Signs—To furnish directory information to the traveling public—the following system has been adopted:

First: At the corporate limit of each city and vil-

FIGS. 1, 2 AND 3—CAUTION AND DANGER SIGNS ON ILLINOIS STATE ROADS

FIGS. 4, 5 AND 6—DIRECTION AND DISTANCE SIGNS ON ILLINOIS STATE ROADS

lage, a sign board of the same size as those carrying the warning signs is erected. The name of the city and the words "City Limit" appear on that side of the sign faced by the traveler when approaching the city. (See Fig. 4.)

At the corporate limit there is erected, on the right hand side of the road as the traveler leaves the city, a sign on which is lettered the name of the next town and the distance thereto; also the name of the next principal objective point on the route and the distance thereto.

Second: All State routes are numbered. The back of each warning sign carries this number. On these signs the borders of the State are outlined in black; and within this outline the route number appears in black numerals $5\frac{3}{8}$ in. high. Inasmuch as two warning signs are erected at each cross road and each side road on the state system of highways, the traveler is advised at frequent intervals of the number of the route on which he is traveling.

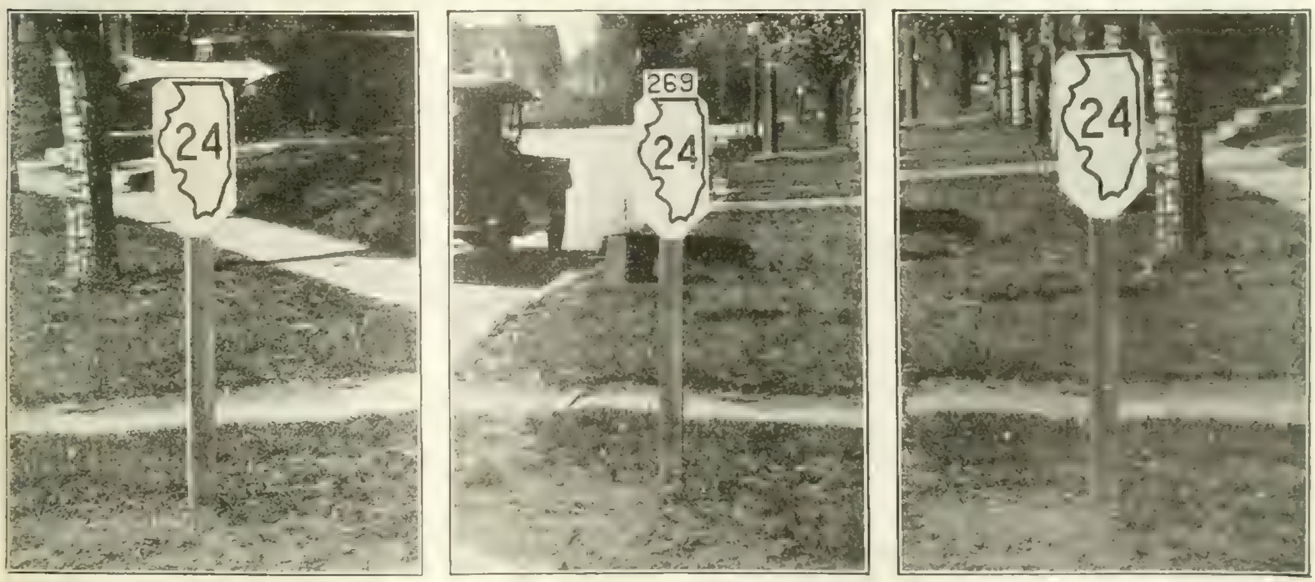
In addition to the route number, by means of red numerals, the distance along the route from its northerly or easterly terminus is noted on each rural warning sign in miles and tenths of miles. (See Fig. 5.)

At all cross roads and side roads leading to near-by cities and villages, an aluminum plate appears just below the sign board. On this aluminum plate the State borders are outlined, with the route number in raised black numerals and the mileage in raised red numerals. (Fig. 6.)

The final scheme contemplates showing on a complete road map of the state not only the route numbers but the mileage numbers of each important intersecting road, which is marked by an aluminum sign. This enables a traveler at any intersecting road to check his exact location by comparing both the route number and the mileage number of the intersection with those indicated on the map. The map, however, will not be available for some months.

The following are illustrations of the use of this marking system:

1. Assume that a traveler desires to start from Chicago, having Chillicothe in Peoria County as his objective. An examination of his map would show that he should follow Route 4 from Chicago to Joliet; Route



FIGS. 7, 8 AND 9—ROUTE SIGNS THROUGH CITIES ON ILLINOIS STATE ROADS

7 from Joliet to Depue and Route 29 from Depue to Chillicothe. If he is a stranger, the city limit sign, as he enters Chillicothe, will advise him that he has reached his destination.

2. Assume that a traveler desires to start from East St. Louis, having Delavan in Tazewell County as his objective. An examination of his map would show that Delavan lies about 4½ miles east of State Route 24; and, further, that the red mile number of the cross road leading to Delavan is 25.9. Without references to the map thereafter, the traveler could hold in mind that he should follow Route 4 from East St. Louis to Springfield; Route 24 from Springfield to the cross road on which the mileage number (25.9) appears all he has to do then is turn east and drive approximately 4½ miles to Delavan.

Marking Through Cities—No warning or danger signs appear within the corporate limits of cities and villages; therefore aluminum markers, showing the route number and the mileage (even miles only) erected on independent posts are used at street intersections to direct traffic.

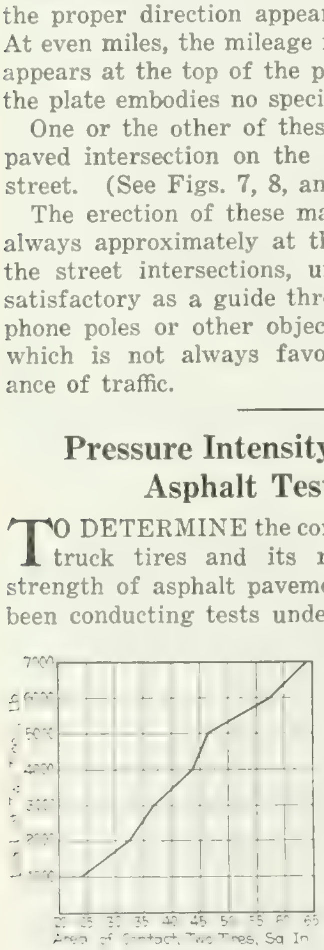
Three different patterns are in use for the city markers, all of which have in common a double-faced flat plate (approximately 22½ in. high by 11 in. wide) showing the State outline in black and the route number in raised black numerals. At turns, an arrow pointing in the proper direction appears above the standard plate. At even miles, the mileage number in raised red figures appears at the top of the plate. At other intersections the plate embodies no special features.

One or the other of these designs is erected at each paved intersection on the far side of the intersecting street. (See Figs. 7, 8, and 9.)

The erection of these markers on independent posts, always approximately at the same position relative to the street intersections, undoubtedly will prove more satisfactory as a guide through cities than where telephone poles or other objects are used, the location of which is not always favorable for the proper guidance of traffic.

Pressure Intensity of Truck Tires on Asphalt Tested at Detroit

TO DETERMINE the concentration of loads on motor truck tires and its relation to the compressive strength of asphalt pavements the city of Detroit has been conducting tests under the direction of J. C. McCabe, research engineer. In the table and curves herewith, are presented the results obtained by applying loads of from 1,000 to 7,000 lb., in 1,000-lb. increments to a Clark diskwheel equipped with dual 36x5-in. Goodyear cushion tires. The weight of a wheel and tire was 570 lb. For a *single* tire (dividing by 2) the load applications were equivalent to a range of from 500 to 3,500 lb. The manufacturer's maximum rating was 2,000 lb.

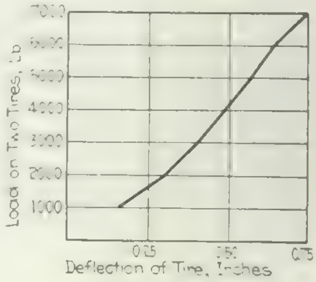


AREA OF TIRE CONTACT UNDER DIFFERENT LOADS

Under a total load of 5,000 lb., or 2,500 lb. on each tire, which was 25 per cent over the rated maximum, a maximum pressure intensity of 135 lb. per square inch was recorded. Compression tests of asphalt paving mixture samples made in conjunction with the tire tests showed that the yield point was reached at 116.6 lb. per square inch at 150 deg. F. In other asphalt tests the yield point has been reached at 100 lb. per square inch at 150 deg. F., a temperature which Mr. McCabe has found to exist in pavements during midsummer.

RESULTS OF LOAD TESTS ON 36 X 5-IN. DUAL CUSHION TIRES

Load on Two Tires, Lb.	Deflection, In.	Contact Area (Two Tires), Sq. In.	Max. Load Per Lin. Inch, Lb.	Max Load Per Sq. In., Lb.
1000	0.162	23.6	120	50.5
2000	0.300	32.4	198	74.8
3000	0.402	36.8	255	92.7
4000	0.483	43.8	310	107.4
5000	0.568	46.4	402	135.0
6000	0.640	57.8	509	150.0
7000	0.751	64.0	555	157.0



RANGE OF DEFLECTION OF TIRE

Studies of Flow Through Cleared and Uncleared Floodways

Mid-Course Gagings—Velocities Taken by Current Meter from Boat—Difference in Discharge Capacity 62½ Per Cent

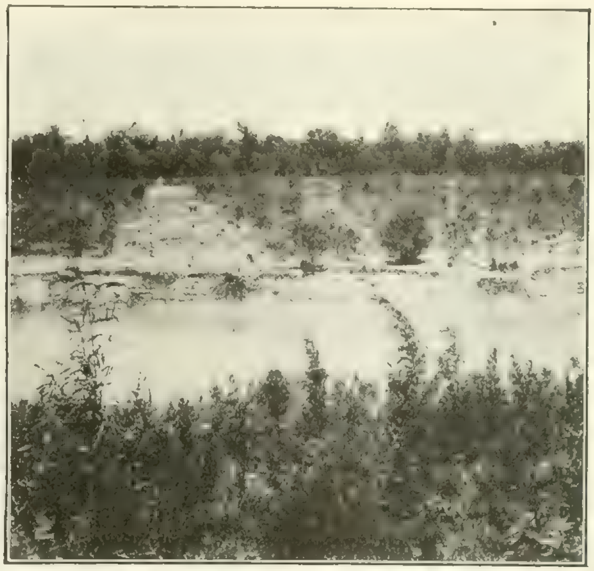
BY CHARLES E. RAMSER
Senior Drainage Engineer, U. S. Department of Agriculture, Washington, D. C.

ALTHOUGH the use of the floodway, as a device for preventing overflow of land by streams, is quite common, little information is available upon which the engineer can rely in the design of such structures. In November, 1921, investigations were begun by the United States Department of Agriculture in the Little River Drainage District, south of Cape Girardeau, Mo., for the purpose of securing such data.

The diversion floodway of the Little River Drainage District is about 32 miles long. It extends from a point near Greenbier, Mo., along the border of the foot hills of the Ozarks in an easterly direction to the Mississippi River. It collects all the water from the streams emerging from the foothills to the north, and by the shortest route conducts it to the Mississippi River.

Since the beginning of these investigations there have occurred no general heavy rains to produce high rates of runoff in the floodway, but an ordinary general rain in combination with a high stage in the Mississippi River produced a measurable flow in the floodway, the maximum depth of which was about 5½ ft. Thus an opportunity was afforded for the determination of the rate at which the water could be removed by the floodway; or in other words for the determination of the value of n in Kutter's formula—the one most generally used in computing the discharge of a floodway.

These experiments were conducted on a straight section of the floodway about 2¾ miles in length near Nash, Mo. Two courses of 3,000 ft. each were selected along this straight section, one of which was cleared of all growth and obstructions except stumps for 500 ft. above and below the ends of the course and the other was left



FIGS. 1 AND 2—CLEARED AND UNCLEARED FLOODWAYS, LITTLE RIVER DRAINAGE DISTRICT, MISSOURI

In (1) the trees and brush were cut from the entire floodway, but in (2) they were not cut. In each boat-gaging station or course the stumps were cut even with the ground for a width of 10 ft. to prevent interference with the current meter, and in the boat course in the uncleared floodway (2) all growth was cut from a strip 40 ft. wide. The boat was attached to a 1¼-in. guide wire, supported on poles, in each case; the poles show in Fig. 1.

uncleared below the lower end of the course and for 500 ft. above the upper end.

The floodway lies between parallel levees, the distance from center to center of levees being 1,120 ft. The north levee is about 14½ ft. in height and the south levee about 18 ft. The dimensions of the main channel in the floodway are about as follows: Top width, 145 ft.; bottom width, 60 ft.; depth, 20 ft.

To eliminate the accelerating influence of the high velocities in the main channel upon the flow in the floodway, the boundary of the floodway was taken at about 30 ft. from the edge of the channel.

In the table are given the hydraulic elements and values of n in Kutter's formula as obtained for the cleared and uncleared courses of the floodway respectively. Four measurements were made on the cleared course for average depths in the floodway ranging from 4.4 to 5.5 ft., and three measurements on the uncleared course for average depths ranging from 4.5 to 4.9 ft. The average value of n obtained for the cleared course is 0.0465 and for the uncleared, 0.0777. The condition of the two courses as regards stumps was practically the same so that the differences in the values of n obtained may be attributed to the growth permitted in the floodway. To determine the probable relative efficiency in terms of discharge for the uncleared course in its present condition and after it has been cleared, computations for discharge were made using $n = 0.047$, the value obtained for the cleared course on April 2, and using the hydraulic elements as obtained for the uncleared course on April 2 when n was found to be 0.079. The computations show a difference in discharge capacity of 62½ per cent.

HYDRAULIC ELEMENTS AND VALUES OF n IN KUTTER'S FORMULA FOR CLEARED AND UNCLEARED FLOODWAYS

Date	Mean Gage Height	Average Depth Ft.	Average Surface Width Ft.	Discharge Sec.-Ft.	Average Cross-sectional Area Sq. Ft.	Wetted Perimeter Ft.	Hydraulic mean depth $= r$ Ft.	Slope $= s$	$\sqrt{rs}$	Mean Velocity $= v$ Ft. per Sec.	c Equals $\frac{v}{\sqrt{rs}}$	n
For Cleared Course of Floodway												
4/1/22	337.43	5.2	828.8	4,137	4,372.0	829.8	5.21	.0000843	.0210	0.957	45.6	.047
4/2/22	337.71	5.5	829.7	4,078	4,540.8	830.6	5.47	.0000696	.0195	0.898	46.1	.047
4/3/22	337.18	5.0	828.1	3,141	4,101.0	829.1	4.95	.0000540	.0163	0.766	47.0	.044
4/4/22	336.55	4.4	826.6	2,243	3,579.7	827.6	4.33	.0000506	.0148	0.627	42.4	.048
For Uncleared Course of Floodway												
4/1/22	336.77	4.5	824.9	2,672	3,698.0	825.8	4.48	.0001592	.0267	0.723	27.1	.077
4/2/22	337.14	4.9	826.7	2,631	4,004.2	827.2	4.84	.0001233	.0244	0.657	26.9	.079
4/3/22	336.75	4.5	825.4	1,875	3,682.0	825.9	4.46	.0000798	.0188	0.509	27.1	.077

Gagings of the flow in the floodway were made at stations midway between the ends of the two courses. Velocity measurements were made with a Gurley-Price current meter from a boat. The boat was attached to a ¼-in. wire stretched across at a right angle to the floodway and held in place by poles as shown in the illustrations. The wire was secured at both ends and could be adjusted to the desired height on the poles, depending upon the depth of the water in the floodway. An anchor was used at the stern of the boat to hold the boat steady and parallel with the direction of the current. Measurements of the velocity were made at top, middle and bottom depths, and at intervals of 40 ft. across the floodway. Measurements in the main channel were made at intervals of 10 ft.

The slope of the water surface was measured on both sides of the floodway and the utmost care was exercised in order to secure accurate measurements. Cross-sectional measurements of the floodway were made at intervals of 500 ft. The mean of the slopes of the water surface as measured on each side of the floodway, and the average of the cross-sectional areas, were used in the computations.

The investigations were made by the writer under the direction of S. H. McCrory, chief, Division of Agricultural Engineering. H. J. Bartz, junior drainage engineer, assisted with the computations and field examinations. Engineers of the Little River Drainage District furnished valuable advice and assistance.

Lost Time in Construction—2

Winter Idleness

Methods of Doing Work in Cold Weather Are Well Developed—Economics of Year-Around Construction is the Unsolved Problem—Extensive Research Required

By C. S. Hill
Associate Editor, Engineering News-Record

Second of a Series of Four Articles

CONSTRUCTION generally is curtailed in winter. During this comparatively idle period the industry is sustained by drawing on what it earned in the portion of the year when it was active. The correction of this condition is a task which engineers and contractors are called upon to undertake as their share in solving the great problem of reducing industrial waste.

Winter construction presents a technical and an economic problem. The technical problem is to develop effective construction practices for cold weather; it has to a considerable extent been solved. The greater problem is economic and almost no purposeful effort has been made to solve it. It involves the stupendous labor of changing construction, with its correlated activities, from a seasonal to a year-around industry and the simultaneous changing of building habits.

Obviously, reformation of the country's second largest industry cannot be accomplished out of hand. It is possible, however, to state the problem, to disclose the means that have been employed to solve it and possibly to suggest further means. A comparatively superficial examination indicates amazing possibilities of immediate progress, particularly in codifying and correlating methods of cold weather construction.

Governing Conditions—Cold affects adversely every element of construction; labor, water supply, drainage, materials, equipment, transportation and structure suffer disturbance. Extreme frost aggravates the effect of cold, and wind and snow magnify the action of frost. From these two facts come the first two general conditions of winter construction.

1. Winter construction is a different problem in different temperature zones—for example, the Canadian line states, the Gulf and Mexican boundary states and the belt of states between have separate problems in winter construction.

2. In any locality the possible volume and continuity of winter construction change as the season is mild or severe, is open or has a heavy snowfall, is of even or fluctuating temperature and has few or frequent storms.

Certain construction processes are obviously more susceptible to disturbance by cold weather than are others. Shallow excavation and fill over wide areas, steel erection high in the air and concrete road construction are particularly exposed to the effects of frost and storms. Tunneling or deep excavation in cuts or pits of small area and interior building construction are comparatively sheltered. From these facts comes a third generalization:

3. The nature of the construction operation largely determines the practicability of its successful prosecution in winter.

On the face of the three conclusions which have been stated, the problem of winter construction appears to have many complexities. This is true if the economic solution is being sought. While the technical solution differs with temperature and weather conditions, the difference lies in the degree to which cold weather construction methods are required and not in the methods which have to be employed. Once the processes are determined for, say, excavation or concrete construction, the only change in practice required in any circumstances of temperature and weather is the extent to which all or any of the processes have to be employed. A fourth general condition results:

4. Weather and temperature conditions determine the extent to which cold weather construction methods may be necessary but do not necessitate any change in the nature of the methods.

Statement of Problem—With these fundamental conditions established the problem of winter construction is to determine (1) the kinds of construction which can be performed in winter; (2) the methods of and equipment for cold weather work; (3) the extra cost of doing winter work and (4) the expenditure warranted to secure the increased production resulting from winter operations. A fair start has been made in determining the kinds of work that can be done and the methods of doing it. In some kinds of construction, particularly concrete building work, the excess cost of winter construction has been fairly well established; but experience furnishes no facts of importance on the economics of winter construction as a general practice.

The progress that has been made in winter construction is the best promise of its future possibilities. To make the statement specific, consideration is limited to heavy excavation, road building, municipal works and concrete and building construction. As a matter of fact, however, other operations introduce few conditions which require different methods, so that the determinations reached for the operations named comprehend construction in general.

Heavy Excavation—The following conclusions have been set down from notes on about twenty steam shovel or dragline heavy excavation operations described in technical journals or personally observed:

1. With preparations and precautions which can be carried out without serious difficulty heavy excavation can be confidently undertaken in winter.

2. Generally depth of cut and volume of material in a restricted area determine the feasibility of winter operations. Shallow cuts not penetrating the frost crust are not practicable except as emergency operations.

3. Labor is somewhat less efficient in cold

weather. Men have to be relieved from work at intervals to warm themselves, particularly those working in exposed positions like that of cranesman on a steam shovel. Warm clothing is necessary—not merely anything that will keep out the cold but clothing designed to allow bodily activity like, for example, the outfit for Red Cross workers in Russia. In the most severe frost, shorter working days are necessary. On the other hand, owing to general winter idleness, more choice is possible in the men employed.

4. Motorized hauling equipment—motor trucks, tractors and locomotives—and in general machinery for all operations should be used to the utmost extent because it reduces the number of men and teams to be affected by cold and has excess power to meet the more difficult operating conditions caused by frost.

5. Water supply, except when urban supply is available, is expensive. Surface pools and pipe lines will not do. Frost-protected pumps, pipes and tanks or tank-car haulage are required.

6. Excavating equipment has to be prepared for winter work by insulating steam pipes and cylinders and closely housing every working part which it is practicable to shelter.

7. Snow sheds and barriers help to keep pits and cuts free from drifted snow and can often be installed at small expense.

8. Efficiency is gained by blasting the frozen crust, particularly in dragline work, and it is generally advantageous to "dig in" before frost so as to have a good working face when frost comes. In winter blasting the use of non-freezing explosives or of means to keep explosives unfrozen are essential.

9. If the cold is particularly severe and continuous, double-shift operations, so as to keep ahead of the frost, may, in large operations, be profitable.

10. Power-dump cars are superior for handling spoil, usually mixed with snow and liable to freeze so that it is hard to dump. Prompt movement of spoil trains is necessary for the same reason.

11. More capable supervision is required to meet the hazards of frost and storm.

12. Electric - motor or gasoline - engine - driven equipment greatly reduces the difficulty of water and fuel supply.

Road Building—Second to industrial and residence building-construction, road building is the most general construction operation and involves the largest expenditures. As a winter construction problem it, therefore, has great economic importance. It also introduces conditions of earth moving, hauling, water supply and fabrication of structure (paving or surfacing) which are not common in general excavation and in concrete and building construction.

Earth moving in road construction generally involves shallow cuts and fills. Where heavy cuts and fills have to be made the conditions are those of heavy excavation just previously considered. Cuts and fills not deeper than the frost crust are practically impossible once the crust has frozen. It has been found practicable, where the grading has been completed, to prevent freezing for a time while pavement was being constructed. The method was to stretch three lines of steam pipe from a steam roller along the subgrade and to cover them with straw and a canvas blanket. In general the following conclusion is warranted:

1. Except as an emergency operation and except in cuts and fills of considerable magnitude winter grading of highway is impracticable.

While grading is, broadly speaking, not a winter possibility, the next most important operation of hauling is made easier in some respects by cold weather. Frost hardens the ground. Snow gives a track for sleds. If storms are not too frequent winter hauling is entirely practicable in road building (1) to stockpile construction materials and (2) to distribute gravel surfacing. In Wisconsin and Minnesota many miles of gravel surfacing have been successfully and economically placed in winter. Stated as a conclusion:

2. In road building the hauling of construction materials and equipment is entirely practicable in winter with probably no more delay because of wind and snow storms than is experienced in summer because of rainfall.

Water supply in winter road work is even more serious a problem than it is in heavy excavation; conclusion (3) under heavy excavation applies to water supply for road building, and is here repeated:

3. Water supply, except where urban supply is available, is expensive. Surface pools and pipe lines will not do. Frost-protected pumps, pipes and tanks or tank-car haulage are required.

There are numerous examples of winter paving operations which have demonstrated that any kind of pavement may be constructed by (1) heating the materials; (2) housing and heating the subgrade and the completed pavement; (3) using chemicals to retard freezing. These are all common processes in concrete building construction and are described in many articles and books.

There are virtually no records of the extra cost of winter road building. It has been variously assumed as 25 to 50 per cent more than the cost of summer construction, but these figures are nothing but guesses.

Winter road building is not practicable as a general proposition in states having a severe winter climate; it is practicable to prolong the construction season well into the fall season of moderate night frosts by methods which do not call for elaborate equipment or excessive expenditure; it is also practicable to do in winter a large amount of hauling and storing materials and other work preparatory to warm weather construction.

Municipal Works—The only recorded study of winter construction practices has been made by Canadian engineers. In 1920, inquiry made by Prof. W. Clifford Clark, Queens College, Kingston, Ont., of 36 Canadian cities which had done municipal work in winter, disclosed the following information:

The kinds of work pronounced successful, or fairly so, are sewer construction, tunneling, deep excavation, heavy cuts and fills, mass concrete and work in muskeg or swamp where subsurface water prevails. The degree of success depends upon the preparation which is made in the fall for continuing work in severe weather and also on the supervision of the work.

Estimates of the increase in the cost of construction in winter vary from nothing to double the cost of summer work. In some instances winter construction was found less expensive. In all cases the kind of work

and the local weather conditions must be taken into account.

There is general agreement that tunneling can be done as economically in winter as at any time. The average increase in the cost of rock excavation is less than 25 per cent. In ordinary sewer work the increase probably runs from 25 to 100 per cent.

Various reasons are given for the increased cost. The frozen top has to be broken through. Spoil banks freeze. Brick and concrete materials must be heated. Workmen have to be sheltered and provided with means of warming themselves.

In general winter work keeps organizations intact, overhead charges are spread over twelve months and wages are lower.

Concrete and Building Construction—Work on concrete structures of all kinds, and building operations generally, are commonly carried on in winter. Methods have been highly perfected and are now text-book knowledge. The conditions can be stated as follows:

1. All concreting and building masonry operations can be carried on in winter with dispatch and absolute safety by heating the materials, housing in the work under construction and heating the enclosure.
2. Steel erection in winter is largely a function of storm and temperature. In any weather in which the workman can withstand the cold and work safely, structural steel can be erected.
3. Interior building work, plumbing, steamfitting, plastering, etc., can be performed in winter with little loss of efficiency.
4. Winter construction in building adds from 3 to 10 per cent to the cost according to the records of large concrete building contractors.
5. There is probably some greater risk of poor workmanship in winter concreting, masonry work and steel erection which calls for more exacting supervision and inspection.

General Conclusions—Nothing in the general conditions laid down, or in the conclusions from practice, place the problem of methods of winter construction beyond the range of easy solution by engineers and contractors. With very moderate inquiry and analysis it would be practicable to state recommended practices or standard methods. This investigation may precede more complex study of economic conditions because whether or not winter construction in general is economical there are always individual operations which it will pay to carry on in winter. In other cases, such as winter hauling in road building, it may be profitable to perform parts of the work in winter. As a broad generalization of the technical problem of winter construction it may be concluded:

Any kind of construction can be performed for which the owner is willing to pay cold weather prices.

Economic Problems—The economics of winter construction do not lend themselves to the simple methods of handling the technical problem. As applied to a single structure the economic question is: Will possession of the structure at a definite earlier date be of enough value to pay for the extra cost of winter construction and leave a little over? Visualizing the construction industry as a whole the query is much the same. While, however, in the case of the individual structure the means are at hand for a ready answer there are inadequate, indeed almost no, data by which to determine the answer for the whole industry. Determination of these data is the great task of research before engineers and contractors and the *determination needs to be quantitative.*

Briefly, winter construction appears to offer economies by (1) spreading overhead costs over twelve producing months instead of some less period; (2) reducing the seasonal employment of men in construction and the allied industries; (3) ironing out the peak in the curve of production of construction materials and equipment; (4) equalizing the demand on transportation agencies. The economic waste in all these activities due to reduction of construction during cold weather is universally admitted as a general truth but there are no determined figures of the amount of waste. These quantitative data are what research is called upon to supply. The reasons are:

1. The construction industry is the servant of the building public and evidence of specific savings is necessary to induce the building public to alter its practices.
2. Without full knowledge of the economic waste from winter idleness in construction the industry cannot stabilize its own business or assume the duty, which it must, of teaching the building public.

The third article of this series—developing the problem of Rain and Mud Delays in detail—will appear in the next issue.

Water Treatment Works of Buenos Aires, Argentine Republic

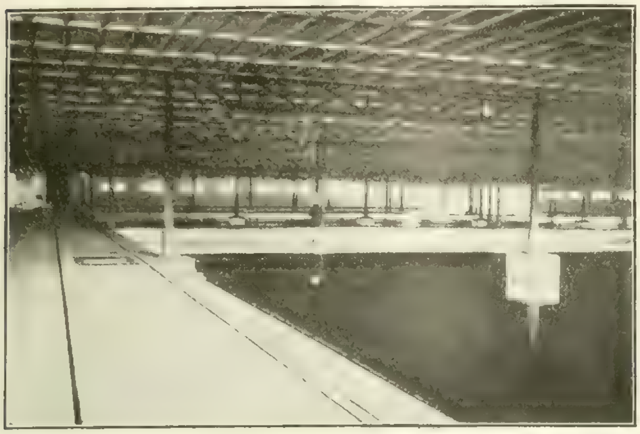
Coagulation and Sedimentation Before Slow Sand Filtration Form One of the Features

COAGULATION and sedimentation before slow sand filtration is a feature of the water supply of Buenos Aires, Argentina. The city, which has a population of about 1,500,000, draws its water supply from the Rio

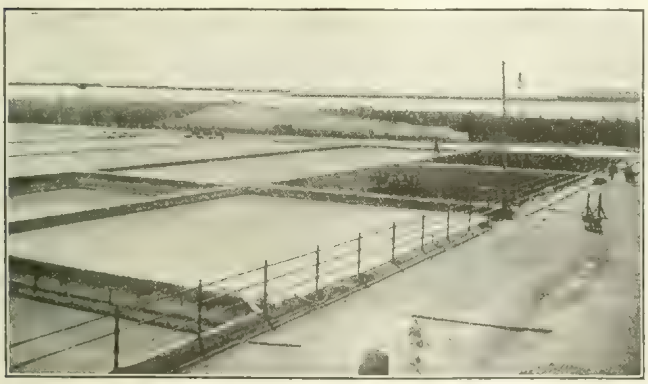
PUMPING STATION AS SEEN FROM ALVEAR AVENUE

de la Plate, pumps it to coagulation and sedimentation basins, passes it through slow sand filters to clear-water reservoirs and then pumps it to a distributing reservoir.

Because of the finely divided matter in suspension and the humus matter in solution the water is not only settled before filtration but is also coagulated by means of sulphate of alumina, introduced just before the water is discharged from the force mains to a distributing chamber which supplies the settling reservoirs. No detailed information is available regarding the design of this chamber, the settling reservoirs and the filters, except that the beds are composed of graded layers of sand resting on similar layers of gravel; that the filter underdrains discharge into filter regulators; and that there are ten filters, with a combined area of 54,069 sq.m. (581,782 sq.ft., or about 13.3 acres). As to purification results, Mr. Negri states only that coagulation and sedimentation reduce the bacteria 80 to 90 per cent and that the filters add to the clarification of the water and "destroy the organic matter which has not been precipitated before filtration."



INTERIOR OF FILTER HOUSE



SETTLING RESERVOIRS AND FILTER HOUSE

GARDENS WITH FILTER HOUSE BEHIND

The clear-water reservoirs are located under 5 of the 10 filters and have a total capacity of 91,248 cu.m. (24,000,000 gal.).

The high-service pumps are of various types, including two triple expansion pumping engines and some electric-driven centrifugal pumps. They have a combined daily capacity of 310,200 cu.m. (about 81.5 m.g.d.) and deliver filtered water to a large distributing reservoir through seven inter-connected and valve-controlled 51 to 91.4 cm. (20- to 36-in.) cast-iron force mains.

The accompanying views of the pumping and purification plants have been sent to *Engineering News-Record* by Henry W. Wendt, president, Buffalo Forge Co., who visited Buenos Aires some months ago and made the acquaintance of Mario L. Negri, civil engineer of the waterworks. In February of this year Mr. Negri supplied Mr. Wendt with photographs and descriptive notes of the water-works, from which the material here presented has been selected.

Intake towers and tunnels lead the water to low-service pumps, of a combined capacity of 367,000 cu.m. per 24 hours (97 m.g.d.) which have a lift of about 10 m. (33 feet).

Layer of Fine Sand Within Slow Sand Filters at Chester, England

A LAYER of fine sand beginning 15 in. from the top of the water-works filters of Chester, England, has stood the test of time, stated F. Storr and C. W. Bennett in a recent paper before the British Institution of Water Engineers, and doubtless "the remarkable results obtained are in great measure due to its action." The composition of the entire bed and further excerpts from the paper just mentioned are given in the London *Surveyor* of June 16, 1922, as follows:

As is well known, it is a comparatively simple matter to reduce by filtration the total bacteria contained in a raw water from thousands per cubic centimeter to hundreds, or perhaps tens, but reduction below some such limit can seldom be continuously relied upon by the ordinary practice, and it is in effecting this object that the interposed layer of finer sand serves a useful and important function. It is true that sub-surface clogging takes place to a slight extent in course of time, but this is remedied by going down to the fine sand-layer and removing a light scraping from its upper surface when replenishing the coarse sand removed by successive cleanings.

ARRANGEMENT OF MATERIAL IN CHESTER FILTERS

	Ft.	In.
Perforated bricks on filter bottom	0	4½
Pebbles passing ¾-in. mesh	0	4
Fine pebbles passing ½-in. mesh	0	2
Coarse pit sand 60 per cent retained on a 40 per inch mesh	1	3
Fine pit sand 65 per cent retained on a 70 per inch mesh	1	0
Coarse pit sand 60 per cent retained on 40 per inch mesh	1	3
Total depth	4	4½

There are practical reasons why the fine sand should not be placed on the top, as the trampling it would receive in the course of cleanings would quickly reduce it to an impervious mass, and when removed to the sand-washers, together with algae, mud, and other debris, it would not be so readily dealt with as with the coarser grade of sand.

The rate of filtration varies from 0.75 to 2 [Imp.] gal. per sq.ft. per hour [0.9 to 2.4 U. S. gal. per hr. or 940,000 to 2,500,000 U. S. gal. per acre per day.—EDITOR.]

Aerial Tramways Serve Mixing Plant at Gilboa Dam

Rugged Country Makes Surface Roads Difficult—Air Lines Reliable and Cost Less—Lines Have Surplus Capacity—Operation Undisturbed by Rain and Snow

By Charles K. Traber
A. Leschen & Sons Rope Co., St. Louis, Mo.

Aerial tramways are transporting all the concrete materials for the 450,000 cu.yd. of concrete in the Gilboa Dam for the water-supply system of New York City. It is believed that this installation is one of the most extensive ever employed on a construction operation and its success in meeting, at a comparatively reasonable cost, the requirement of providing, in a rugged country, a large and uninterrupted supply of materials makes it especially interesting to the construction engineer and contractor.

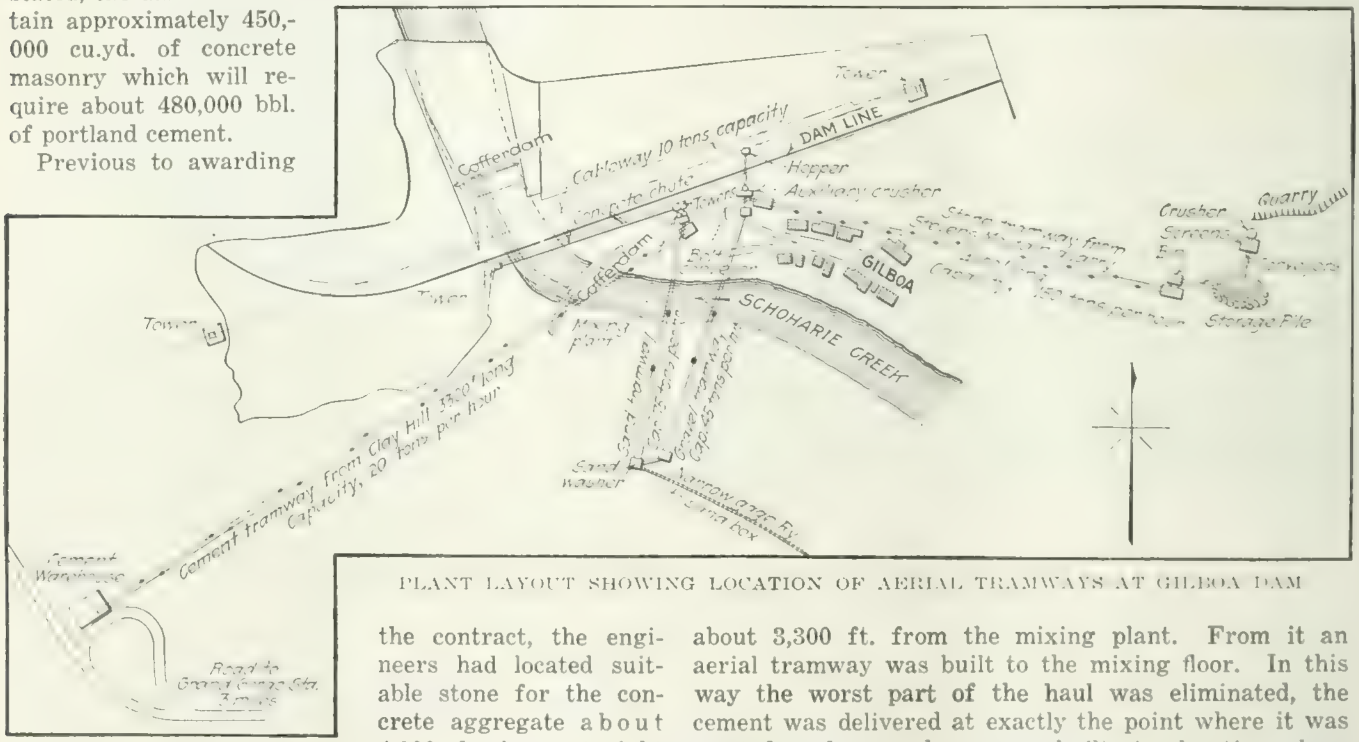
The Gilboa Dam a part of the latest link in the New York City Catskill water supply, is located at the town of Gilboa, N. Y., about four miles by road from the Grand Gorge Station of the Ulster & Delaware R.R. The contract for building the dam was awarded to the Hugh Nawn Contracting Co., of Boston, in 1919. As stated, the dam will contain approximately 450,000 cu.yd. of concrete masonry which will require about 480,000 bbl. of portland cement.

Previous to awarding the contract, the engineers had located suitable stone for the concrete aggregate about 4,000 ft. in a straight line from the proposed location of the mixing plant, but at a somewhat higher elevation. Suitable sand was located on the banks of Schoharie Creek, about three miles upstream from the site of the dam. The cement had to be brought in from the railroad, the nearest station of which was about four miles from the site of the dam. The road was a poor one, having some very heavy grades and being difficult to keep in condition.

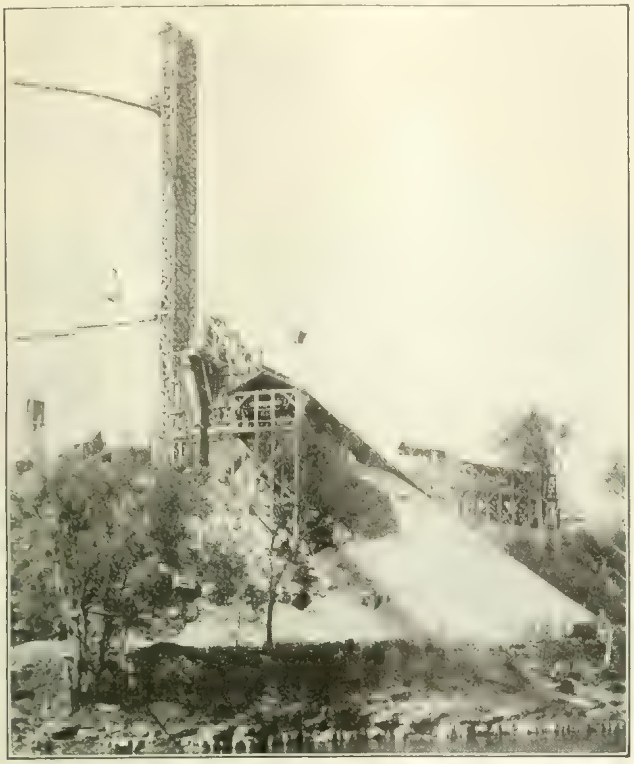
To find some means of getting these 480,000 bbl. of cement from the railroad to the mixing plant was the contractor's first problem. An aerial tramway connecting a switch, at a suitable location on the railroad, directly with the mixing plant was the first thought. This tramway would have been somewhat over three miles in length. However, it was found that a right-of-way could not be secured, except at an unreasonable cost, and it was necessary to abandon this idea. Still, hauling by road was a worse solution. The logical place for the mixing plant was on the far side of the gorge, across which the dam would be built, and the road crossed this gorge at exactly the location of the dam. If the cement, then, were to be brought in by road, it would have to go over a new road to be built to take the place of the old road which made the distance over a mile longer.

Finally it was considered that an aerial tramway might be built across the gorge and over the worst part of the ground to a favorable location on the old road for a warehouse, to which the cement could be brought by trucks. This was done. The warehouse was located about 3,300 ft. from the mixing plant. From it an aerial tramway was built to the mixing floor. In this way the worst part of the haul was eliminated, the cement was delivered at exactly the point where it was wanted, and a warehouse was built at a location where it did not interfere with the other operations taking place at the point of work. The capacity of this tramway was fixed at 20 tons of cement per hour, although it can easily be pushed to a greater capacity if this becomes necessary.

The next problem was to handle the crushed stone from the quarry, which was located on the side of a mountain about 4,000 ft. distant from the mixing plant and on the other side from the cement tramway. A narrow-gage railway would have meant a considerable amount of grading, and it did not figure out nearly so well as an aerial tramway, so this method of transport was again chosen. The capacity required here was 150 tons of crushed stone per hour. The stone, after being



PLANT LAYOUT SHOWING LOCATION OF AERIAL TRAMWAYS AT GILBOA DAM



MIXING PLANT AND TOWER FOR GRAVITY CHUTING
In the left foreground is seen a carrier on the cement tramway approaching the terminal; in the center a carrier of the sand tramway, and in the background the terminal of the stone tramway.

crushed and screened, is deposited on a storage pile, under which is a tunnel in which runs a belt conveyor. This belt conveyor delivers the stone into a small bin from which the tramway buckets are fed. At the mixer end it was found convenient, instead of making the mixer bins the terminus of the tramway, to build this terminal next to an auxiliary crushing plant which handled the rock taken out of the excavation. The tramway buckets, therefore, deliver their loads to the belt conveyor which handles the material from the auxiliary crushing plant up into the mixer bins.

These two problems having been disposed of there remained the problem of transporting the sand from the bank to the mixing plant. A narrow-gage railway proved to be the best method of handling the sand from the sand bank to a washing plant which was located just across Schoharie Creek from the mixing plant. A short aerial tramway from this washing plant to the bins over the mixers was decided upon. The capacity required here was 75 tons per hour.

After sand washing plant had been in operation for several months, it was found that a great quantity of small boulders and gravel accumulated, which were wasted at the site of the washer. It seemed a pity to waste this material, since it had to be handled for the three miles from the sand bank to the washing plant and run through this plant, so it was decided to utilize the auxiliary crushing plant and to carry this gravel and boulders by means of a fourth aerial tramway from the washing plant to the auxiliary crushing plant. This tramway, being suitably located, could also be used as an auxiliary tramway for handling sand. This is accomplished by running the surplus sand from the washing plant onto a large storage pile, which also helps in de-watering, and then handling it from there by means of a derrick and clamshell into a small bin which feeds the aerial tramway buckets.

Although aerial tramways have been previously used very successfully in construction work, this is the first place, to the writer's knowledge, where all the principal materials going into the work are being so handled. The advantage in this particular case has been very clearly demonstrated. These tramways have been in operation since October, 1921, and during the month of May, 1922, as much as a thousand yards of concrete per day were placed on some days. There was no interruption of work at any time due to failure to deliver the material; in fact, at nearly all times, the tramways ran ahead of the mixer and had to be run intermittently in order not to overflow the mixer bins.

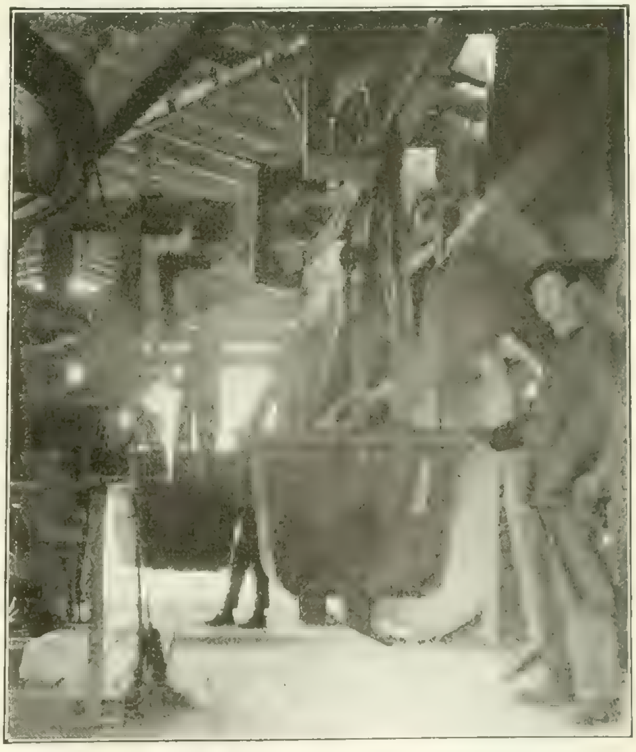
The advantages of tramway transportation can be briefly stated as follows:

1. The lines can be built over very rough ground, usually as easily as over level country.

2. Operation is not interfered with by weather conditions, since all of the essential parts are up in the air and out of the way.

3. The cost of upkeep is quite small, since all of the parts subject to wear can be taken care of very easily; and the speed being slow, there is no danger of derailments.

As indicated on the layout plan the cement and stone tramways are of the continuous type and operate much like a belt conveyor, inasmuch as they carry comparatively small loads at frequent intervals and travel at a slow speed. It is the continual flow of material that allows large capacities to be secured with a comparatively inexpensive equipment. The sand and gravel tramways are of the two-bucket type and consist of only two carriers running back and forth each on its own rope. Large capacities can be secured here because the distance to be covered is small. In other words,



LOADING TRAMWAY BUCKETS WITH CRUSHED STONE
Stone is chuted into bucket [illegible] 1-cu.yd. bucket is loaded in about four seconds.

the type of aerial tramway is adapted to the conditions to be met.

The cost of operation is quite small. The load being uniform and the friction moderate, but little power is required. In fact, both the stone tramway and the cement tramway operate by gravity when running at full capacity, although the drop is slight between the loading and discharge points.

When the material can be handled through chutes from a bin, as in the case of the crushed stone tramway, very little labor is required. In this particular case, three men can handle the loading terminal very nicely; and, in fact, if it were not for the necessity of often starting and stopping the tramway on account of the bins becoming full, two men could probably handle this terminal. At the discharge end two men also handle the buckets. Under certain conditions the discharging end of these tramways can be made automatic, if it is found more economical to put in a little more equipment and save on labor. For smaller capacities, both the loading and discharge can be made automatic. The two-bucket tramways require but one man each for the entire operation.

If the reader will imagine what would have been required on this job with the usual methods of transportation, where in the first case a very deep gorge, with a span of some 500 ft. had to be crossed, in the second case hills and valleys of various heights and depths, and in the third a swift stream, which would occasionally rise very rapidly, he can easily see the advantages of the air-line system.

An alternative in the first case would probably have meant a long detour with trucks, and then the cement

LOADING BAGS OF CEMENT INTO TRAMWAY BUCKETS

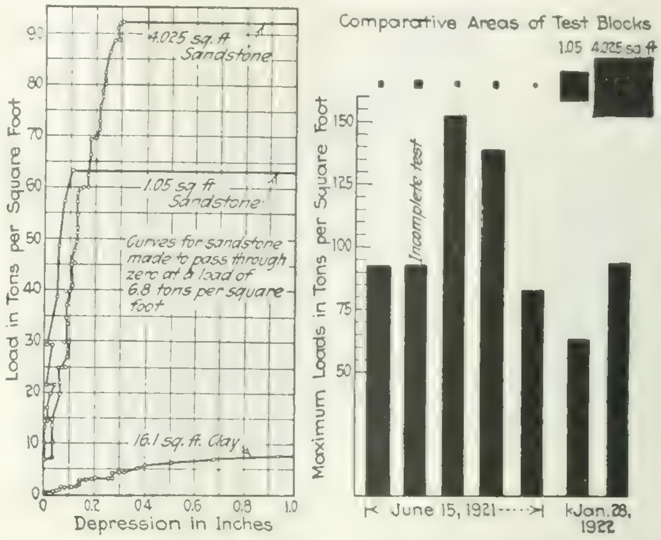
would only have been delivered on the ground at the foot of the mixing plant. In the second case, that of the crushed stone tramway, a narrow-gage railroad would probably have been the next best solution, and this would have had many curves in order to keep down the grade, and again the stone would probably have had to be delivered at on inconvenient point. In the third case, that of the sand tramway, it would have been necessary to build a bridge across the stream, with a belt conveyor and then a bucket elevator at the mixing plant, to elevate the sand into the mixing bins.

The line drawings and views give a general idea of the construction of these aerial tramways, all of which were designed and furnished by the A. Leschen & Sons Rope Co., of St. Louis, Mo.

Foundation Tests for Nebraska State Capitol

Methods and Results of Loading Small and Large Test Areas of Sandstone and Loess Clay—Breaking Load Disintegrates Rock

BEARING tests on clay and rock in which test areas of 1 to 16 sq.ft. were loaded and the disintegration pressure for sandstone was determined have been made



FIGS. 1 AND 2. LOADING TESTS ON CLAY AND SANDSTONE

on the site of the new State Capitol at Lincoln, Neb., with the result that all foundations will be on rock and that a limit of 15 tons per square foot was recommended. The architect is using a 12-ton unit load in his designs.

This building is to be a hollow square with 437-ft. sides and having the interior space divided by a cross-shaped structure at the center of which will be a tower 80 ft. square and 405 ft. high above the ground. The outer portion will have only two stories, attic and basement, but the inner portion will be somewhat higher. This combination of low structure, interior courts and

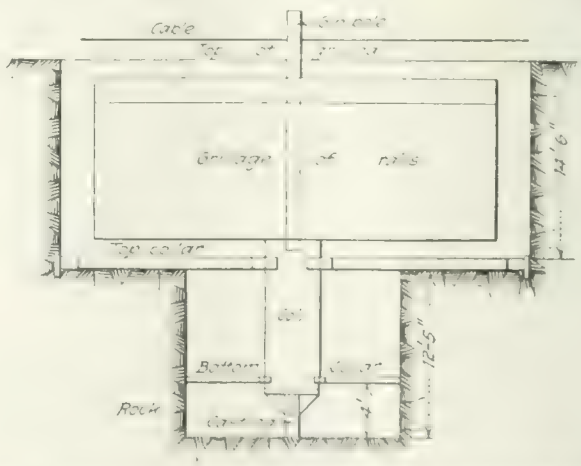


FIG. 3. LOADING APPARATUS FOR FOUNDATION TESTS

long exterior walls is designed to provide abundant light for every room without the aid of skylights and light shafts.

Soil Conditions—Under a black top soil $1\frac{1}{2}$ to $5\frac{1}{2}$ ft.

thick is a 15-ft. bed of loess clay, and then approximately 6½ ft. of gravel (glacial drift with boulders) over the Dakota sandstone. The clay will stand in excavations without need of sheeting. The bed rock is a light buff sandstone, but at some points there is an upper 7½-ft. bed of light brown sandstone which is

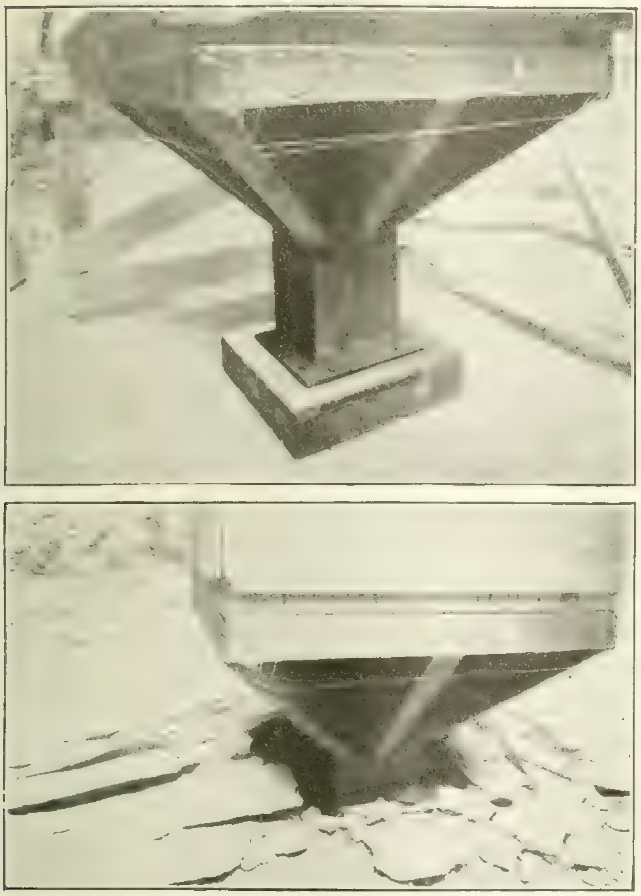


FIG. 4. RESULT OF LOADING TEST ON FOUR SQUARE FEET OF ROCK

separated from the bed rock by a seam of soft blue shale. The Dakota sandstone bed rock is too hard for excavation by picks or grab buckets without the use of explosives, but pier excavations or shafts can be enlarged or belled at the base by picks in order to provide the necessary bearing area. It is an almost pure silica sand weakly cemented with iron oxide. The stone is easily scraped or bored and after being removed from its bed many of the particles can be crushed readily in the hand.

Fig. 1 shows the loads and deflections in the tests in clay and rock, and Fig. 2 gives the comparative test areas and loads in the rock tests.

Tests on Clay—In preliminary tests on the loess clay 8 ft. below the surface 2 x 2-in. and 3 x 3-in. blocks were forced down continuously while the load was increased to 421 and 369 lb. per square inch respectively. Later an area of 16 sq.ft. at a depth of 17 ft. was loaded by the plunger shown in Fig. 7. The result is plotted in the left-hand curve of Fig. 1. Settlement was appreciable at 3.24 tons per square foot; the maximum load reached was 7.9 tons per square foot, with 1.30 in. settlement.

Tests on Soft Rock—For a test of the upper stratum of rock (light brown sandstone) a 7¼-in. loading post (52.6 sq.in.) was placed on a cleaned surface at 17 ft. depth. A small but gradual penetration continued up to a load of 112 lb. per square inch, and was followed by a more rapid penetration, reaching 1.3 in. at 218 lb. In a second test, a 4 x 4-in. block under the post settled gradually with increasing load, until at a unit pressure of 486 lb. it was flush with the surface of the rock.

Tests on Bed Rock—In a test on bed rock at 39.6 ft. below the surface, with a 2 x 2-in. loading block, the sandstone gave way suddenly at a unit pressure of 1,160 lb., apparently flowing from under the block and carrying the edges of the block with it. A block 3 x 3 in. in another position was loaded to 1,275 lb. per square inch without failure and with a settlement of only 0.005 in., but this 5½-ton load was the maximum that could be applied safely. With a 2 x 2-in. block in a water-filled hole the rock in one test failed at 1,973 lb. unit pressure, while in another test the block split at 1,965 lb. A steel block 1⅝ in. in diameter gave sudden failure of the rock at 1,210 lb., the rock penetrating about an inch.

Two tests on large bearing areas were made. In one a casting bearing on the rock with a face of 1.05 sq.ft. (Fig. 3) carried the 4 x 4-ft. loading column already mentioned; the results indicated that the sandstone was elastic up to a load of approximately 50 tons per square foot. Failure occurred suddenly at 63 tons, with all the testing apparatus dropping 6.3 in. due to the bearing surface penetrating the sandstone. Up to this loading the total settlement had been 0.11 in. In the second test the loading casting was placed upon a cast-iron block having a bearing area of 4 sq.ft. (Fig. 4). Two microscopes, placed as in Fig. 5, were used in this test to supplement the level readings on a vertical steel rod. The microscopes were removed when the load reached 52 tons per square foot, in view of the 63-ton limit of the previous test, but failure did not occur until the load reached 94.4 tons, when the rock failed suddenly. The loading began on Dec. 14 and failure occurred on Dec. 23. The maximum depression under load was about 0.30 in. until the failure, when the block penetrated the rock to a depth of over 13 in. below the depression, as shown in Fig. 4. These two tests are plotted in Fig. 1.

Conclusions as to Bearing Strength—After the first series of tests, in May, 1921, it was concluded that the loess clay has as great a bearing strength as the upper stratum of sandstone and that the safe load was 3 tons

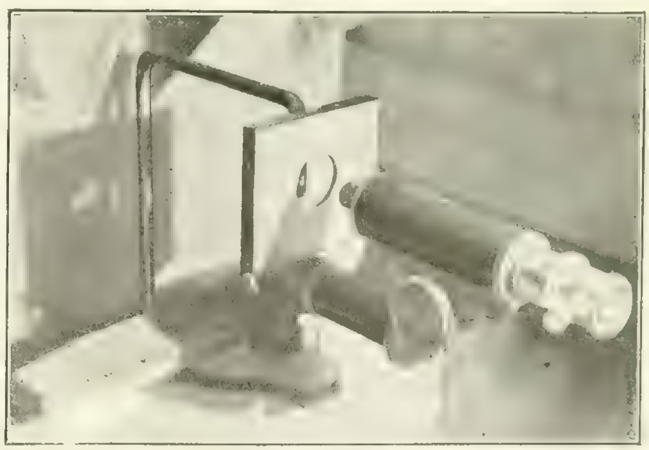


FIG. 5. MICROSCOPE SET FOR OBSERVING DEFLECTIONS

per square foot for depths not exceeding 25 ft. For the sandstone bed rock at depths of 30 to 40 ft. the safe load was estimated at 15 tons. From the results of the second set of tests, in December, the safe load of the clay was estimated at 2 tons per square foot and that of the bed rock at 15 tons. The architect is using

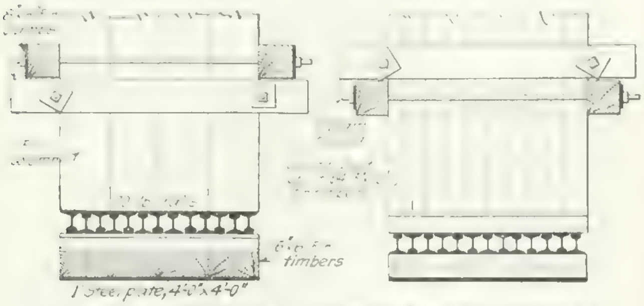


FIG. 6. METHOD OF LOADING 16 SQ.FT. OF CLAY

a 12-ton unit foundation load in the design of the structure.

These tests also indicated clearly that the entire building should be founded on the sandstone, since no arrangement of foundation could be designed to carry the building loads on both clay and rock without resulting in unequal settlement. Further, the foundation engineer's estimate of a combined foundation on both the clay and sandstone exceeded his estimate for an all-rock foundation at 25 to 45 ft. depth.

Testing Apparatus—In the May tests a 12-ft. post 7½ in. square had a loading platform near the bottom, as shown in Fig. 7, and was held plumb by having its upper end fitted to a square collar on a lever of adjustable length wedged across the pit. Two plumb-bobs were hung on the post and a vertical scale was attached to a nail in it. For observations, a thread was stretched between nails at the sides of the pit, being kept tight by having one end tied to a rubber band fastened to the nail. In testing, the post rested on a bearing block.

Placing the load of 90- to 180-lb. tractor rollers by hand gave the platform a tendency to rotate and this tendency being transmitted to the testing block caused a grinding action which probably was responsible in part for the deflection. Slight impact in placing the weights was also unavoidable, but these factors of twisting and impact were not large. For testing, the platform was loaded as evenly as possible. Ditches were provided for excluding storm water, and at night the pit was covered with a large tarpaulin.

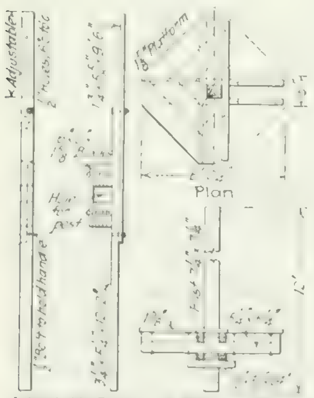


FIG. 7. APPARATUS FOR TESTS ON SMALL AREAS

For loading a test area of 16 sq.ft. in the December tests on the clay, the arrangement shown in Fig. 6 was used. Upon the upper layer of rails was seated an 11-ft. column 4 ft. square built up of 3 x 12-in. fir timbers, spiked, bolted and clamped together. For the later rock tests the column was stiffened by a covering of diagonal planks spiked to each side and then bound by heavy clamps and bolts. This column was held in

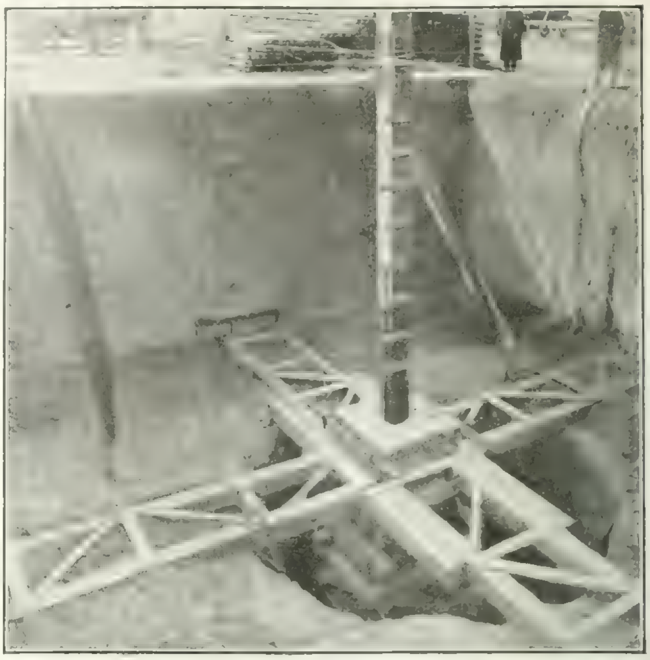


FIG. 8. TEST COLUMN IN SHAFT READY FOR LOADING

position by guide collars at top and bottom, the collars being braced to the side of the shaft, as shown in Fig. 8.

A 12 x 12-in. gin pole in a hole 12 in. deep in the center of the top of the column was guyed by cables to four posts (see Fig. 3). This pole held the column vertical and served as a guide in placing the rails. In a 3-in. hole near the center of the column was placed a 1-in. pipe containing a ½-in. steel rod which rested on the steel bearing plate. A scale was clamped to the upper end of the rod for readings with a precise level.

For the rock tests, the timber column rested on a base casting with a top surface 4 x 4 ft. and a stem

FIG. 9. LOAD OF RAILS WIDENS TOWARD TOP

having a bearing area of 1 sq.ft., as shown in Figs. 3 and 4. In the first test this stem was set directly upon the rock, but in the second test it rested upon a cast-iron block which increased the bearing area to 4 sq.ft. For the load, layers of 56-lb. rails were placed upon the head of the 4 x 4-ft. column, the length increasing gradually from 4 ft. 1 in. at the bottom to 30 ft. at the top. Thus with a total load of 500 tons each rail would have been stressed to the allowable limit of 16,000 lb. per square inch. Fig. 8 shows the column in place in the shaft ready for the loading. Fig. 9 shows the load in place, with the arrangement of increasing length of rails as described above.

These tests were planned and carried out under the direction of Prof. Clark E. Mickey, consulting and testing engineer for the Nebraska State Capitol Commission. The May tests were made by W. B. Alexander, R. E. Glover and Wm. H. Pahl, of the State Department of Public Works. The November-December tests were made by the Jarrett-Chambers Co., Lincoln, consulting foundation engineers, assisted by Robert E. Glover, assistant testing engineer of the State Department of Public Works. Bertram G. Goodhue, New York, is architect for the Capitol.

Salaries of State Sanitary Engineers

By James A. Tobey
Washington, D. C.

Every state in the Union except Arizona, Delaware, Idaho, Nevada, North Dakota, Oregon, Utah, and Wyoming now has a state sanitary engineer. The District of Columbia also has such an engineer, though he is not under the Health Department, and there are engineering divisions in the Porto Rico and Hawaii Boards of Health. Next to the 40 bureaus of engineering in the state health departments come laboratory bureaus, of which there are 36; bureaus of venereal diseases, 35; child hygiene, 32; communicable diseases, 24; and other bureaus or divisions in lesser numbers.

The average yearly salary paid to 37 directors of engineering during 1921 was $3,220; for 24 heads of communicable diseases bureaus, $3,446; for 31 directors of child hygiene, $3,385; for 34 chiefs of laboratories, $3,356. Table I summarizes the salaries in the various divisions. (From the Report of the Committee on Salary Standards of the American Public Health Association, of which the author is secretary, dated August, 1922.)

TABLE I—SALARIES OF DIVISION CHIEFS, STATE DEPARTMENTS OF HEALTH

	$5,000 and up	$4,000-$5,000	$3,000-$4,000	$2,000-$3,000	Under $2,000	Total	Reporting Average
Child Hygiene	1	7	9	12	2	31	$3,385
Communicable Diseases	0	11	8	4	1	24	3,446
Engineering	3	9	11	12	2	37	3,220
Food and Drugs	1	1	8	6	1	17	2,9[illegible]0
Laboratory	1	10	15	7	1	34	3,356
Vital Statistics	1	1	5	6	5	18	2,412
Venereal Diseases	2	4	16	7	4	33	3,058
	9	43	72	54	16	194	

The highest salaries paid to bureau or division heads in any of the state health departments are one of $7,000 in Pennsylvania, which goes to the director of the division of engineering, and one of $7,000 in New York, paid to the director of laboratories. There are seven $5,000 salaries, of which two, in Ohio and Massachusetts, are received by engineers. The lowest salary paid to state sanitary engineers is $1,800, of which, however, there are only two, in Maine and New Hampshire. Nineteen engineers' salaries are below the average of $3,220, while 18 are above. A list of salaries of directors of engineering is given in Table II.

No salary less than $3,000 a year should be paid to any chief of a division of a state health department, according to the committee report mentioned above. Bearing in mind the factors of training, experience, length of service, personality and other qualifications of an individual, the committee believes that in most instances more than this sum should be paid. It will be observed that at present 14 state sanitary engineers receive less than $3,000 per annum.

The salaries of sanitarians have, as a rule, increased somewhat during the past few years. This does not hold true of state sanitary engineers, however. In 1920 there were 25 such engineers. Their average annual salary was $3,293, as compared to $3,220 now. On the other hand, the average compensation of state health officers increased from $4,040 in 1920 to $4,453 in 1922. There is no reason why the compensation of these engineers should not keep pace with that of other sanitarians. To be sure, a sanitary engineer requires two years less college training than does a medical man, but the character of his work is no whit less important than that done by any medical chief of a division. In fact, in many states, it is no exaggeration to say that most of the actual constructive public health work is done under the direction of the state sanitary engineer. More non-medical men with this type of training are needed in public health work and their remuneration should be made more attractive.

TABLE II—SALARIES, CHIEFS OF ENGINEERING DIVISIONS STATE DEPARTMENTS OF HEALTH

State	Salary	State	Salary	State	Salary
Alabama	$4,000	Maine	1,800	Ohio	5,000
Arizona	....	Maryland	3,250	Oklahoma	2,100
Arkansas	3,000	Massachusetts	5,000	Oregon	
California	4,000	Michigan	4,000	Pennsylvania	7,000
Colorado	2,400	Minnesota	4,500	Rhode Island	4,000
Connecticut	2,500	Mississippi	2,750	South Carolina	2,400
Delaware		Missouri	2,400	South Dakota	2,400
Florida	3,000	Montana	3,000	Tennessee	3,600
Georgia	....	Nebraska	2,000	Texas	2,700
Idaho		Nevada		Utah	
Illinois	4,000	New Hampshire	1,800	Vermont	
Indiana	2,500	New Jersey	3,300	Virginia	3,500
Iowa	2,500	New Mexico	3,300	Washington	4,200
Kansas	3,000	New York	3,500	West Virginia	3,000
Kentucky	2,400	North Carolina	4,000	Wisconsin	4,000
Louisiana	....	North Dakota		Wyoming	
				Average	$3,220

A Bridge-Testing Locomotive

Testing bridges by loading with a gasoline locomotive of special design is a novel method introduced on the government railways of Switzerland. According to the *Railway Gazette*, London, the engine is of the 2-2-2 type, with a middle pair of 74-in. driving wheels and leading and trailing wheels 37 in. in diameter. Provision is made for transferring the load from these latter wheels to the drivers in order to give a concentrated load at any desired point. When thus adjusted the engine can be moved in either direction. The weight is about 36 tons, which in normal operation is distributed equally. To permit of testing light structures about 7 tons of the weight consists of movable blocks, so that the total weight can be reduced to 29 tons. A 10-hp. engine drives the locomotive, which can ascend grades of 2½ per cent, but for transportation the locomotive can be hauled by a regular train.

Flow in Tennessee Checked Against Hydraulic Formulas

Studies of These and Irrawaddy River Curves Indicate That Ganguillet and Kutter's Formula Does Not Allow Fully for Effect on *C* of Slope and Hydraulic Radius

By Benjamin E. Jones
Hydraulic Engineer, U. S. Geological Survey, Washington, D. C.

The formulas proposed by Bazin and by Ganguillet and Kutter for the flow of water in open channels were based upon at least two assumptions that are open to question. Bazin, in proposing a formula for the coefficient C in Chezy's formula $V = C\sqrt{RS}$, assumed that C does not vary with the slope, and Ganguillet and Kutter in proposing their formula for C assumed that an increase in slope would increase C when the hydraulic radius was less than 1 m and would decrease C when the hydraulic radius was greater than 1 m. The measurements described in this article seem to show that, at least under certain conditions, both these assumptions are wrong.

In Chezy's formula for the flow of water in open channels all the variations due to changes of slope and hydraulic radius, as well as changes due to the differences in the roughness of the channel, are included in the coefficient C. Ganguillet and Kutter's formular for C is

$$\frac{\frac{1.811}{n} + 41.6 + \frac{0.00281}{S}}{1 + \left(41.6 + \frac{0.00281}{S}\right)\frac{n}{\sqrt{R}}}$$

in which n expresses the effect of roughness of the channel.

They make an allowance for the effect of change in slope and in hydraulic radius, so that the only unknown factor will be the roughness of the channel. In using

FIG. 1. TENNESSEE RIVER SECTION AT CHATTANOOGA

their formula it is customary to assume a value for n for a stretch of river channel and to use the same value regardless of change in slope or in hydraulic radius. Also in fixing the value of n the character of the channel alone is considered, the slope usually being disregarded so far as its effect on n is concerned. This procedure is correct only in so far as Ganguillet and Kutter succeeded in eliminating the effect of all factors except the roughness of the channel.

The measurements described below, which were made on a large river, show the effect of changes of slope and hydraulic radius under certain conditions on the factor n, which is supposed to represent only the degree of roughness of the channel. The information obtained has a bearing on the use of velocity formulas in

TABLE I—SLOPE AND DISCHARGE MEASUREMENTS, TENNESSEE RIVER, CHATTANOOGA, TENN.

No	Date	Stage, Ft	Area Sq. Ft	Hydraulic Radius Ft. R	Slope In Ten millionths S	Discharge, Sec. Ft.	Velocity, Ft. Per Sec.	Chezy C	Kutter N
1	Mar 9, 1917	44 20	63,700	28 9	622	276,000	4 33	102	029
2	Mar. 9, 1917	42 80	60,800	27 9	649	262,000	4.31	101	029
3	Mar. 10, 1917	35.93	48,600	26.0	722	195,000	4 01	92	.032
4	Jan. 11, 1916	25.75	33,300	24 5	828	129,000	3.87	86	.0335
5	Mar. 31, 1917	23.38	30,100	22.6	842	113,000	3.75	86	033
6	Feb. 5, 1918	22.14	28,500	21.7	793	99,500	3.48	84	.034
7	Jan. 15, 1916	20.57	26,800	20 8	825	94,000	3.51	85	.033
8	Oct. 6, 1915	18.58	24,500	19 4	795	81,900	3.34	84	.033
9	Oct. 7, 1915	16.55	22,000	17.9	763	65,400	2 97	80	.035
10	June 4, 1915	13 53	18,600	15 5	877	53,100	2.85	77	.035
11	May 10, 1915	13.32	18,300	15 3	796	48,200	2.63	75	.036
12	Mar 29, 1918	13.23	18,200	15 2	947	51,700	2 84	75	.035
13	Sept. 9, 1915	*12.58	17,500	14 4	582	35,000	2.00	70	.0395
14	May 11, 1915	12.37	17,200	14 3	766	41,600	2.42	73	.037
15	May 8, 1915	*12 02	16,800	14 1	650	34,800	2.07	68	.0405
16	Apr 13, 1915	11.61	16,200	13 6	858	39,300	2.43	71	.0375
17	June 18, 1915	11.28	16,200	13 5	774	36,200	2.23	69	.039
18	Apr. 16, 1915	11 26	15,900	13 4	776	36,000	2 26	70	.039
19	July 12, 1915	10 54	15,300	13.0	750	31,400	2.05	66	.041
20	May 8, 1915	10 45	15,000	12 7	744	30,500	2 03	67	.0395
21	July 13, 1915	9 99	14,800	12 5	754	28,700	1.94	63	.0425
22	June 2 1915	9.85	14,500	12 3	755	27,300	1.88	61	044
23	Apr 7, 1915	9.64	14,200	12 1	698	24,100	1.70	59	046
24	June 11, 1915	9 44	14,100	12 1	758	25,300	1.79	59	045
25	May 31, 1915	9.15	13,700	11.8	690	22,100	1.61	56	048
26	Sept. 15, 1915	*8 86	13,200	11 5	457	14,900	1 13	50	057
27	May 10, 1916	*8.77	13 200	11 5	668	17,900	1.36	49	056
28	May 5, 1915	8.76	13,200	11 5	717	20,700	1.57	54	0495
29	Aug 17, 1915	8.79	13,100	11 4	617	20,000	1.53	58	046
30	June 14, 1915	8.53	13,000	11 3	679	19,300	1.48	53	050
31	Apr. 30, 1915	8.50	12,900	11 3	684	18,800	1.46	53	051
32	May 3, 1915	8 05	12,500	11 0	'788	19,200	1.54	52	.051
33	Jan. 14, 1918	8 00	12,400	10 9	506	11,500	0 93	40	067
34	Aug. 16, 1915	7 66	12,000	10 5	839	18,400	1.53	52	050
35	Oct 14, 1916	7 42	11,600	10 2	582	11,200	0 97	40	067
36	July 30, 1915	7 17	11,400	10 1	765	15,100	1.33	48	054
37	Aug 14, 1915	6 10	10,200	9 1	901	13,400	1.31	46	055
38	Aug 4 1915	5.95	10 100	9.0	928	12,800	1.27	44	.057

* Flashboards on dam

computing the flow of water in large open channels, and if other experiments covering all the various conditions of their use can be made their results may show how to eliminate most of the sources of error in the application of the formulas.

The accompanying tables and diagrams give the results of 38 slope and discharge measurements. Curves have been drawn to show the variation of C and n due to differences in slope and in hydraulic radius. The measurements made at the same stage but with different slopes produced by the use of flashboards are of particular interest.

The discharge measurements shown in Table I were made several years ago by Warren E. Hall, district engineer, United States Geological survey, in a study of the discharge of rivers of variable slope. They were made with a small Price current meter from a bridge on the Tennessee River at Chattanooga, Tenn. The area and velocity for all the measurements are referred to the section at this place which is shown in Fig. 1. The slope was obtained from two gages, one at the measuring section and the other at a bridge seven miles upstream. The normal or usual fall in this distance is about 3 ft. Backwater from Hales Bar dam, 33 miles below the lower gage, extended above

both gages, and flashboards placed on the dam at low water decreased the slope for some of the measurements. (See Fig. 2).

Table I shows the results of the discharge measurements on the Tennessee River, the slope at the time each measurement was made, and the value of C in Chezy's formula and of n in Ganguillet and Kutter's formula. Fig. 3 shows the value of C plotted against the hydraulic radius and the variation from the value

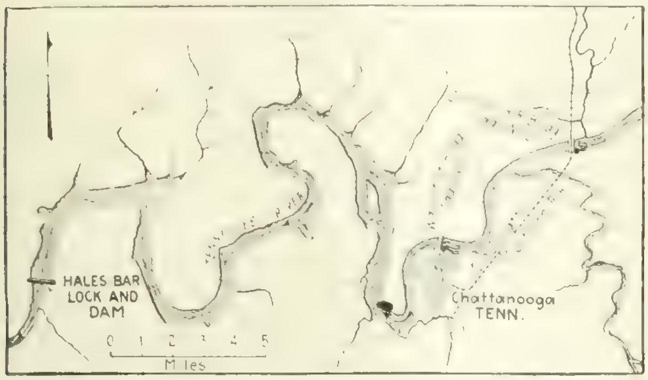


FIG. 2. GAGING STATION SITES AT CHATTANOOGA

The distance between the two gaging stations is about 7 miles. The reservoir formed by the Hales Bar Dam extends to a point at or near the longer island above Gage No. 2, a distance of 42 miles.

of C as computed by Ganguillet and Kutter's formula for $n = 0.035$. The value fixed for $n = 0.035$ was selected as best fitting the results of all the measurements. For comparison, the results of measurements made on Irrawaddy River, at Saiktha, Burmah, are given in Table 2 and Fig. 4. The results of these measurements are taken from Hering and Trautwine's translation of Ganguillet and Kutter's work.

The extent to which the values of n and C obtained in these experiments could be applied to other similar channels depends, of course, on the relation that the cross section at the bridge on Tennessee River bears to the average cross section of the whole stretch of channel involved in the measurements. The area of the piers of the bridge is a very small percentage of the area of the stream, (Fig. 1.) and on the whole the area at the bridge doubtless represents fairly well the cross section of the seven miles of channel. The addition of the area of the piers, which increases the cross section of the stream, gives somewhat lower values for C, but the slope and shape of the curve are the same. The curve shown in Fig. 3, therefore, shows the variation in the value of C under the conditions of slope and stage indicated and also the departure from C as computed by Kutter's formula.

As the minimum hydraulic radius for any of these measurements is 9 ft., the slope and hydraulic radius have proportionately greater effect on the value of C and n than they would have at lower stages, when the effect of the condition of the channel itself would be greater. Figs. 3 and 4 shows that for low velocities C is likely to vary greatly, even in the same channel, but the slope formulas are used principally in designing canals and estimating flood discharge. For the design of canals, in most of which the velocity is low, ample data on the value of n and C are available. During floods the velocity is usually so high that the large error possible at low velocities need not be considered except so far as the cause of the variations at low rates of discharge may have the same effect at higher rates.

For stages on the Tennessee River when the hydraulic radius is greater than 14 ft. the results of the measurements follow more nearly the results as computed by Ganguillet and Kutter's formula, but even here the increased slope and hydraulic radius and resulting increased velocity affect the value of C and n.

As already stated, Ganguillet and Kutter assumed that for a hydraulic radius greater than 1 m. C would decrease as the slope increased, but on the Tennessee River C increased with an increase in slope when the velocity was low, although the hydraulic radius was between 9 and 14 ft. The value of C indicated by measurements 23, 24, 25, and 30, which were made with flashboards on the dam, and by measurements 31 and 36, all of which show a small slope, was considerably lower than that indicated by other measurements made practically at the same stage but with a greater slope owing to the absence of flashboards. Bazin assumed that C does not vary with the slope and based his formula on that assumption, but there seems to be no other cause for the changes in C shown by the measurements on the Tennessee River. Measurement 33, with a hydraulic radius of 10.9 ft. and a slope of 0.0000506, shows a value of 40 for C, whereas measurement 34, with a hydraulic radius of 10.5 ft. and a slope of 0.0000839, shows a value of 52 for C. As the velocity increases an increase in slope has less effect on C, as shown by measurements 12, 13, 14, and 15. Measurements 13 and 15, with lower slopes, show only slightly lower values for C than measurements 12 and 14. At the higher velocity of 4 ft. a second represented by measurements 1, 2, and 3, which were made at flood stage, increase in slope seems to decrease

TABLE II—SLOPE AND DISCHARGE MEASUREMENTS, IRAWADDY RIVER AT SAIKTHA, BURMAH

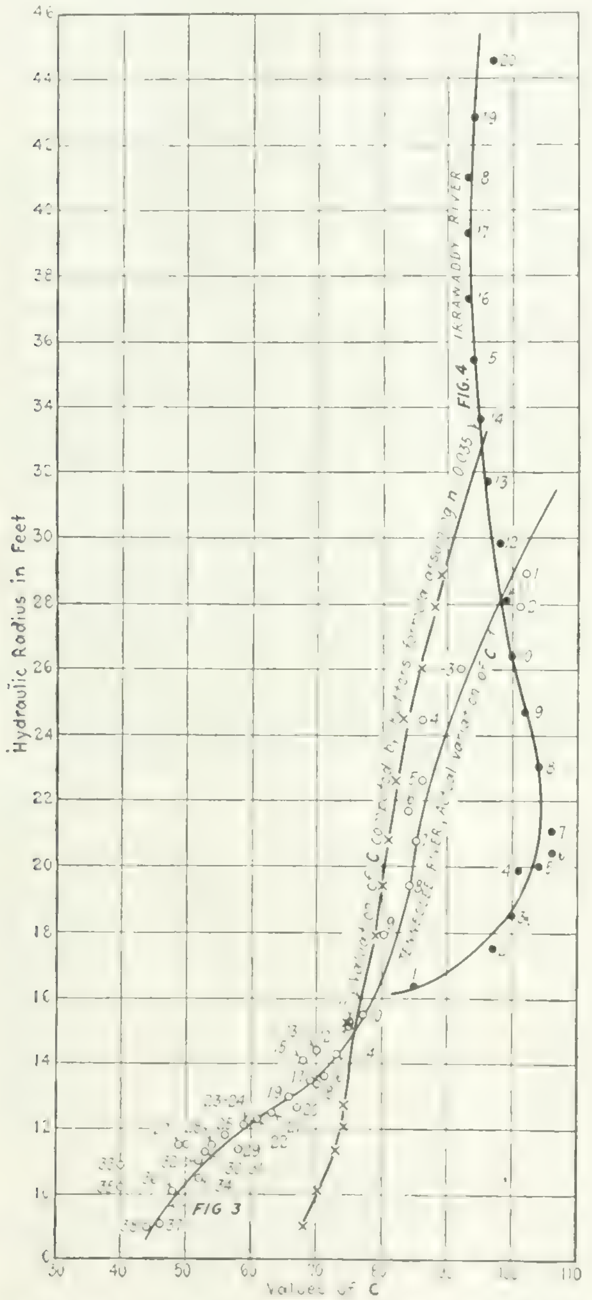
No.	Hydraulic Radius In Feet R	Slope in Ten Millionths S	Velocity, Feet Per Second V	Chezy C	Kutter n	Surface Width Feet
1	16.28	86	1.007	85.1	.0420	3,395
2	17.52	129	1.45[illegible]	97.0	.0357	3,528
3	18.49	172	1.783	99.[illegible]	.0336	3,710
4	19.88	215	2.083	100.7	.0328	3,930
5	19.99	258	2.360	103.9	.0304	4,208
6	20.40	301	2.620	[illegible]	.0292	4,605
7	21.13	344	[illegible]	[illegible]	.0286	4,780
8	22.97	387	3.091	103.6	.0293	4,820
9	24.70	430	3.321	101.9	.0300	4,859
10	26.42	474	3.548	100.3	.0306	4,899
11	28.11	516	3.771	99.0	.0310	4,938
12	29.80	560	[illegible]	97.8	.0315	4,970
13	31.68	603	4.213	96.4	.0320	[illegible]
14	33.57	646	4.432	95.2	.0325	4,982
15	35.44	689	4.652	94.2	.0330	4,988
16	37.31	732	4.874	93.3	[illegible]	[illegible]
17	39.16	775	5.110	92.8	.0337	5,002
18	41.01	818	5.382	[illegible]	.0336	[illegible]
19	42.82	861	5.717	94.2	.0327	5,025
20	[illegible]	904	[illegible]	97.0	.0314	5,045

the value of C, but this effect is not shown so conclusively as the opposite effect is shown for the lower velocities.

Measurements of the Irrawaddy River, however, indicate the same effect. For a hydraulic radius between 16 and 21 ft. on Irrawaddy River the value of C increases rapidly with that of S and R. For a hydraulic radius above 21 ft., S and R continue to increase, but C decreases slightly and then remains fairly constant. Evidently the tendency of C to increase with R for values of R above 21 is counterbalanced by its tendency to decrease with an increase in velocity due to the increase in R and S. Measurement 7, on the Irrawaddy River, which was taken about at the point where C stops increasing, was made at a velocity of 2.86 ft.

Measurements 13, 14, and 15 on the Tennessee River were made at velocities of 2.0 to 2.4 ft. a second. Hence for these two rivers it seems that for velocities up to 2.5 or 3 ft. a second an increase in S is accompanied by an increase in C. For higher velocities C tends to decrease as S increases.

Although general conclusions can not be drawn from only two sets of measurements it seems fairly certain that the slope and hydraulic radius, through their influence on velocity, do affect the value of C, and that this effect is not fully taken into account by Ganguillet and Kutter's formula.



FIGS. 3 AND 4. VARIATIONS IN C, TENNESSEE AT CHATTANOOGA AND IRRAWADDY AT SAIKTHA, BURMAH

Curves show that n and C change greatly with hydraulic radius. The difference in the shape of the upper ends of the two curves is probably due to the fact that the slope of the Irrawaddy increases with the stage, while the slope of the Tennessee decreases slightly at the higher stages.

On the Tennessee River C increased with an increase in slope for velocities below 2.5 ft. per second. For higher velocities C increased with the hydraulic radius, although the slope remained constant, or even decreased. On the Irrawaddy River C remained fairly constant, although both slope and hydraulic radius increased. A more rapid increase in slope than that on Irrawaddy River would probably cause a decrease in C.

These experiments afford no data to indicate the effect of changes of slope and hydraulic radius at low stages, when the hydraulic radius is small and when the effect of slope is generally slight compared to the effect of roughness of channel. The slope should be considered, however, in selecting the value of n when the hydraulic radius exceeds 6 ft. especially in using a value of n determined at a low stage of the stream to compute the discharge at flood stage.

At present there are very few measurements of slope and discharge covering a wide range of stage for a single stretch of channel which can be used in studying the effect of changes in stage and slope on C or n and until the results of a number of such series of measurements are obtained computations of flood discharge based on Ganguillet and Kutter's or any other formula for C are subject to any error which may result from disregarding the effect of slope and hydraulic radius on C and n. The error thus caused, though probably small in some computations, may be large in others, and all computations should be considered doubtful until more information is available.

The measurements desired could easily be made in connection with work at gaging stations, for convenient stretches of river could be selected and gages installed for use in determining the slope. After that it would only be necessary to read these gages at the time current-meter measurements were made in order to obtain the slope. It is hoped that more measurements of this kind will be made and published, for although Ganguillet and Kutter's formula is very good, engineers agree that, for flood estimates at least, it must be used in connection with slope and discharge measurements that will indicate its limitations and the modifications that may be necessary to make it fit any individual problem.

Small Contractors Clear Reservoir at Lowest Cost

The last of the clearing in the 1,800-acre area that will be submerged by the Hetch Hetchy dam in California has recently been completed and the 22,000 cords of wood cut from this area is being used for power purposes in the construction of the dam. In letting contract for the clearing work the bids of large firms who figured on the entire job were three to four times as much as the bids of individuals who contracted for clearing small areas and who gave their personal attention to the work. Contracts of the latter class covering 3- to 30-acre tracts were awarded at prices ranging from $25 to $75 per acre. In addition to the contract price an allowance per cord for wood corded at the river bank in 4 ft. lengths was made as follows: cedar, $2.50, pine, $3, oak, $4. The city of San Francisco, for whom the dam is being built, advanced these small contractors equipment and supplies from stock at the dam site, later deducting the charge from payment on the contract. Out of a total of 86 contracts only 4 were abandoned.

Rules and Regulations for Operating Iowa Sewage-Works

Recommendations of Committee of Sanitary Engineers Were Adopted by State Board of Health—185 Plants in Iowa

SEWAGE-WORKS in Iowa are supposed to be operated in accordance with a set of rules and regulations adopted as a guide recently by the State Board of Health. The rules, which are given below somewhat abridged, were written and recommended to the board by a committee of sanitary engineers composed of the following: H. V. Pedersen, John H. Dunlap, Prof. C. S. Nichols, Prof. R. S. Wallis, Lafayette Higgins, Sr., C. H. Currie and M. G. Hall. According to Mr. Pedersen, civil and sanitary engineer of the board, the rules do not cover in detail all the things that might be done for certain specially constructed plants but are meant to cover all works in a general way that are most common in Iowa. There are 185 plants in Iowa.

By-Passing—No raw or unsettled sewage shall be by-passed either at the inlet or from the siphon chamber except when absolutely necessary. Whenever by-passing becomes necessary the length of the time and the reason for it should be reported to the State Board of Health.

Grit Chambers—Grit chambers shall be flushed out or cleaned out after every storm. In time of dry weather they shall be cleaned out whenever the contents obstruct the flow of the sewage or tend to become a nuisance. Such cleaning might be necessary every week. Contents of grit chambers shall be either hauled away and buried or dried upon a sludge bed and then disposed of in the most convenient manner that will not cause a nuisance. In case the grit chamber has a system of screens, these screens shall be cleaned thoroughly every day.

Septic Tanks—The contents of septic tanks shall be kept as quiet as possible. The solids which settle out may remain as sludge on the bottom of the tank, or rise to the surface and float as gas-lifted sludge or scum, or may remain partially on the bottom as sludge and partially on the top as scum. The accumulation of scum and sludge shall not be allowed to decrease the working depth of the tank more than 25 per cent. In general the scum and sludge shall be removed at least every six months, preferably in the spring and fall, or more often if a dark, flaky substance appears in the effluent. No naked lights of any kind shall be taken into any septic tank or compartments accessory thereto.

Imhoff Tanks—Do not allow sludge to accumulate on the side-walls, bottom or any other surface of the flowing-through chamber. In removing such sludge be careful to force it entirely through the slot in the bottom and into the digestion chamber. Any sludge rising to the surface shall be skimmed off and dumped into the gas vents. Any oily material shall be skimmed off and buried. Break up any gas-lifted sludge in the gas vents frequently to release the entrained gases and allow the sludge to re-settle. Where foaming in the gas vents cannot be controlled consult your operating engineer or the sanitary engineer of the State Board of Health. Remove sludge from the bottom of the tank at least every six months, preferably in the spring and fall, or more often as conditions may demand. The removal of small amounts of sludge every four to eight weeks is frequently advantageous and is necessary if the digestion chamber is too small. Care should be taken to remove only the well-ripened sludge. Never allow the sludge in the sludge chamber to rise closer to the slot than 20 in. Make sure late each fall, when the sludge is removed, that the storage capacity of the sludge chamber is sufficient for the storage of the winter sludge. Always backfill the sludge pipe with water or settled sewage, and flush out the pipe running to the sludge bed after the sludge has been withdrawn. No naked light should be taken inside of a closed or housed Imhoff tank.

Dosing Chamber—Any appreciable amount of sludge accumulating in the dosing chamber, which will in any way find its way into the siphons and be discharged upon the filter beds, shall be removed to the sludge bed when available or be disposed of in some other effective manner so as not to become a nuisance.

Intermittent Sand Filters—Watch for wash-ins and repair immediately after they occur. Remove the sludge which gathers on the surface of the beds so as to maintain good operation at all times and thus prevent ponding. Never disturb the sand on the surface of the bed deeper than is necessary to break the scum, or sludge, and to obtain a good infiltration. Do not remove any sand unless necessary to prevent ponding. Under no circumstances shall the surface of the sand bed be plowed under or be mixed in any other way with the remainder of the sand. Keep the surface free from weeds and grass. In late fall prepare the beds for winter operation by piling or ridging the sand. Regulate the openings in the distributing troughs and pipes so as to secure a uniform distribution of sewage over the surface of the beds. Do not allow the filter beds to stand flooded. Sewage should never be passed directly to the underdrains by digging holes through the sand. Never add new sand which has not been approved by your operating engineer or by the State Board of Health. Repair a broken vent pipe immediately. Never permit a team, or heavy machine that will tend to compress the sand, to be driven over the sand beds.

Trickling Filters—The nozzles shall be kept clean so that the sewage spray may be evenly distributed. The filter medium must be kept free from surface mat or vegetable growth which may cause pooling. Distribution pipes and underdrains must be flushed out frequently so as to prevent any accumulation of putrescible organic matter.

Contact Filters—Care must be taken to see that the timed siphons, regulating the rest period, the filling and emptying period and the contact period, are working properly. Remove all the solid material or vegetable growth from the surface of the contact bed to prevent clogging or pooling. When oily matter or other difficult material clogs the contact filter below the surface it is necessary to replace the clogged filter stone with clean filter stone.

Sludge Beds—Sludge should be allowed to remain on the sludge bed until thoroughly dry. Dry sludge should be removed from the bed before more sludge is applied. In removing sludge from the bed be careful not to remove any more sand or other filter medium than is absolutely necessary.

Sampling and Testing—Fill the Imhoff conical settling glasses at the same hour each day with samples of the raw and settled sewage. After one hour read the cubic centimeters of settled solids and record them for future reference. For the relative stability tests take samples of the filtered sewage and the outlet stream below the outlet. Put about 150 c.c. of sewage in a glass stoppered bottle so that all air will be excluded. After adding with a pipette 0.4 c.c. of methylene blue solution the mixture should be kept at room temperature and should be observed regularly to determine how many days it will retain the blue color. Retention of the blue color for at least ten days is considered necessary.

General Caution—When working in manholes, or in any confined areas, around sewage-works, remember that much gas is held entrained in decomposing sewage sludge. When the pressure on the sludge is relieved from any cause, such gas may escape from the sludge in quantities sufficient to cause asphyxiation and may cause death in extreme cases.

Missouri-Kansas Water-Works Tax Treaty

A treaty between the states of Kansas and Missouri designed to facilitate the construction of new water-supply works for Kansas City, Mo., has been ratified by Congress. The treaty mutually exempts from taxation water-works improvements extending from one of the states into the other.

Municipal Improvements Society Discusses Many Problems

Abstracts from Papers on Separate Systems for Sewers and Storm Drains and on Garbage Disposal, and Committee Report on Street and Sidewalk Design, Read at Cleveland Oct. 2-6

Use and Abuse of Systems of Separate Sewers and Storm Drains

By Harrison P. Eddy
Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

SEPARATE sewers with few or no storm drains has become common practice in small communities and somewhat prevalent in the larger cities. This has been based, generally, on either real or fancied economic necessity. As it is rather unusual to make complete accurate estimates of cost of the two systems under consideration it may add interest to illustrate the subject by a case in which three plans were designed complete and estimates of cost of all three systems were based upon the lowest bid of contractors upon one of the systems. Estimates of cost of the three projects are given in the accompanying table:

COMPARATIVE ESTIMATE OF COST SEWERS UNDER THREE PLANS

	Cost of Sewers or Sewers and Drains	Cost of House Connections: Work in Streets	Work in Private Property	Total Cost
Combined sewers	$476,625 (72.7%)	$56,425 (8.6%)	$122,600 (18.7%)	$655,650 (100%)
Separate sewers and partial system of storm drains	$477,700 (68.7%)	$80,125 (11.6%)	$140,900 (19.7%)	$698,725 (100%)
Separate sewers and complete system of storm drains..........	$524,850 (67.2%)	$90,280 (11.6%)	$164,900 (21.2%)	$780,030 (100%)

The estimates indicate that under the conditions of this case the combined system would be substantially cheaper than the system of separate sewers and a partial or incomplete system of storm drains, and considerably less expensive than the complete systems of separate sewers and storm drains.

Causes of Misuse of Separate Sewers and Storm Drains—The principal causes of the misuse of separate sewers and storm drains may be grouped in six classes as follows:

1. Ignorance of the purpose and objects of the sewers, due to lack of proper instructions from those designing the systems, or to frequent changes in administration, or to the loss of records and drawings.
2. Indifference of municipal officials.
3. Lack of authority to enforce suitable regulations.
4. Favoritism or "pull" has undoubtedly played an important part in permitting the making of incorrect house connections.
5. Surreptitious connections. In many cases, particularly in times of high cost of construction work, building owners undertake to make certain improvements or repairs directly, or through the employment of journeymen mechanics.
6. In a relatively few instances misuse has undoubtedly been due to incorrect connections made through error.

Remedies for Misuse of Separate Sewers and Storm Drains—Great care should be exercised in the selection of the type of sewer system to be installed. It should not be assumed that separate sewers are more advantageous, but conclusion should be reached only after careful study of all the conditions including comparative estimates of cost. In making such studies due weight should be given to the value of the opportunity for disposal of roof water into sewers and to the inequity of affording such facilities to a portion of the property owners and withholding them from others. It may be accepted as a fact that residents will not tolerate standing water in their cellars. In thickly settled communities water cannot be allowed to flow over sidewalks to the street gutters, and, at least in the northern portion of the country, roofs and areas cannot satisfactorily be drained into gutters by pipes passing under sidewalks. Topography, character of soil, climate, present and prospective density of population, frequency and intensity of precipitation, as well as conditions influencing the problem of sewage disposal, are among the important considerations bearing upon such a selection.

Discussion—A. P. Folwell, New York City, summarized the results of a questionnaire on the control and abuse of sewer connections, which showed much diversity of practice as to the admission of street and roof water to sanitary sewers and also as to the admission of industrial wastes to sewers. T. C. Hatton raised a point as to conditions found by cities that annex or without that provide sewerage facilities for outlying districts, such as no exclusion of roof water from sanitary sewers. A speaker said that two-thirds of Lancaster, Ohio, is sewered on the combined plan and the State Department of Health refuses to grant permits for extensions except for separate sewers. This means increased assessments over those heretofore made, with resulting complaints from property owners. S. A. Greeley said he knew of a half dozen towns with populations of from 10,000 to 40,000 where sewer extensions are at a standstill because existing sewers are overcharged and those on these sewer lines protest against further overcharging.

Some Garbage Disposal Troubles and Remedies

By Samuel A. Greeley
Of Pearse, Greeley & Hansen, Consulting Engineers, Chicago, Ill.

REFUSE collection and disposal in American municipalities has been characterized by some well informed observers as a mess of mistakes. They see a wide variety of disposal methods in use and in some cities apparently abrupt changes from one method to another, sometimes involving the abandonment of seemingly useful and expensive going plants. They see large and costly disposal works built and operated for a few years and then abandoned to gradual disintegration. The city engineer of Gary writes that "our incinerators have been out of service for seven years and would have to be rebuilt to make them serviceable." Los Angeles, after seven years operation of a garbage reduction plant, has abandoned it (at least for the present) in favor of hog feeding. Baltimore, after a few years of hog feeding for garbage disposal, has turned again to reduction; and Buffalo, with hog feeding established for a while has recently taken bids for incineration [of material rejected by pigs; tentative project—Editor]. The large reduction plant at New York and a group of incinerators at Seattle, have all been abandoned, New York dumping at sea and Seattle dumping on land in "sanitary fills."

Fundamental Considerations — If service to householders and proprietors be held of first importance, with economy of operation following closely, then the disposal of refuse is of somewhat less importance than the collection service.

Much has been accomplished through motorization, as at Los Angeles, Montclair, Minneapolis and elsewhere, although final economies are not yet established. Further progress toward economy has resulted through the use of the tractor-trailer and the establishment of transfer stations which permit the decrease of the expensive collection haul with an increase in cheaper quantity haul.

A Yard Stick for Haul—Let me assume that a collection unit of two men can make collections of house refuse at the rate of 75 pick-ups per hour. If the unloading point is so located as to require four hours of haul, each such collection unit will serve around 300 houses per working day. If the team haul be reduced to three hours, the number of pick-ups (or houses served) will be increased to 375 per day.

In larger cities, the team haul can be supplemented by quantity haul. If the team haul (averaged with collection service) costs $4.50 per ton, quantity haul may cost only a third time as much or about $1.50 per ton. What then is the economical relation between team haul and quantity haul? Obviously this can only be determined after a careful study of all the local conditions, including the rate of collection work, the travel of teams and motors, the available locations for transfer stations, the life and location of dumps and disposal plants, rates of wages and other similar considerations. But the yard stick for haul is the number of houses to which collection service can be given by a unit of collection and haul equipment.

Wha About Failures—As commonly considered the term "failure" as applied to refuse disposal projects, refers to the abandonment of a finished disposal plant representing invested capital and ready for operation. If a considerable sum of public money is put into the works and these works are not used but are allowed to disintegrate, something is certainly wrong. Such upsets, however, are not the real failures. They are the symptoms of a deeper trouble. I offer for your consideration some of the causes of these upsets and plant abandonments as follows:

1. A failure, in the first place, on the part of city officials, to appreciate the true measure of a refuse disposal project. Communities should understand that the first objective is clean houses, with the construction of a disposal plant second.
2. A failure to secure and adopt a general plan for all the refuse disposal work, including proper ordinances and kitchen cards, collection equipment and management, transfer stations, hauling equipment, dumping facilities, etc.
3. Failure to profit by co-operation with experts of independent judgment who can bring to the local problem the helpful experiences of other situations.
4. Failure to operate disposal works with reasonable skill and economy.

* * *

Report of Committee Upon Street and Sidewalk Design

BY E. R. CONANT, G. A. CRAYTON AND S. Q. CANNON

IT MIGHT be said that only of comparative recent date has the subject of street and sidewalk design been attempted in a scientific manner, for comparing the answers to the committee's questionnaire it is noted that in older cities, with the exception of recent layouts, street design is far behind that in the newer cities.

Widths of Roadways—Replies to the question on this subject show conclusively that the width of roadways should be based on the number of lines of traffic to be accommodated and while but a very few cities report that they give consideration to the density of traffic to aid them in establishing the necessary number of lanes, yet the Committee feels that a study of the present and prospective amount of traffic is very important.

Traffic Lane Widths—Analysis of the replies received would indicate that for each line or lane of traffic a width of from 7 to 8 ft. is necessary for motor vehicles parked at the curb and from 8 to 10 ft. for vehicles moving, with a somewhat greater average width in business than in the residential sections. Space for street car tracks should be from 8 to 9 ft. for single and 18 to 20 ft. for double track.

Alleys—In a city laid out on the rectangular system, alleys are of special value, since in them may be placed sanitary sewers and unsightly poles. Alleys also afford access for deliveries to residences, for the collection of garbage and rubbish and to garages on the back of lots. Alley widths should not be less than 18 ft.

Width of Sidewalks should be determined by the intensity of traffic. From the replies received it appears that the best practice is a width of from 5 to 6 ft. for residential sections, and from 10 to 15 feet for business sections.

Grass Plats afford space for trees, poles and hydrants and widening of the traveled roadway without the acquisition of additional land. Where trees are planted, grass plats should not be less than 5 ft. wide. A number of cities allot from 1 to 2 ft. of grass space between the sidewalk and the property line, when the grass plat is next to the curb.

Safety Zones—The general practice is to paint the pavement with lines which designate the area or zones where vehicular traffic must give way and look out for foot traffic. These lines may mark zones where street cars stop or they may mark crossings for foot traffic from one sidewalk to the other. The zones where street cars are approached are usually 6 ft. in width and of proper lengths and a safety walk from the middle of the zone to the sidewalk on the side of the street where zone is marked off is advantageous. In a number of cities a 4-in. platform of plank or concrete is constructed. In other localities posts or stands connected with ropes are installed.

Sidewalk Crossings—There is a tendency to get away from the step at the curb to the street at street intersections, especially where the foot traffic is heavy. Such steps should not exceed 6 in.

Radii of Curbs at Street Corners—Before the introduction of the automobile and motor trucks, a 6- or at most 8-ft. radius curb was considered adequate. Under present conditions in new layouts the radius of the curb in residential sections should not be less than 10 ft. In business sections, from 10 to whatever limit can be introduced according to width of sidewalk and roadway. For alleys, 5 to 6 ft. radius is sufficient.

Catch Basin Inlets—Catch basins should be connected directly to the sewer at the manholes, by means of an individual pipe. They are generally located at street intersection, but where necessary to increase the number intermediate inlets may be located in the middle of the block. Modern practice provides for the entrance of the water into the catch basin through [ungrated] openings either cut out of the curb or better through openings in castings set in the sidewalk flush with the curb.

Street Crowns—Generally the grade varies directly with the width and inversely as the function of the grade of the street. A quite general practice is to fix the crown from 1/60 to 1/100 of the width, depending on the grade and character of service. Analyzing the answers to our questionnaire, the following appears to be the general practice where grades of streets are normal and where the surfacing of the pavement is concrete, brick, bituminous or surfacing of light nature: For street width of 20 to 22 ft., the amount of crown 4 in.; 24 to 28 ft., 5 in.; 30 ft., 5½ in.; 32 to 42 ft., 6 in.; 45 ft., 7 in.; 48 to 52 ft., 8 in. For rough surfaced streets, such as granite block, the crown should be increased from 20 to 25 per cent; for macadam or gravel, 50 to 75 per cent; and where the grades of the street exceed 4 per cent the amount of the crown can be reduced in proportion to the grade, from 20 to 40 per cent.

Gutters—Where very flat grades are encountered the slope of the gutter is often made much steeper than the general crown of the street and in a number of instances cited the slope may be as heavy as 1 to 3 in. to the foot.

Lamp Posts, Poles and Hydrants—In many cases poles, hydrants or posts are set just back of the curb but a better practice would be to have them set back from the curb a sufficient distance so that vehicles in parking will not hit them. This need not be more than 1 or 2 ft.

Discussion—Of the 23 committee reports and papers on streets, pavements, and sewers listed for the two sessions on Wednesday this by Mr. Conant was the only one that elicited much discussion. Several speakers favored direct inlets to storm sewers rather than catch basins, except for special conditions. Radii for curbs at corners received considerable attention, with special attention to the needs of automobiles. Two or three advocated compound curves at these corners, particularly at intersections of wide and narrow streets. A width of 20 ft. for alleys was urged by one speaker, and a concave section instead of a crown for alleys was reported by two members. Related to this general subject was a paper on Crowns of Streets and Highways, by G. A. Crayton, Pierre, S. Dak., who proposed a low crown composed of two straight lines from the curb to near the center, joined by a short curve.

Engineers Discuss Licensing

Letters Commenting on Editorial Discussion Published in Engineering News-Record July 6

With this installment is concluded the publication of comment on the editorial discussion of licensing that appeared in the issue of July 6. Other extracts from the letters that have reached us on the subject appeared in the issues of Aug. 31 and Sept. 21.—EDITOR.

George F. Swain

Consulting Engineer; Professor of Civil Engineering, Harvard Engineering School; Past-President, Am. Soc. C. E.

I entirely agree with you that the question of licensing is a public, and not a professional question. Furthermore, I have always been opposed to laws requiring the licensing of engineers. I think we have too much legislation anyway and if we would let things alone we should get along much better. Many people are being led to think that the legislature can cure almost any evil, but it is a fallacy.

I can see no public good that would be accomplished by licensing engineers. The qualifications of a man cannot be prescribed in a way to do justice. Licensing would not, in my opinion, promote public safety. Most of our states already have public commissions dealing with the various functions in which engineering is applied, such as public utilities, public health and building construction. The commissions dealing with those subjects are empowered to employ engineers and they do so. We do not need any more protection.

Licensing would simply complicate matters. An engineer practicing in different states would be obliged to obtain a license in each state. Those who grant the license, or who pass on his qualifications would, in many cases, be far inferior to the applicant himself. No rules could be made which would cover this matter adequately and justly. No diploma from a technical school is a guarantee of ability to construct safely and properly, nor is membership in any engineering society.

I entirely agree with your second principle that if the state undertake to vouch by license for the technical qualifications of an engineer, it should define accurately the type of engineering work it has found him competent to undertake. I do not think, however, that the state, or any state examiner, or any rules that can be formulated would insure the competence of those who might receive a license.

I also agree entirely with your third principle that any licensing requirements should apply to those engineers only who are called upon to bear ultimate technical responsibility. I also agree with your fourth, fifth and sixth principles. Indeed, I think you have covered the subject very well in your editorial.

It would be apparent from what I have said that I lay the main stress on your fourth principle, that licensing is not required for the protection of the public.

I may add that I believe that most of the agitation in favor of licensing originated in the selfish desire on the part of some individuals to promote their own individual prospects. I feel very sure that if licensing is practised, many engineers would be licensed and will obtain engineering work, who would not otherwise be called upon to do that work. They will obtain a fictitious guarantee of ability which will deceive rather than protect the public.

Charles M. Spofford

Consulting Engineer; Professor of Civil Engineering, Massachusetts Institute of Technology, Boston, Mass.

The editorial in your issue of July 6, entitled "A Rational Approach to the Licensing Problem," presents the subject of the licensing of engineers in an illuminating manner and with conclusions that seem inescapable.

Experience in Massachusetts, where a licensing bill was introduced into the legislature in the 1920-21 session, indicated, to put it mildly, no urgent demand on the part of the public for its passage and the committee to which it was referred did not think it necessary to report the bill. The writer has seen no indications that as yet either the public or the engineers of Massachusetts have suffered from the lack of such legislation.

It is to be regretted that the American Engineering Council in its recent report neither reached a conclusion upon the wisdom of licensing nor set forth the fundamental issues with the clearness displayed in your editorial.

Kenneth H. Osborn

Secretary, The Osborn Engineering Co., Cleveland, Ohio

I have read over the editorial discussion entitled "A Rational Approach to the Licensing Problem," published in your issue of July 6, and found it very interesting.

In it I find clearly stated a great many of the ideas on the subject of licensing that have always been in my thoughts when this subject was under discussion. I feel that you have brought out quite clearly the shortcomings of the licensing idea and the defects which are likely to be present in any licensing law. Although I have listened to considerable discussion on the subject of licensing and realize that there is a very strong sentiment in its favor, I have never been convinced that there was anything to be gained by a license requirement, and from my own experience I feel that it is little more than a nuisance to the engineer who practices in several states. I fail to see where either the public or the profession has gained anything by the proceeding.

I find a number of engineers who favor the enactment of license bills simply with the thought that if they do not pass one satisfactory to the engineer, either through the architects or through the work of state legislatures, who have not studied the problem, bills will be enacted which are unsatisfactory to the engineer. Since I am not in favor of such bills at all I feel that a better attitude is simply to watch the state legislatures to see that no unsatistactory bill is passed rather than to insist on the passage of one which is considered unnecessary.

W. H. Courtenay

Chief Engineer, Louisville & Nashville R. R., Louisville, Ky.

The editorial is the best discussion of the subject that I have seen, and the six principles which are formulated in it are good. I particularly concur with the first principle that licensing must be justified wholly on the grounds of the public welfare, and not at all on that of professional advantage.

So far as my information goes the greatest activity in an effort to prevail upon state legislatures to pass laws requiring that engineers be licensed has been by engineers, and in their interest, and not in the interest of the general public.

Large public service corporations, many of which have property of value in a number of different states, have engineers continually in their employ. These corporations can be relied upon to employ men, responsible for the engineering work done, who are competent, and who have the work done with reasonable economy, for such corporations are vitally interested in the safety of their structures and in avoiding wasteful methods.

It is very questionable whether legislative requirement that engineers be licensed before they can practice engineering is productive of any beneficial results.

George Gibbs

Consulting Engineer, New York.

I have read the editorial discussion on licensing which appeared in *Engineering News-Record* of July 6, with a great deal of interest. It seems to me to cover the subject

admirably. I have never been in favor of the form of licensing which has been adopted in our state, and in general my reasons for objecting to it are the same as you so well bring out in your editorial.

In lieu, therefore, of writing a dissertation on the subject, I would endorse the summarized principles of the editorial of July 6, except, perhaps, for Number 3, which I think will be difficult to incorporate in a practical way in the license. "Technical responsibility" is rather a loose term and varies enormously in degree with the character of the job and the form of administration.

* * *

Morris Knowles
Consulting Engineer, Pittsburgh, Pa.

Everyone seems too prone to leave the solution of so difficult and abstruse a subject to someone else. Many of us have been willing to drift with the tide and accept that which seems to be the inevitable, viz., that licensing will come and so try not to stem the stream but direct the current. It has needed an editorial such as that appearing in the issue of July 6 to arouse the thought of the profession, and the wonder is that so few are aroused. We have for a long time needed the clear-cut expression of fundamental principle.

There ought to be a general agreement with most if not all of the principles stated in conclusion. There can be no doubt, however, that licensing, if to be justified at all, must be upon the ground of public welfare. But in most discussions this seems to have been forgotten and clannish or group advantage—even approaching trade unionism—seems to have predominated in actual sentiment, even if still covered up in the submerged undercurrent of thought. It is a fair question, however, whether public health, safety and welfare are not better conserved and protected, after all, by the effective and wise administration of just and adequate laws prescribing results and limiting conditions, rather than by placing the sovereign seal of approval upon personal fitness and judgment by some form of licensing.

Your analysis of the differentiation of the professional engineer from the doctor and lawyer is apt and to the point. Certainly the doctrine of *caveat emptor* applies more in the case of the former than for the other learned professions. Again the suggestion that licensing should be a requisite, if at all, for principals and not for subordinates, is a point well taken. And the need for definition of abilities in selected and even narrow lines is quite apparent; for the title "Licensed Engineer" conveys no information as to special ability and fails to indicate whether the licensee is equally qualified to direct the construction, of either a rolling mill or a filter plant.

Your editorial has performed a real service and it is to be hoped that it will stimulate thought, discussion and action.

Bulk Cement Deterioration Less Than in Bags

Deterioration of cement stored in bulk is less than in bags, owing to the smaller area exposed, according to Serial 2377, published by the U. S. Bureau of Mines. The conclusion is the result of an investigation to determine the cause of deterioration of portland cement during storage and transportation. Hydration takes place only at the exposed surface, and the bulk of the cement is unaffected. Cement transported in bulk must be shipped in a tight, closed car, and must be protected from moisture during loading, shipping, and unloading, preferably it should be used immediately after unloading at the point of destination. This practice is now followed by several manufacturers and where conditions are suitable it is becoming more common as its advantages are seen. Shipping in bulk effects a saving by eliminating the use of bags—which is an important item in the cost of cement—and it should also permit a saving in freight rates.

Colorimetric Test for Concrete Sand Studied

Limitations Found in the Standard Test for Organic Impurities in Studies by Bureau of Public Roads

By Charles E. Proudley
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There is no doubt that much harm is sometimes done by the presence of certain organic impurities in concrete sands, but the reliability of the present colorimetric method of indicating such impurities (Am. Soc. T. M. Standard C 40-22) is a matter subject to varying opinions. The many organic substances which may occur in sand and gravel deposits, their individual or collective influence on the behavior of these materials in portland cement mixtures and their peculiar reaction with the test reagents are subjects which cannot be considered here. Suffice it to say that any difference between the character of the substances is very difficult to determine and that all substances do not act alike on the sand mortars.

During the past few years the Abrams-Harder colorimetric test has been made on a great number of sands received by the Bureau of Public Roads testing laboratory from practically every section of the United States. For the purpose of this article 160 normally graded sands were selected, that is, sands which according to general observations should give a mortar strength at least equal to standard Ottawa sand briquettes. Their gradings were within the following limits:

Total retained on:	Per Cent
20-mesh	20-50
50-mesh	50-90
100-mesh	95+

A complete description of the colorimetric test as made on these sands and the color scale with which comparisons were made is given in the *Proceedings* of the American Society for Testing Materials, Vol. XIX, Part I. The strength ratios were found in the usual manner, a description of which may be found in U. S. Department of Agriculture Bulletin 949. With the results of these tests, the sands were classified according to color plate number and change in strength ratio from 7 to 28 days of the various materials.

TABLE I—APPARENT EFFECT OF ORGANIC MATTER ON STRENGTH RATIO AT 7 DAYS

Color	Strength Ratio Over 100%	Strength Ratio Under 100%	Total
Plate I	33	3	36
Plate II	42	5	47
Plate III	30	11	41
Plate IV	12	11	23
Plate V	11	2	13
	128	32	160

It will be seen in Table I that of the total number of sands considered (160), there were only 32 which failed to show 100 per cent strength ratio. Realizing that the character of the sand particles frequently influences the strength, each of the sands was examined and wherever feldspar or other minerals generally considered weakening were found they were noted. It is quite interesting, therefore, to observe from Table II that 56 per cent of those below 100 per cent contain objectionable minerals, whereas less than half that amount is found among those of higher strength ratio.

This, no doubt, accounts to some extent for the low strength shown by some of the sands regardless of the organic matter.

By reference to the color plate previously mentioned, it will be seen that when sand solutions show colors equal to or darker than Plate 3, they are not recommended for use in concrete. Since this is the practical dividing line between supposedly good and bad sands, let us consider it as giving us two grades, light colors, satisfactory, and dark colors, doubtful.

Considering first, then, Table I, it will be seen that 83 (52 per cent) of the sands show satisfactory color and the other 77 (48 per cent) are subject to doubt but it will be further noted that of the 83 "good" sands, eight are low in strength, and of the 77 "doubtful" sands 53 (or 69 per cent) really are satisfactory. In other words, it is much more likely that a satisfactory sand will be rejected by this test than that an unsuitable sand will be recommended. In this respect the test is a fairly safe one.

TABLE II—SANDS OF DOUBTFUL QUALITY AMONG THOSE TESTED

Color	Above 100 No.	Above 100 %	Under 100% No.	Under 100% %
Plate I	7	21	1	33
Plate II	11	26	4	80
Plate III	7	23	8	73
Plate IV	3	25	5	45
Plate V	2	18	0	0
	31	24	18	56

The full effect of organic matter is not always reached within 7 days, however, as is sometimes brought out by the appearance of a reduction in strength ratio from 7 to 28 days. The reduction or increase in strength ratio from 7 to 28 days of sands exhibiting different colors is shown in Table III.

The percentage of samples showing increased strength ratios beyond the range of probable error in testing is practically negligible and so those in which considerable decrease occur only need be considered. From Table III it appears that more of the sands decreased in strength ratio than remained constant, thus showing that a certain amount of consideration for the possible reduction in strength ratio at 28 days should be given.

If, then, we have a well-graded sand and make a color test for organic matter upon it and find that the color is similar to Plate 1 or 2, the chances of the strength ratio decreasing are about equal to that of its remaining constant, while if it is darker than Plate 3, the probability of a lower strength ratio at 28 days is about three to two.

TABLE III—APPARENT EFFECT OF ORGANIC MATTER ON STRENGTH RATIO FROM 7 TO 28 DAYS

Color	Strength Ratio Decrease	Strength Ratio Constant	Total
Plate I	13	23	36
Plate II	28	19	47
Plate III	23	18	41
Plate IV	13	10	23
Plate V	10	3	13
	87	73	160

Occasionally, one will find mineral salts in sands which act either detrimentally or as an accelerator and these substances will not show up with the caustic soda solution. This, of course, causes the test to fail completely in its ultimate purpose and reliance must be made upon other physical tests. For this reason if no other, it should be said that overconfidence in the colorimetric test must be avoided.

An important point not to be overlooked, however, is the peculiarities of the district from which a sand comes. Large areas are sometimes supplied with materials which, if use depended upon the indications of organic matter, would never build concrete roads. As has been pointed out, there are many sands of good quality showing a dark colorimetric test. On the other hand, there are regions in which a testing engineer can safely prophesy the tensile strength ratio by reference to mechanical analysis and color. Still others never find organic matter in their sand even though they experience the usual difficulties with the strength. Thus, the dependability of the test is best judged by those who use it according to the circumstances involved.

The greatest value of this test is felt by the prospector who is searching in new territory or examining unfamiliar materials. Then with the aid of a few observations about the source of supply, such as whether it is a pit or a river material, amount and character of overburden or location of stream and character of pollution, this information with the organic matter test as a check would form a sound basis for preliminary reports, provided the size and quality of the sand grains appeared satisfactory.

Excellent use may also be made of this test in the control of materials on the job or at the source of supply. If the organic matter test means anything whatsoever in the particular instance, it could be made to check up such details of production as stripping and washing. A darkening in color would indicate that organic matter was increasing and that materials and operations should be investigated.

In general, it can be said that the colorimetric test for organic impurities as made at present on concrete sands gives only an indication of where trouble might be expected and, as intimated above, should not be used as a positive factor in judging sands except in those localities where experience has shown it to be of undoubted reliability.

Study Inundation Method of Measuring Sand

Reports from the Bureau of Standards state that it has started an investigation to determine the feasibility of measuring sand for concrete in an inundated condition. This is in continuation of the studies made by R. L. Bertin, reported in *Engineering News-Record*, June 22, 1922, p. 1047. The Bureau of Standards notice on the subject reads as follows: "With small additions of moisture to sand, the sand swells, that is, the volume occupied by a given quantity of sand increases, and this increase sometimes reaches an amount as large as 38 per cent of the original volume. Conversely, the quantity of sand in a measure of given size varies greatly with the amount of moisture in the sand. This fact makes it difficult to insure the same proportion between sand and cement in successive batches of concrete because the percentage of moisture in sand varies greatly from time to time. Preliminary investigations have indicated that if the vessel in which the sand is measured contains sufficient water to submerge the sand, the same quantity of sand can be placed in the vessel regardless of the quantity of moisture originally obtained. The investigation is to determine whether the measurement of sand inundated will effect uniformity in the proportioning of sand to cement and consequently uniformity in the strength of the concrete. An affirmative answer to this question would mean the solution of one of the most troublesome problems in the concrete industry."

Greenheart as Teredo Resistant on Panama Locks

Experience Indicates that Shipworm Will Thrive in Timber Generally Held to Be Highly Resistant to Its Attack

By C. J. Embree

Office Engineer, the Panama Canal, Balboa Heights, C. Z

EXPERIENCE on the structures of the Panama Canal has not borne out the estimate of the value of greenheart as a teredo-resistant contained in the following definitions:

> "Greenheart—A valuable timber tree * * * remarkable for being almost exempt from the attack of white ants on land and of the teredo in water. * * * *"
>
> *New International Encyclopaedia*

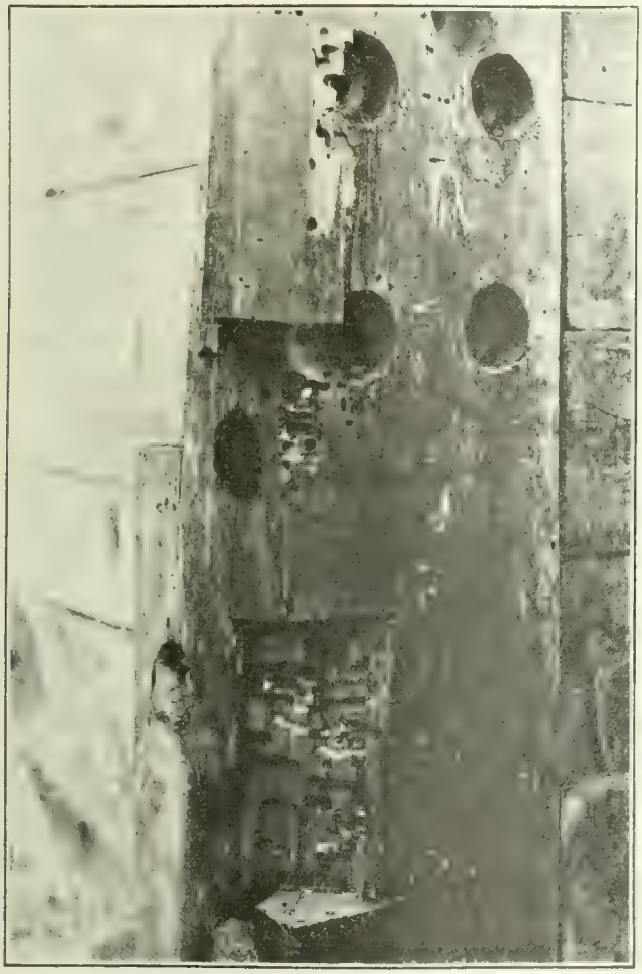


FIG. 1. END OF MIRAFLORES REGULATING VALVE
End view of valve shown in Fig. 2. This valve was installed in the brackish water of Miraflores Lake, 54 ft. above sea-level.

> "Greenheart—One of the most valuable timbers * * * and its value is greatly enhanced by the fact that it is proof against the ravages of many marine borers which rapidly destroy piles and other submarine structures * * * *"
>
> *Encyclopaedia Britannica*

When the Panama Canal lock structures were being designed it became necessary for the engineers to select some kind of timber that would be practically proof against the attack of marine borers such as the teredo Naturally they turned to some of the better known woods used in lock-gate and ship construction, among them being teak wood and greenheart, which are rated by Lloyd's, first and second respectively. Before determining the kind of wood to be used, an investigation was made referring to as many authorities as possible. Among these were: "Greenheart Timber," by P. M. Moir, *Van Nostrand's Magazine*, Vol. 1, 1869; "Timber in Marine Works," by C. Graham Smith, *Engineering News*, April 5, 1879; "Timber and Timber Trees," Thomas Laslett, 1894; "Construction Woods of British Guiana," by L. M. Hill, *Proceedings Inst. C. E.*, Vol. 147; R. Hammersley-Heenan, *Proceedings Inst. C. E.*, 1897; "Greenheart de Demerara," published by Nouthandel vorheen G. Alberts Lzn & Co., Middleburg, Holland, 1904; G. Lacy-Good, *Proc. Cape Soc. C. E.*, Vol. II, 1905; R. Devenish-Mears, *Proc. Cape Soc. C. E.*, Vol. II, 1905; "Timber," by J. R. Baterden, Van Nostrand & Co., N. Y., 1908; "Wood," by G. S. Boulger, Ed. Arnold, London, 1908; "Some Data on the Resistance of Demerara Greenheart," by Houthandel vorheen G. Alberts Lzn & Co., Middleburg, Holland, 1910; Lieut. Col. Bailey; *Trans. Royal Scottish Arboriculture Soc.*, Vol. XXIII, Part II, 1910; "Greenheart," trade pamphlet published by Sprostons, Ltd., Georgetown, Demerara, 1912; also correspondence with various American consuls, foreign engineers, and handlers of timber in Demerara.

As a result of the investigation made at that time, the following facts were determined regarding greenheart. The specific gravity of the wood varies from 1.08 to 1.23, equivalent to 67.5 to 75 lb. per cubic foot. The heaviness of the wood seems to increase as the predominant hue deepens. It is also considered that the quality of the wood varies directly as the predominant hue of the timber, that is, the darker the wood, the higher the quality. The sapwood is not resistant to marine wood borers and should be removed when possible from timber exposed to their attacks. The shipworm and crustacean borers undoubtedly attack greenheart, but in the Netherlands, for instance, the attack does not proceed deeper than $\frac{3}{4}$ in., and ordinarily less. The wood is supposed to posses a poisonous character, rendering care necessary in working it; and this quality seems to be the basis for the belief that the heartwood softens the calcareous lining of the teredo's burrow, destroying the mollusk.

Reports on the use of greenheart timber in the tropics seemed to indicate that it would have considerable life. Some of these were as follows:

In Trinidad, W. I.: 15 years against the teredo. (American Consul, Trinidad, 1912.) At Georgetown, Demerara: 20 to 25 years against the shipworm. (American Consul, Georgetown, 1912.) At Bombay, India: Gates of Prince's Dock opened January, 1881, removed and replaced once. Steel gates now installed. At Calcutta, India: Kidderpore Docks; timber jetty approaches driven in 1890. After ten years many timbers reduced from a diameter of 14 in. to a diameter of 8 in. (*Proceedings Cape Soc. C. E.*, Vol. II, 1905.) South America: Firms handling greenheart admit that it together with all timbers is destroyed by marine borers.

As a result of the investigation outlined above, it was believed that greenheart would be the best timber that we could use. The locks and gates are fed by

fresh water in Gatun Lake, the lock structures being about seven miles inland from the ocean. In 1915 it was decided to install some regulating valves, and greenheart timber was used, as the valves would be subjected only to a velocity head of water and no trouble had been noted with the greenheart sill timbers. The valves were installed in May, 1917.

In 1918 and 1919 it was noted that the sill timbers were being pitted but it was not thought that this would prove serious. Later, in 1920, 20 per cent of the sill timbers were taken out at Miraflores Locks, as it was found that they had been attacked by teredo. Samples of the teredo were taken to James Zetek, entomologist for Ancon Hospital, for identification, and they were advised that they were probably of the species Xylotrya, but that he wanted to forward them to Washington to have them examined. Dr. Paul Bartsch, curator of marine invertebrates, U. S. National Museum, declared them to be a new species which he called "Bankia (Neobankia) zeteki," a scientific description of which will be found in the *Proceedings of the Biological Society of Washington*, March 31, 1921, p. 26.

During the past year about 41 per cent of the sill timbers were removed at Miraflores Locks and replaced with a native timber known as Almendra, which has the physical characteristics of greenheart (strength) but which we know will be attacked by marine borers. This timber has been used because it can be obtained locally and we hope that it will have at least the life of greenheart, whereas it is far less expensive.

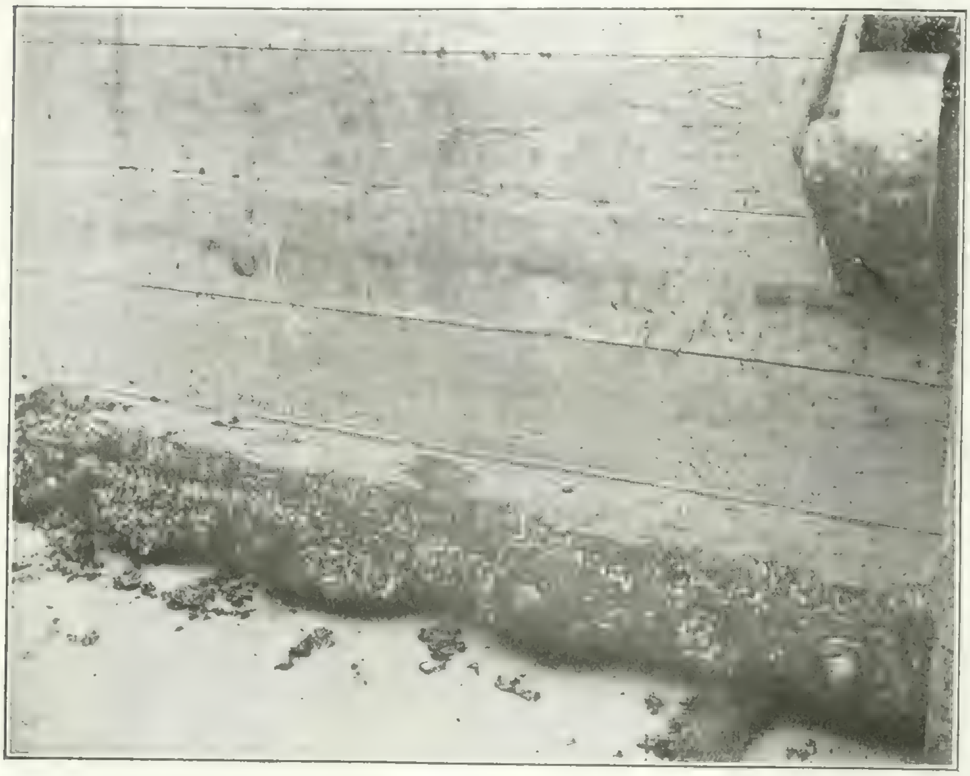


FIG. 2 FRONT OF MIRAFLORES REGULATING VALVE

These valves and those at Pedro Miguel Locks were practically destroyed by teredo although made of greenheart and submerged in water 54 ft. and 85 ft. above sea-level

Fig. 1 shows one end of a regulating valve removed from the upper end of Miraflores Locks in April, 1922. Fig. 2 shows the front of the same valve, on which it will be noted that the attack of the teredo is considerably advanced on the lower timbers, and that there are surface indications that the shipworm has practically destroyed the valve proper. This was proved to be a fact when some of the timbers of the valve were broken up. Fig. 3, pieces *C* and *D*, are are also part of the regulating valves. These illustra-

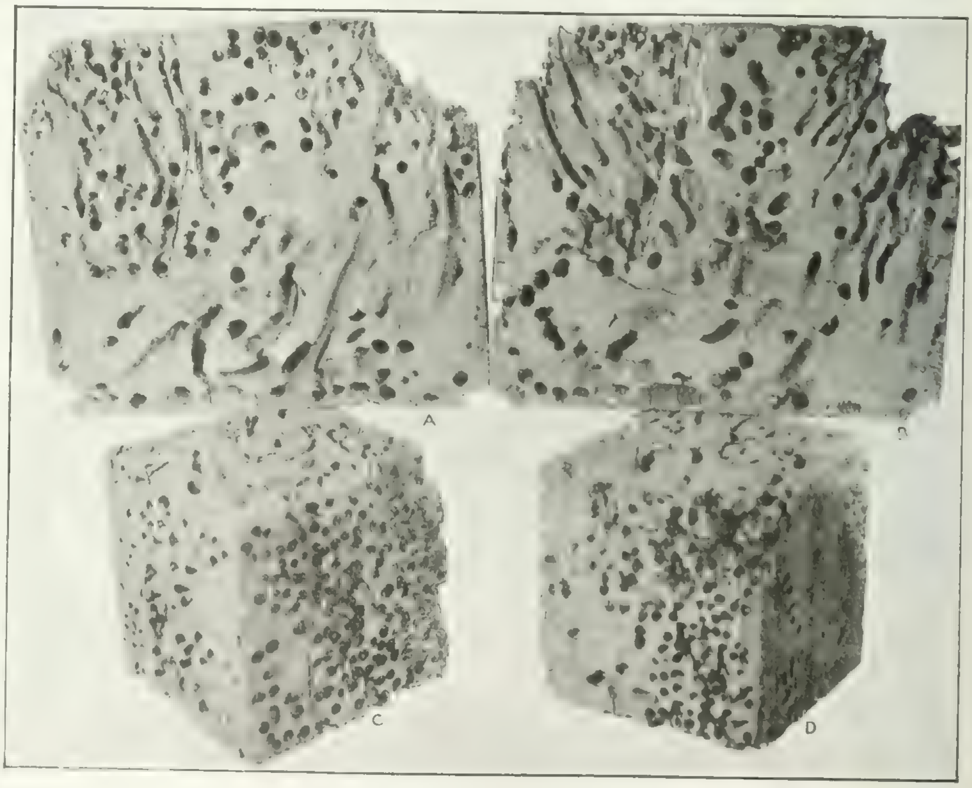


FIG. 3. SECTIONS OF GREENHEART HONEY-COMBED BY TEREDO

Pieces A and B are sections of Miraflores lock-gate timbers installed in January, 1914, and removed in March, 1922. Pieces C and D are parts of greenheart regulating valves shown in Figs. 1 and 2.

tions indicate plainly that the worm has destroyed the valves. It is also known that the regulating valves at the upper and lower ends of Pedro Miguel Locks will have to be removed and replaced with steel valves.

In Fig. 3, pieces *A* and *B* show sections of one of the lock gate sill timbers originally installed in January, 1914, and removed in March, 1922. The timber shown was part of the intermediate gate sill in the west chamber of the upper lock at Miraflores. It is known that similar replacement must be made at Pedro Miguel Locks when maintenance work starts there next fall. Pedro Miguel Locks are used between Gatun Lake level (85 ft. above sea level) and Miraflores Lake (54 ft. above sea level).

Some action of the teredo has also been noted at the Atlantic locks, but not to such an extent that is has required the removal and replacement of the greenheart sill timbers.

The result of our experience with teredo and greenheart at the Pacific locks indicates that the shipworm will live and thrive in greenheart timber in sea water, in the brackish water of Miraflores Lake, 54 ft. above sea level and even in timbers located in upper Pedro Miguel Locks where the water is supposedly fresh (85 ft. above sea level) and fed by Gatun Lake.

Strengthening Truss Bridge Over Tracks at Chicago

Corrosion of Old Bridge Carrying Heavy Traffic Necessitates Reinforcement in Advance of Building New Structure

TEMPORARY reinforcement of trusses in the Jackson Boulevard bridge over the tracks approaching the Chicago union station has been carried out recently on account of extensive deterioration of the bridge and pending its reconstruction within the next few years.

This structure consists of a 64-ft. half-through plate girder span and a 213½-ft. pin-connected through truss span, both built in 1888. The structure is so located that smoke and gases from locomotives standing in the station caused extensive corrosion in members of the truss span. There are two 21-ft. roadways with an intermediate truss and two 8-ft. sidewalks outside of the outer trusses. In addition to very heavy automobile traffic, there is a large number of heavy mail trucks going to and from the Union Station. Since this street is a city boulevard it is not used by heavy commercial trucks, but for a large part of the day the structure is loaded from end to end with two rows of pleasure vehicles on each roadway and when the river span is open for passage of a vessel these vehicles stand as close together as possible on the approach span.

FIG. 1—BOTTOM CHORD AND WEB REINFORCEMENT IN MIDDLE TRUSS
The original eyebar chord is under the floor.

An inspection of the bridge, during which the minimum reduced section of each member was calipered, showed reductions in section of from 30 to 60 per cent, so that when calculations were made excessive stresses were found to exist in chords and diagonals. The live-load used in these calculations was 100 lb. per square foot on roadways and sidewalks.

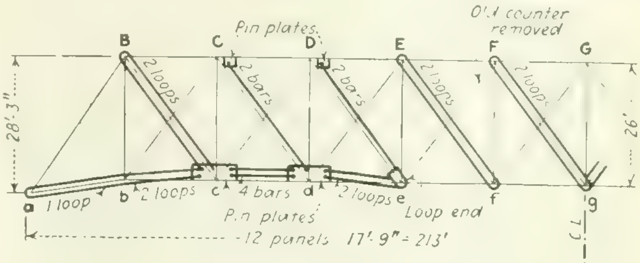


FIG. 2—REINFORCEMENT OF MIDDLE TRUSS

A new viaduct will be built at this point in connection with the new Union Station work and probably will be completed within the next two or three years. The north half of the existing structure will be removed when the new viaduct is started and the entire traffic of Jackson Boulevard will be carried by the south roadway until the first section of the new bridge is completed, and in service. Somewhat more extensive repairs were made, therefore, to the south roadway on account of the additional traffic which will be carried during construction of the new bridge. But on account of the short remaining life of the present structure only those members having a calculated stress which greatly exceeded safe working values were reinforced. For the same reason pairs of 4 x 18-in. timbers were bolted to the steel floor stringers for strengthening them, as a substitute for the more expensive method of renewing with steel members.

Part of the bottom-chord reinforcement is shown in Fig. 1, this work being above the floor while the original bottom chord, composed of eyebars, is below the floor. The location and arrangement of reinforcing members in the middle truss is shown in Fig. 2 and details of typical examples are given in Fig. 3. In the middle truss (Fig. 2) the work is as listed below, and this is duplicated at the other end of the truss.

Chord Reinforcement

a—*b*, One loop, 2⅛-in. bars, both ends looped.

b—*c*, Two loops with 1⅞-in. bars; loop at *b* and pin ends in plates at *c*.

c—*d*, Four bars 1⅞-in. with pin ends in plates.

d—e, Two loops, with $1\frac{7}{8}$-in. bars; pin ends at *d* and loop at *e*. Web reinforcement.
B—c, Two loops with $1\frac{3}{8}$-in. bars; loop at *B* and pin ends at *c*.
C—d, Two 2-in. bars with pin ends.
D—e, Two 2-in. bars with pin ends at *D* and loops at *e*.
E—f, Two loops of $1\frac{1}{2}$-in. bars.
F—g, Two loops of $1\frac{7}{8}$-in. bars.

Truss reinforcement consisted of loop rods wherever space was available for placing these loops on the truss pins, the bars and loops being connected and adjusted by turnbuckles. In two panels of the middle truss the old counters were removed to provide room for placing the new loops on the pins. At some panel points an alternative method was made necessary by the position of the chord eyebars. This method consisted of riveting pin plates to the truss posts for the connection of flat yokes carrying the new chord bars. At some of the top-chord panel points also it was necessary to rivet pin plates to the chords for the attachment of yoke ends on the diagonal bars. These various connections are shown in Figs. 2 and 3.

Jacking Posts—In addition to the reinforcement of the trusses it was found necessary to renew the timber bents supporting the east end of the south truss, owing to the crushing of the caps under load. This timbering was placed under the span in 1917 to form an extension of the masonry pier when the bridge was shifted southward about 5 ft. to line up with the new bascule span built across the river at that time.

Restricted space under the bridge made it impossible to place jacking bents at panel points and the method adopted was to raise the trusses by means of steel jacking posts connected to the end posts, as shown in Fig. 4. It will be noted that bar loops were used to connect the jacking point with the pin at the first panel point of the bottom chord in order to provide against bending the end post. Four 50-ton jacks were used under the post, the jacks being mounted on temporary timber bents

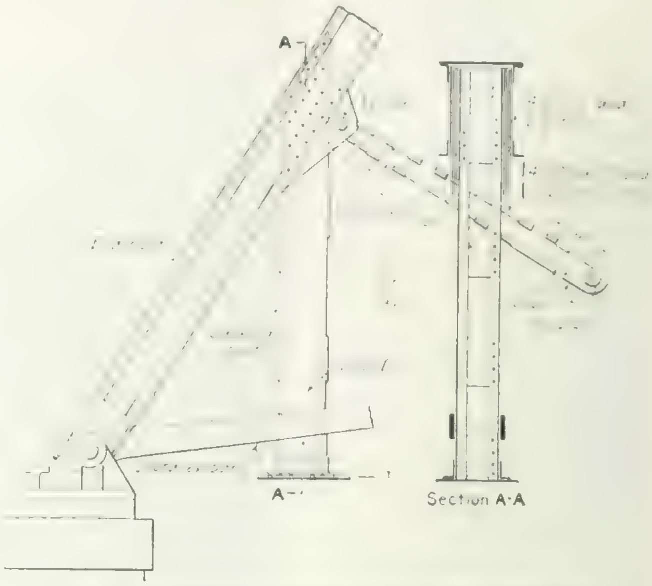


FIG. 4—JACKING POST FOR RAISING BRIDGE

placed close against the bridge pier. The calculated load of the middle truss was about 140 tons.

This entire work was made necessary largely through postponement of the Union Station work during the war, and from its temporary character it was more or less of a makeshift, only such repairs being undertaken as were considered absolutely necessary for the safety of the structure until its renewal. The truss and floor-system reinforcing was designed by J. C. Bland.

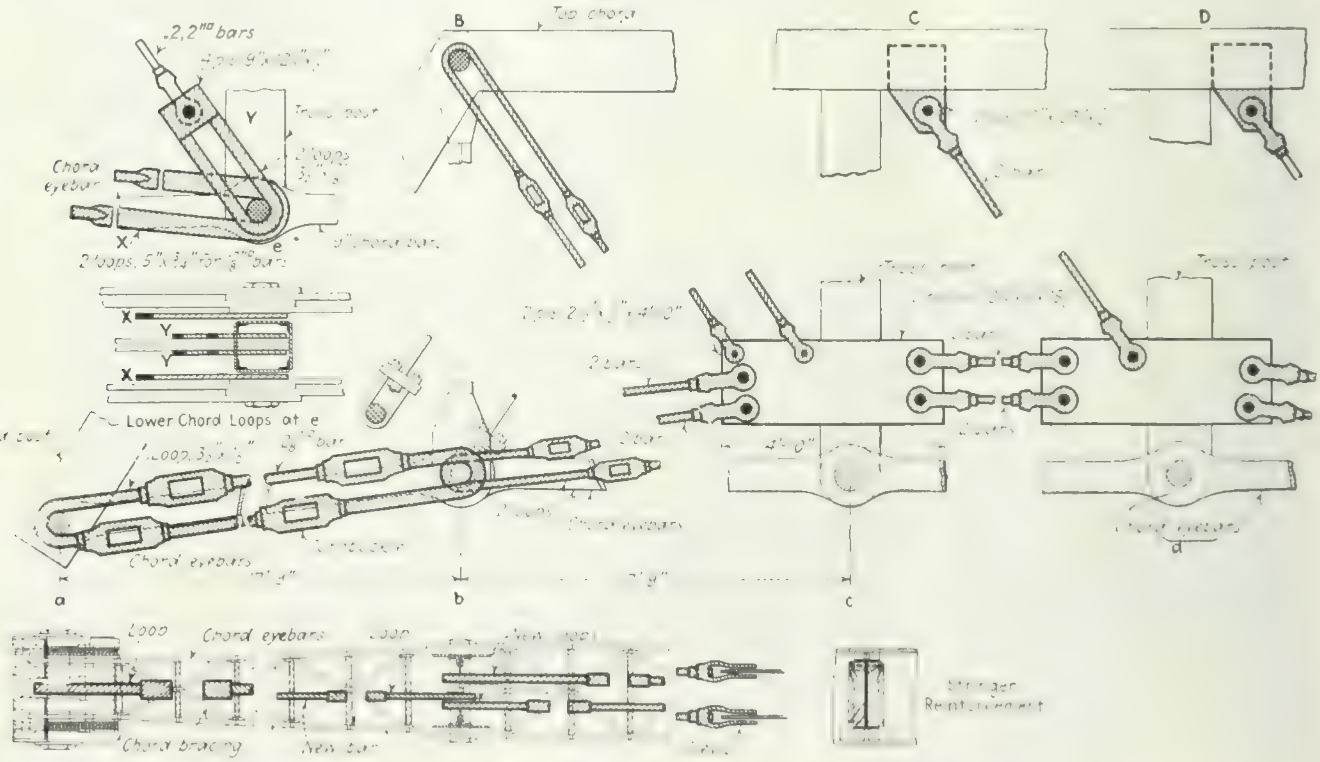


FIG. 3—DETAILS OF REINFORCING MEMBERS OF BRIDGE TRUSS

engineer of bridges and buildings, Pennsylvania R.R., Pittsburgh, Pa. The work was done by the Ferro Construction Co., Chicago, under the supervision of C. L. Barnaby, division engineer, Pennsylvania R.R. Field inspection was done and the raising apparatus designed under the direction of T. J. Skillman, chief engineer of maintenance-of-way, Pennsylvania R.R. (northwestern region), Chicago.

FIG. 5—JACKING POST CONNECTION TO END POST OF TRUSS

Somewhat similar reinforcement operations on two other Chicago bridges, one of which was a drawspan, were described in *Engineering News-Record* of May 8 and 15, 1919, pp. 913 and 956.

Transfer of Whole Town 11 Miles by Truck and Trailer

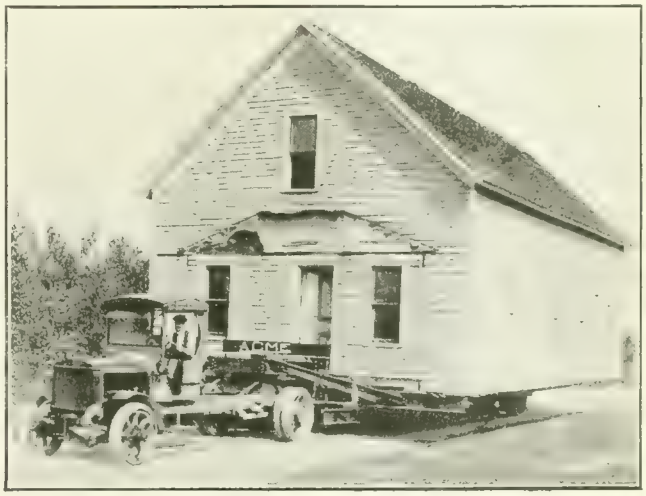
Jennings, Mich., Being Moved to Cadillac on Specially Built Structural Steel Frame of Trailer — Running Time Four Hours

HOUSES in the abandoned town of Jennings, Mich., are being transferred by truck and a specially built gigantic trailer to Cadillac, Mich., 11 miles distant. Jennings was founded about 25 years ago by the Mitchell Brothers Lumber Co. A sawmill, flooring and chemical plant gave employment to 500 men. Now the industries, families and residences are all being moved. Many plans for the transfer were considered and rejected as impractical. Finally engineers of the Acme Motor Truck Co. proposed building for the lumber company a trailer with four wheels abreast supporting a steel frame capable of carrying a 35-ton house.

There are 75 to 100 houses to move, an operation which will require three or four months' time. They vary from 24 x 30 ft. to 24 x 40 ft., and are all 1½ stories high, well-built, comfortable and arranged for convenience; and many of them have hardwood floors. Their weight varies from 15 to 35 tons. The windows are left in all of them and none has been cracked, except in passing through the city of Cadillac, when the limbs of shade trees along the streets broke one or two when the first house was brought in.

The 11-mile trip is made in about 4 hours, which includes all necessary stops to wait for traffic to pass before entering upon a stretch of road too narrow to allow passing, though the actual running speed is from 5 to 8 miles per hour. Loading and unloading and passing through the city requires a longer time, however, as it is often necessary to raise or remove the electric light and telephone wires. Up to Sept. 1 the rate of moving was about two houses every three days, although as the crew doing the work grows more accustomed to it it is probable a house a day will be brought over the road. The flooring and chemical plant will also be brought to Cadillac, which will result in an increase of from 500 to 1,000 in population and make additional homes necessary; at present a shortage of houses exists in the city.

The frame of the trailer is 24 ft. wide by 42 ft. long and consists of five longitudinal members of structural steel, securely held in place by two main and four supplementary transverse beams. Diagonal cross-braces are built into the frame to distribute the stresses where excessive weaving and twisting would occur. To give added rigidity and strength to the structure, the three center longitudinal members are reinforced with large

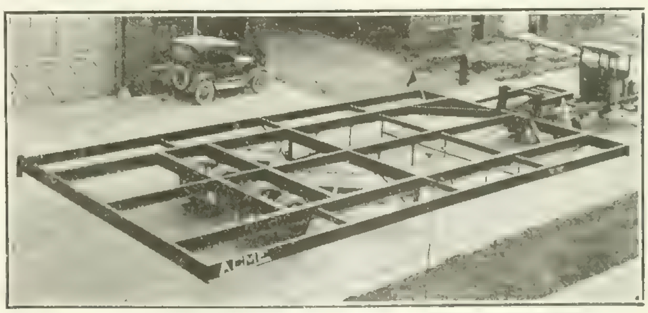


STORY-AND-A-HALF HOUSE READY FOR 11-MILE JOURNEY

trussrods securely anchored to the member at each end and supported at equal intervals by cast-iron struts. The tension in these rods is equalized by a series of turnbuckles.

The platform at the forward end of the frame is raised 18 in. above the trailer and is constructed of channels, I-beams and plates, substantially braced with diagonal members to the forward transverse member of the trailer proper in order to eliminate side sway. This platform is connected to the trailer frame by means of heavy gusset plates and channels of sufficient strength to transfer safely approximately 25 per cent of the weight of the trailer and load to the rocking fifth-wheel mounted on the truck.

At the rear the trailer is carried on four cast-steel truck wheels, all abreast, equipped with 40 x 6 dual truck tires. The wheels are arranged in pairs, each wheel operating on tapered roller bearings supported by a tubular steel axle shaft. The shafts of each pair of wheels are bolted together at the center through a large steel casting which is supported by an extra heavy wrought-iron pipe extending through it and at right angles to the shaft. Heavy steel pillow blocks at either



STRUCTURAL STEEL TRAILER FRAME FOR TRANSPORTING HOUSES

end of this pipe support the weight of the trailer and load through coil springs attached to the trailer frame. This unique construction not only cushions the load but successfully provides for road inequalities, an essential result when taking into consideration that the distance between the outside wheels is 11 ft. To relieve the springs from driving stresses a radius rod with flexible connections is provided for both sets of wheels, the forward end of which is secured rigidly to the trailer frame and the rear end fastened to the end of the wrought-iron pipe through a swivel connection. In order to maintain perfect alignment of all four wheels, the wrought-iron pipes supporting the axle shafts are tied together by a system of flat bars secured to the trailer frame and so arranged as to compensate for spring deflection.

In loading the house is raised by a series of jacks located at each side. The two outside longitudinal members of the trailer, which are bolted on, are removed, the trailer is then backed under the building and the house is lowered until it rests evenly on the trailer frame. The side members are replaced if it is found necessary and the unit is ready for its journey.

One Man in Thousand Is Oregon Engineer Ratio

THIS year the holders of licenses to practice engineering in the state of Oregon number about one for every thousand of the state's total population. The Oregon license law was passed July 1, 1919, to go into effect Jan. 1, 1920. Reference to the act appeared in *Engineering News-Record*, Sept. 25, 1919, p. 631. Within the time limit prescribed for the granting of licenses without examination about 1,150 applications had been received. Only about seventy-five applicants have been examined since that time and many of these are engineers from other states wishing to practice in Oregon.

While some 1,200 engineers is considered a relatively large number for a state of only 783,000 total population (1920 census), only about 800 engineers are now operating, as shown by the number of licenses taken out this year. Under the Oregon law, once an engineer has qualified and received a license he does not forfeit that license by non-payment of the annual fee and even if no annual fees are paid for a number of years he is entitled to practice again whenever he pays up the accumulated fees, plus a slight additional tax imposed as a penalty for delay.

The first licenses issued were obtained in a comparatively easy way under the terms of the law, but the policy of the board of examiners is now to maintain a strict standard of high professional qualifications. As a result only about two-thirds of the candidates that apply for examination are now being rated with a passing grade. Applications are being received at the rate of two to four per month.

Handling Customers Water Bills in Toledo

The 45,000 water customers accounts in Toledo, O., cost in 1921 slightly less than $2 each. This is too much for bookkeeping, billing and collecting, according to the latest annual report of the water department, and steps are being taken to reduce it. Accounting, meter reading and administration cost $9.28 p. m. g. as against $8.52 in 1920.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Drainage Wells That Might Pollute Water Controlled in Florida

Sir—In *Engineering News-Record*, of July 13, p. 75, I note an article by R. M. Downie, Keystone Driller Co., Beaver Falls, Pa. As this article opens with a reference to Florida, and may be misleading to people interested in that state, I wish to call attention to the fact that the sinking of such wells is a violation of state laws [except where approval for the wells is secured from the State Board of Health—EDITOR]. An act was passed by the Florida Legislature (approved June 7, 1913) entitled: "An Act to Preserve the Purity of the Underground Waters of the State of Florida for the Protection of the Public Health." This act specifically states that:

"No municipal corporation, private corporation, person or persons, within the state, shall, after the passing of this Act, use any cavity, sink, driven or drilled well now in existence, or sink any new well within the corporate limits, or within five miles of the corporate limits, of any incorporated city or town, or within any unincorporated city, town or village or within five miles thereof, for the purpose of draining any surface water or discharging any sewerage [sewage] into the underground waters of the state, without first obtaining a written permit from the State Board of Health." The act further states that the State Board of Health may "revoke such permit at any time on due notice after investigation and hearing."

The object of this act of the Legislature is to prevent the fouling of the very excellent underground waters of the State, as turning the surface drainage into the same underground sources from which the water supply of many of the cities, villages and towns of the State of Florida receive their supply, is a very dangerous expedient.

The last sentence of the next to the last paragraph of Mr. Downie's article reads: "The outlet from the wells is always some hundreds of feet below sea level and the sewage does not at all contaminate the underground waters." The outlet from these wells is an uncertain matter as the head on most of them is from 12 to 17 ft. above sea level on the west coast and if a well is left open it will flow at sea level, so that the water that is put in at one place may flow out at another.

CHESTER D. MCFARLAND,
General Manager, Tampa Water Works Co.
Tampa, Fla., Sept. 11.

Color and Harmless Bacteria in Water Supplies

Sir—The articles by C. M. Saville and A. L. Gammage in *Engineering News-Record*, Sept. 7, pp. 380 and 391, and the discussions at the New England Water Works convention on Sept. 15 by J. E. Garratt on the effect of copper sulphate on the length of filter runs at Hartford and by Robert Spurr Weston on hydrogen-ions have led the writer to set down here some radical thoughts on water purification that have persisted with him for two or three years. These suggestions are made not with the idea that even the writer himself has reached unalterable conclusions, but rather in the hope that someone with more opportunity for experimentation may be sufficiently interested to pursue the matter in a practical way.

The exceedingly interesting studies of hydrogen-ion concentration that have been made in recent years have indicated the value of that study in the solution of several troublesome problems connected with water purification, but it is not clear that their greatest value has yet been appreciated. It is my opinion that the most important

possibilities of these hydrogen-ion studies will be found to lie in the direction of preventive measures rather than the curative ones so far considered. For example, it has long been my belief that the installation and operation of expensive filter plants for no more important reason than the removal of color and organisms—both perfectly harmless—is an unscientific and unjustifiable expense, and that if we water-supply engineers, combining forces with our friends the chemists and the physicists, could but perform a sufficiently thorough research to determine the fundamental nature of color in water and why some streams are highly colored while others flowing from apparently similar watersheds are not, we would perhaps discover that the installation of small automatic dosing machines on the principal influent streams of a reservoir would eliminate the color problem and possibly also that of organisms. The value of the hydrogen-ion studies, it seems to me, is in solving the question of what materials to put into such dosing machines for the purpose of neutralizing color.

As a practical illustration of this kind of a problem, it would be interesting to know the relation between the hydrogen-ion concentration of the water of Esopus Creek as it enters and as it leaves Ashokan Reservoir—particularly at times of high runoff. It has been pointed out to me that there is often a quite distinct line of demarcation in the reservoir between the slightly milky turbidity of the entering water, carrying as it does colloidal clay, and the practically colorless water of the main body of the reservoir. I cannot help wondering if there is not a change in the hydrogen-ion concentration at that line of demarcation and whether the clay content of the influent water is at that point neutralized by some more dominant characteristic of the main body of accumulated water. The color of the water in the East Basin of the Ashokan Reservoir is low while the color of the stream that in pre-reservoir days flowed out of the unstripped swamp that formed most of its bottom rivaled the "dark" brand of liquid that once made Milwaukee famous. Is one not justified, then, in hazarding the guess that colloidal clay neutralizes the color and that something connected with the color neutralizes the clay and thus both the turbidity and the color are eliminated? If this can be accomplished by natural means does it require too great a stretch of the imagination to suggest that scientific methods could be devised to eliminate by relatively simple means either color or turbidity? Further, would not the cost of such a scientific study be insignificant in comparison with the cost of even a single modern purification plant?

Coming home from the New England Water Works convention the other day a number of engineers were discussing the crude but customary method of applying copper sulphate to a reservoir water by dragging bags from a boat as compared with the more scientific application of definite quantities per million gallons in the Catskill Aqueduct between Ashokan and Kensico Reservoirs, and it was suggested that probably the main reason for this crude method was the fact that the first man who applied copper sulphate did it in that way. Whether or not the growth of organisms can be controlled by continuously dosing the influent streams of a reservoir with copper sulphate or some other substance (and it may well prove inadvisable, even if possible, to entirely prevent their growth) it is evident that one reason why corrective measures have mainly been followed in the later refinements of water purification rather than preventive measures is plain inertia—the fact that the discovery and development of the principle of slow sand filtration was such a notable achievement that unconsciously we have felt that future progress in water purification must be made from that as a starting point, whereas it seems quite evident to me, in spite of the contrary opinions of some of our most eminent sanitary engineers, that the time is not far distant when, sterilization having been standardized, the filtration of a bacterially clean surface water supply will be a thing of the past.

FRANCIS B. MARSH,
Designing Engineer, Providence Water Supply Board

Providence, R. I., Sept. 16.

Model Tests of Skew Arch Thrust Questioned

Sir—In your issue of April 20, p. 638, Prof. Clyde T. Morris reports the results of experiments upon a model of a skew arch of reinforced concrete. His method was to subject the model to a uniformly distributed load, permitting one end (supported on springs) to yield under the load, and then by means of jacks to bring the movable end back to its original position. Under these conditions he found that the resultant horizontal thrust was very near the obtuse corner of the arch.

The generally accepted theory of arch analysis is premised on fixed abutments. The model with which Prof. Morris experimented did not have fixed ends and its action was in effect that of a spring.

Consider a steel spring in the form of a skew arch standing on a smooth level surface and subjected to a symmetrically distributed load. The spring would begin to bend about an axis perpendicular to the face of the "arch," which would lift the acute corners off the supporting plane and leave only the obtuse corners bearing. Further bending would be about an axis perpendicular to a vertical plane through the obtuse corners, and the obtuse corners would slide in the direction of a line joining those corners. To bring the spring ends back to their original position (within the limits of observation), it is only necessary to apply equal and opposite horizontal forces at *any* symmetrically located points of the spring ends so that both of the applied forces are in a vertical plane which passes through the center of the crown. To restore the spring ends to *exactly* the same position as before distortion, with unit stresses at each point identical with those which would have developed had the spring ends been fixed originally, would require a definite distribution of forces; but to determine that distribution experimentally supposes an accuracy of measurement not easily attained.

Prof. Morris applied replacing forces so that the horizontal resultant acted near the obtuse corner, with components of about 910 lb. normal to the abutment and 220 lb. end thrust for the maximum load. It is believed that a horizontal resultant of 1,700 lb. applied at the acute corner —910 lb. normal to the abutment and 1,440 lb. end thrust—would serve equally well as a replacing force.

The burden of proof is upon Prof. Morris to show that conclusions based upon his experiment are applicable to skew arch bridges.

W. H. YATES,
Consulting Engineer.

New York, Aug. 28.

The Mission of the University

Sir—Permit me to express to you my unqualified approval of your editorial on "The Mission of the University" in the number of Aug. 31.

The expressed intention of the scheme of instruction which our universities have so far proposed for their engineering students is to develop, so far as they are able, trained technicians. Now a man who is a trained technician may not be in any meaning, except a very limited one, an educated man. A skillful carpenter or an expert mechanic are specialized technicians in perhaps as accurate a sense as the numerous common or garden varieties of graduates our schools are so busily occupied in turning out. It may even be that the mechanic would be equally trained with those select few who on the day of their graduation could elucidate the theory of least squares or develop the analysis by which, on the elastic theory, the stresses in monolithic arches are computed.

It is only one of the duties of the university to impart specialized instruction; it is indeed only one of its duties to develop the power or increase the capacity of its students to think in a logical and orderly fashion. The capacity to reason acutely and to analyze accurately is for any man a most important intellectual attribute, and it may be that our schools, while they cannot create, are doing all that can reasonably be expected of them to develop and expand this quality. But the true essence of education is another matter. For a man to be educated he must at least have touched

something of what is fine, enduring, distinctive—of what is set apart from all that is practical, severe and concrete. He must have felt the glow of higher enthusiasms, of perhaps impractical idealisms. He must be able to set up for himself some standard of comparison, some scale of relative values, even though crude and ill defined, by which he can judge present performances and assay their worth. Only in this way, by an insistence on what appears to the common view impractical, unrelated to the conditions to be encountered, is it possible to develop a finer vision, a profounder conception of the dignity and worth of what we are attempting to execute, and an imagination more creative; because the ideals conceived and the goals attempted are not discreet and particular.

The universities are the only agencies through which to accomplish this. There is no question that they are attempting to fulfill with all their power the obligation of pounding facts into resistant brains; but are they fully aware—and particularly are our engineering schools aware—of their higher and their more insistent duty to evoke, if not reasoned ideals, at least a conception of things beyond that which is practical and opportunistic; to instill, if not culture, at least a regard for culture; to turn out men that are human and sympathetic with the finer touch that comes from more highly developed sensibilities?

Until engineers realize that the most important half of their education lies entirely outside of technical training they will not succeed, they will not even be called upon as leaders in a new world—or in an old world, if you like. And it is entirely right that this should be the case.

THOMAS THOMSON TOWLES,
Member, Am. Soc. C. E.

Richmond, Va., Sept. 11,

Suggests Foreign Woods to Resist Borers

Sir—In view of the inquiry into protective measures against the teredo now being conducted by the National Research Council and the Engineering Foundation, I write to recommend experimental work with certain foreign timbers that are able to withstand the action of marine borers and that are available to South America and Australia.

Holland is making extensive use of greenheart. I remember that the specifications for the fishing harbor of Scheveningen called for greenheart timber, which is still standing intact after 18 years of exposure to shipworm. This greenheart is one of the most valuable timbers and is the product of the *Nectandra Rodioei*, averaging 70 ft. in height. It is a native of Guiana, South America, and exists inland in great abundance. The Indian name of the tree is "bibiru." Greenheart wood is of a dark green color and is one of the most durable of all timbers. Its value is greatly enhanced by the fact that it is proof against the ravages of marine borer.

In Kelvingrove Museum, Glasgow, there are two pieces of planking from a wreck submerged during 18 years on the west coast of Scotland. The one specimen, greenheart, is merely slightly pitted on the surface, the interior of the wood being perfectly sound and untouched, while the other specimen, djati or teak, which comes from the East Indies, is almost entirely eaten away. Greenheart, under either transverse or tensile stress is one of the strongest of all woods. It is exceedingly dense and its specific gravity is very high, being about 1.15. A timber equally used in European waters is jarrah, or *Eucalyptus marginata*, native of S. W. Australia, a close-grained, heavy red wood, often called "ironwood" in Holland. This timber is not attacked by teredo termites, or other destructive organisms, because, perhaps, of its alkaloid carrying property and its great hardness. It very much resembles mahogany.

This jarrah tree grows straight in the stem to great size and yields squared timber up to 24 in. in diameter and 40 ft. long. It has a specific gravity of 1.01. In tropical countries it resists also the ravages of white ants. When filled with the sap at its lowest point and well seasoned, this wood stands exposure in the air, earth, or sea remarkably well, on which account it is in demand for railway sleepers, telegraph poles and piling in British colonies and in the East Indies.

The wood, however, frequently shows longitudinal blisters, or lacunae filled with resin, as may be observed in spurce fir timbers. One disadvantage is that it is deficient of fibre, breaking with a short fracture under comparatively moderate stress. Trautwine quotes lignum-vitae, a similar wood, with a specific gravity of 1.33 weighing 83 lb. per cubic foot. Both greenheart and jarrah timber have been classed at Lloyds' Register for ship building purposes in Table A, lines 1 and 3 respectively.

The greenheart and jarrah woods in particular should be studied. If, however, these timbers are known to engineers in this country, I should like to be excused for this letter, but not having found a single mention of these valuable woods, I simply could not refrain from speaking of them. But why is it that jarrah and greenheart have not been mentioned? If these timbers are known to the National Research Council and the Engineering Foundation, why have they decided to launch a nation-wide campaign against these insects while foreign timber can stand the test? These timbers give splendid service in European waters—why not here? C. KOOY.

New York, May 36.

[As indicated by the article on p. 619 of this issue, experience at Panama does not seem to bear out Mr. Kooy's confidence in greenheart at least, as a solution of the marine-borer problem.—EDITOR.]

Progressive Construction of Highways—A Question of Origin

Sir—The editorial, "Maintenance the First Task of Highway Development," appearing in *Engineering News-Record*, Aug. 17, p. 259, is very pleasant reading to me. The part printed in italics appears to have been taken, almost verbatim, from an article on highways printed in your issue of March 21, 1918, and the whole editorial shows that the article mentioned has had and is having an educational value —although the author gets no credit for the complete change in trend of thought of highway engineers.

I am as firmly convinced as ever that if the progressive method of highway construction were adopted and carried out to its logical conclusion, we would increase our effective highway system by 100 per cent with the same capital investment. Would it not please the people to have twice the improved highway mileage at the same cost? What a boon this progressive method would be to the harassed highway departments in this time of shortage of coal and materials of all sorts. The whole force, and a greatly increased force, could be put to work properly forming subgrades, building bridges and culverts, so that when "normalcy" returns thousands of miles of roadway would be ready for hard surfacing. A. A. YOUNG.

Jewett City, Conn.,
Aug. 19, 1922.

[Progressive construction as a policy of highway development is so natural a thought that one is easily misled into assuming priority in its expression. The writer of the editorial mentioned, certainly, and Mr. Young, probably, were late in the field with progressive construction as a novel idea. It was definitely laid down as a highway improvement policy in Iowa as early as 1913 and had begun to be formulated into practice nearly ten years previous. The account of this development will be found in *Engineering News-Record*, Nov. 27, 1919, p. 953, and Dec. 11, 1919, p. 1008. Incidentally the article contributed by Mr. Young in 1918 was unknown to the writer of these articles on Iowa practice and of the editorial in our issue of two weeks ago. Any verbal resemblance is a coincidence. The editorial writer drew his inspiration from a long knowledge of practice in Iowa and a later conviction of the value of the practice from observing results in North Carolina.—EDITOR.]

NEWS OF THE WEEK

New York, October 12, 1922

Civil Engineers' Directors Favor Federation

Pass Resolution at San Francisco Expressing Sympathy With Movement

Staff Correspondence

The meeting of the board of directors of The American Society of Civil Engineers in San Francisco on Oct. 2 and 3 was representative of all parts of the country, 21 of the 28 directors being present. A step toward joining the Federation was taken by passing a resolution, "That this board is in sympathy with a movement to join the Federated American Engineering Societies when financial and other conditions permit." This resolution was carried by a vote of twelve to eight and it was agreed that the question of when the board deems it advisable to join should be discussed at the January meeting.

It was definitely decided to hold the spring meeting in New Orleans early in the spring but no exact date was set. The subject for that meeting will be ports, harbors and river control. An invitation from Richmond, Va., to hold the annual meeting next year in that city was received and this with an invitation from the Illinois section to hold the fall meeting next year in Chicago was held over for decision by the new board in January. The subject for the fall meeting will be railroad terminals. The next annual meeting must be somewhere in District Five, according to the decision at the Dayton meeting.

A special committee of the board was appointed to handle questions affecting local sections. T. L. Condron was placed on the official list of nominees for director of District Eight succeeding A. S. Baldwin, deceased.

The two-day fall meeting following the board meeting was very well attended, the total registration being about 600, of which about 150 were junior and senior students from University of California and Stanford. The subject of water power was well chosen for a Pacific Coast convention at this time, as was attested by the very general interest and response. Entertainment features and particularly the several excursions arranged by the local section were well attended and were made most enjoyable by favorable weather conditions.

Organize Ontario License Board

Organization for the registration of professional engineers under the act passed by the Ontario legislature has been completed and a permanent office opened in Toronto. Gen. C. H. Mitchell is president and Robert A. Bryce, vice-president of the provisional council and R. D. Wolsey registrar and secretary-treasurer. The council comprises representatives of each of the branches of the profession, namely, civil, mechanical, electrical, chemical and mining.

Buffalo Transit Company Sues City for Strike Damage

Alleging that the city of Buffalo failed to provide proper protection for its properties during the recent strike, the International Railway Co. of that city has filed a claim for damages amounting to $3,805,250. Of this amount, only $4,250 is for property damage. Loss in operating revenue is placed at $1,800,000 and loss of good will in the community at $2,000,000.

Motor Vehicle Weight Limit Restricted in Massachusetts

Seasonal limitations on gross weight of motor vehicles are provided for in an amendment, effective Sept. 12, to the motor vehicle law of Massachusetts which permits a maximum gross weight of 14 tons and 800 lb. per inch width of tire. The amendment grants to the State Department of Public Works authority to rule off the road at any season of the year vehicles having gross weights exceeding 10,000 lb., if in the opinion of the department they would cause serious injury to the highway.

Railway Bridge and Building Association to Meet

At the annual meeting of the Railway Bridge and Building Assn. to be held at the Gibson Hotel, Cincinnati, Oct. 17 to 19, the following subjects will be included: Pile driving records; labor-saving devices in routine bridge and building work; merits of wood, steel and iron tanks; building inspection and records; painting structural steel; framing bridge timbers; reconstruction of the Ohio bridge of the Cincinnati Southern Ry.; construction and maintenance of sewers and drains.

Kansas City to Build Huge War Memorial

Hool & Johnson, engineers of New York City, have been engaged as engineers on the design and construction of the Liberty Memorial at Kansas City, Mo. When completed this will be, it is believed, the greatest memorial structure in the world. It is to be built by public subscriptions after the design made by H. Van Buren Magonigle, architect, of New York City. Mr. Magonigle was awarded the prize some time ago in a competition. The structure comprises a huge base, in the center of which rises an eight-armed shaft, 55 ft. in diameter at the base and 287 ft. high. On either side are two large memorial halls. The main structure is to be of concrete with stone facing. It will be located on the height of land opposite the new Union Station. About $2,500,000 of the subscription has already been raised. The designs are now under way and it is hoped that the first contract will be let within a few months.

Municipal Field Surveyed at Cleveland Meeting

A.S.M.I. Gives Chief Attention to Streets and Sewage Problems—Horner Elected President

Staff Correspondence

The leading subjects discussed at the twenty-eighth annual convention of the American Society for Municipal Improvements at Cleveland last week related to streets, sidewalks, sewers and sewage treatment, but the whole municipal field was surveyed. As usual at these conventions the program was a heavy one, requiring much crowding and leaving scant room for discussion at some points; but could it have been foreseen that most of the numerous committee reports would produce little or no discussion jams might have been avoided. As it was, three sessions ended with much spare time while two or three others could have utilized more time, particularly the four-hour session devoted to sewage treatment.

In his presidential address Edward S. Rankin, engineer in charge of sewers, Newark, N. J., said it was desirable not to give the society, through its name, a limited engineering character, so as to continue to attract to the meetings, as has been done from the first, a considerable number of members of the city governing and executive boards.

Reports by the Executive Committee and the secretary showed that for the eleven months ended Sept. 1 there had been a net membership gain of 15, or from 648 to 663. The active members on Sept. 1 were about 500. A feature of the convention was the daily *A. S. M. I. News*, which gave the names of those in attendance, and made various timely announcements.

AMENDMENTS ADOPTED

Constitutional amendments were adopted providing (1) that the number of committees shall be determined by the Executive Committee, but that there shall be a Committee on Papers; and (2) that engineers employed by street railway and other utility companies occupying streets and highways shall be eligible for active inste : of associate membership only.

The principal officers elected for the ensuing year were: President, W. W. Horner, St. Louis, Mo.; first vice-president, E. R. Dutton, Minneapolis, Minn.; secretary, C. C. Brown, St. Petersburg, Fla.; treasurer, Robert Hoffman, Cleveland, Ohio. Memphis, Tenn., was chosen as the next meeting place, after considering invitations from Washington, D. C., Louisville, Ky., and Atlanta —the latter having been withdrawn or postponed until 1924.

Two evening sessions were held jointly with the Ohio State Conference on City Planning. Monday evening was devoted largely to state park sys

tems, with special reference to needs and opportunities for such a system in Ohio. The feature of the other joint session was a lantern-slide talk by N. P. Lewis, New York City, on the regional plan for New York City and environs. (See *Engineering News-Record*, May 18, p. 842.) Mr. Lewis spoke also as chairman of the City Planning Committee of the A. S. M. I.

E. A. Fisher, Rochester, N. Y., as chairman of a Sub-Committee on Local Subdivisions, outlined the method of controlling subdivisions or new real-estate layouts in Rochester, which is under the jurisdiction of the City Planning Bureau. In a paper on control of heavy traffic at street intersections, Clarence Farrier, Chicago, proposed storage space or temporary parking of cars in areas set aside for the purpose rather than regulation on some circulating plan.

Paving, Sidewalks and Sewers

Altogether there were scheduled for the two Wednesday sessions seventeen committee reports and six papers on paving, sidewalks and sewers. Of the committee reports listed, thirteen were on specifications for the various kinds of pavements. Many of these twenty-three numbers resulted in brief progress reports only and a few brought no response. Nearly all of the reports on paving specifications presented had already been before the society in printed form and were either submitted for final action or else for revision.

For the Sub-committee on Paving, W. A. Howell, Newark, N. J., reported that owing to the high cost of granite blocks there is now a tendency to use less substantial substitutes, renewal of the latter in a few years being economically justified. Recent actions of granite quarrymen and pavers were characterized by Mr. Howell as ill advised. Clarence D. Pollock, New York City, read a paper designed to show the need of further study of tests for granite blocks. The toughness test, he thought, is not in accordance with conditions in service; the test known as that for the French coefficient for wear comes nearer, if attention is given to disintegration of the granite. One speaker questioned the need for these tests, which he said are relatively new here and not used abroad.

George H. Norton, Buffalo, N. Y., as chairman of the Sub-Committee on Street Maintenance, urged the members to study the section of his last year's report dealing with the economic life of pavements since the 1921 *Proceedings* came out too late for study before the 1922 meeting. Considerable discussion arose on backfilling trenches made for sewer, water and other house connections. The common practice of requiring that such connections be required before new pavements are put down was commended while the frequently accompanying rule that no such connections would be allowed for five years after a street is paved was severely criticised because of general non-enforcement. A better plan is to exact rather heavy guarantee funds against damage from settlement and to hold the money for a number of years, since settlement may come long after the trench is backfilled. Puddling on backfilling was deprecated.

The Committee on Sheet Asphalt Specifications, through E. A. Kingsley, chairman, Little Rock, Ark., submitted a number of changes designed to simplify and clarify existing specifications. Proposed specifications for fine aggregate bituminous concrete were submitted by Thomas E. Collins, Elizabeth, N. J., chairman of a corresponding committee. After having voted to send both these specifications to letter ballot, each was referred back to the committee at a later session on account of certain unmentioned discrepancies between the two. Other specifications sent to letter ballot, with changes from the draft printed in the 1921 *Proceedings*, deal with (1) broken-stone roads, (2 and 3) bituminous surface-treated macadam (separate specifications for hot and for cold application) and (4) gravel roads—all from a single committee of which D. B. Davis, Richmond, Va., is chairman. Still another set of specifications that will now go to ballot is the one on subgrades and foundations, F. A. Reimer, chairman, Newark, N. J. These were first presented in 1920, then re-submitted with modifications in 1921 and printed in the *Proceedings* for that year.

Non-Bituminous Paving

For the Special Committee on Standard Tests for Non-Bituminous Paving Materials, Prof. A. H. Blanchard, University of Michigan, recommended the adoption of some 15 tests that have been before the society for a year, and the consideration for later action of a number of standard tests, some with slight changes, for the Am. Soc. T. M. and the Am. Soc. C. E.

Although "full sets of sewer specifications" were submitted in 1921, stated C. L. Howell, chairman, Buffalo, N. Y., they will have to go over another year to give time to consider points brought out by a questionnaire and by conferences at the Cleveland convention.

Dr. A. R. Hatton, specialist in municipal government, gave recognition to the extent to which specialization in engineering, health and law have gone and advocated carrying specialization to embrace all administrative heads, including the chief executive. The complete adoption of the plan is not undemocratic, as some urge, since the democratic principle involves as a first step the election of policy-determining authorities and as a second and no less important step the selection of competent trained men to carry out the policies. In discussing Dr. Hatton's remarks N. P. Lewis, New York City, expressed the conviction that the engineer should contribute to the formulation of policies to a larger degree than Dr. Hatton had implied, but the latter laid stress upon the greater heed given to the opinion of professional men than to those of non-professional instancing the trained city manager as being given more credence than the mayor, though the latter has veto power.

Traffic and Transportation

A tentative report for written discussion up to July 1, 1923, with a view to final drafting for submission to the 1933 convention was submitted by the Committee on Traffic and Transportation, Prof. Blanchard, chairman. Among detailed proposals for motor truck weights and dimensions was a weight limit of 28 tons for truck and load. Prohibition of city licensing of motor vehicles is proposed with a provision for returning part of the state license fees to cities, to be used exclusively for streets. Franchises for companies or individuals operating motor vehicles to carry freight, express or passengers over fixed routes on public streets and highways, the franchises to be granted by a special state board, with municipal consent over routes within their boundaries, is another proposal of this committee. Still other proposals are that so far as possible municipal traffic regulations be uniform; that safety zones be raised platforms to the exclusion of white stripes or other indicators; and that no street reconstruction on business streets or major traffic ways be paid for by abutting property owners.

Statistics of methods of refuse collection—by contract and otherwise—were presented by A. P. Folwell, New York City, chairman of the Committee on Refuse Disposal, etc. In 150 cities thus far reporting garbage is collected by the city in 35 per cent, by contract at city expense in 25 per cent, by some sort of city arrangement but at private expense in 19 per cent, and is left entirely to householders in 2 per cent of the cities. For ashes the corresponding percentages are 27, 5, 5 and 63.

An afternoon and evening were devoted to street lighting combined with an automobile trip to the plant of the National Lamp Works at Nela Park, Cleveland, for both a daylight and lamplight inspection of ornamental street lighting equipment. A buffet dinner was served at the works, after which there was a committee report and paper on street lighting. During the convention moving pictures were shown of International steel twin-tie track construction and of White trucks engaged in snow removal.

Coal Miners Demand Present Wages for Two Years More

Continuation of the present wage scale until March 31, 1925, and a 6-hr. day through a five-day week with time and one-half for overtime are included in the program adopted by the policy committee of the United Mine Workers. These will be the basis of negotiations between the miners and the operators next January when a new contract will be formulated to become effective April 1, 1923.

Two operators and two miners from each of the 27 organized mining districts will meet in conference in Chicago in the middle of November to plan a readjustment of the methods used for wage negotiation. This committee is to submit its recommendations to a joint conference between the operators and miners not later than Jan. 3, 1923, and the actual wage negotiations on the agreed basis are to commence not later than Jan. 8.

The conference of operators and miners at Cleveland has decided to give up the idea of a committee of inquiry within the industry and to co-operate with the governmental fact-finding commission. The miners have acceded to the request of the President for names of candidates for this commission, but the operators have declined to so.

No action has been taken by the miners union with regard to the anthracite mine workers whose contract will expire in the fall.

Agree on Reciprocal Registration Between States

Articles of agreement governing reciprocal registration between states for professional engineers were ratified after three years consideration by the council of State Boards of Engineering Examiners at the annual meeting, Oct. 2 and 3 in Chicago, attended by delegates from 16 of the 21 states having registration laws. Standards of qualification as high or higher than required by any one state were agreed upon. Certification from one state to the other will be granted by submission of evidence as to the qualifications of the applicant and registration will be recorded without further examination. If ratified by the various state boards of engineering examiners the articles of agreement will relieve the necessity of changing various state laws and should make for the convenience of practicing engineers.

The council also passed a resolution urging that the necessary changes in state laws be made so that an engineer registered in one state may be granted reciprocal registration in another state without paying a second registration fee. Consideration was given also to providing mutual reciprocal arrangements with Canada and Mexico.

The terms of the agreement are substantially as published in *Engineering News-Record* of July 27, 1922, p. 156. Modifications adopted in the present draft provide that reciprocal registration shall be granted only to applicants already licensed in some state which is a member of the council, that a professional record properly attested and accompanied by references from three registered engineers shall be filed with the applicant's board of examiners, and shall constitute the basis of the examination, that applicants shall be qualified to design as well as to direct engineering operations, that graduation from an engineering school shall be accepted as equivalent to four years of practice instead of two and that registration shall be by card rather than by seal on the original state certificate. The articles as adopted do not include the provision in the tentative draft for accepting seven years of experience instead of ten when that experience has been of exceptional character; neither do they provide for accepting in lieu of examination the references of three licensed practising engineers.

The officers elected for the ensuing year are as follows: John T. Cox, Ann Arbor, Mich., president; O. Laurgaard, Portland, Ore., vice-president; P. H. Daggett, Chapel Hill, N. C., secretary-treasurer.

L. V. R.R. Restores Piece-Work

In announcing that it had come to an agreement with its shop workers who have formed their own company union, the Lehigh Valley R.R. states that the wage agreements provide for a sliding-scale basis of pay by which the more highly skilled mechanics receive a rate commensurate with their services, while the employment of helpers at rates somewhat lower than those paid to full-fledged mechanics is permitted. There is no provision against the payment of bonuses to efficient workmen for increased production and all of the restrictive features of the national agreement have been eliminated.

The Engineer in Public Life

FREDERICK L. FORD

Although Frederick L. Ford, former city engineer of Hartford, Conn., is now in the general contracting business at New Haven, Conn., specializing in road construction, he has been a holder of many public offices, including membership in the Connecticut Legislature, and has accepted and declined numerous public appointments. Born at North Branford, Conn., in 1871, he was graduated from the Sheffield Scientific School, Yale University, in 1893, and after three years of service with A. B. Hill, consulting engineer, New Haven, he became assistant city engineer of Hartford in 1896 and was promoted to become city engineer in 1902, a position which he held for nine years. In 1911 he became a member of the consulting firm of Ford, Buck & Sheldon at Hartford. A year later, however, the city of New Haven sought his services as city engineer and in accepting this appointment he took charge of about $1,000,000 worth of city paving, sewer, and bridge construction.

Among Mr. Ford's public appointments are: engineer member of the State Arsenal and Armory Commission of Connecticut to which he was named by Governor Henry Roberts in 1905; the special commission appointed by the Secretary of State for improvements to the State Capitol at Hartford; the Technical High School Commission of Hartford; and the state commission appointed by Governor Lake to meet with similar commissions from all the New England States on the petition of the New England railroads for a 10-per cent advance in rates. Commissions similar to the one just named have recently been created to consider the proposed consolidation of New England railroads and Mr. Ford has been named by Governor Lake as a member of the Connecticut commission.

During 1909 Mr. Ford, then city engineer of Hartford, was sent abroad for a ten weeks' study of civic and municipal problems in England, Scotland, Belgium, Holland, Germany, Austria, and France, and from the data secured during this trip prepared an illustrated monograph for the State Rivers and Harbor Commission on public docks and dock facilities.

In 1920 Mr. Ford was elected representative from New Haven to the Connecticut Legislature and served as chairman of the joint standing committee on cities and boroughs. During the session this committee reported out and the legislature passed about 225 bills relating to town, borough, and city charters.

At the present time Mr. Ford is devoting his attention to his road contracting business and has work in hand in half a dozen localities in Connecticut.

Thornton Named as President of Canadian National Rys.

The Canadian government has appointed a new board of directors for the Canadian National Ry. headed by Major-General Sir Henry Thornton as president and general manager, the other directors being Richard R. Gough, Toronto; Ernest R. Decary, Montreal; James Stewart, Winnipeg; John H. Sinclair, New Glasgow, N. S.; Frederick G. Dawson, Prince Rupert, B. C.; Tom Moore, president of the Trade and Labor Congress of Canada, Ottawa; Graham A. Bell, Deputy Minister of Railways and Canals, Ottawa; and Gerard G. Ruel, formerly general counsel of the Canadian Northern Ry.

Two vice-presidents in charge of operation and traffic are to be appointed by the board. Sir Henry Thornton is president of the Great Eastern Ry. in England. He was born at Logansport, Indiana, in 1871 and graduated in engineering at the University of Pennsylvania in 1894. He received his training on the Pennsylvania R.R. and was superintendent on the lines west of Pittsburgh, later becoming general superintendent of the Long Island R.R. In April, 1914, he went to England to become general manager of the Great Eastern Ry., which during the war became one of the most important lines of military communication. Sir Henry held several highly responsible positions in connection with army transportation and in 1918 was made Inspector General of Transportation with the rank of major-general. He was naturalized as a British subject in 1919 and was created a Knight Commander of the Order of the British Empire. Sir Henry Thornton is a member of the Institution of Civil Engineers, the Institute of Transportation, the American Society of Mechanical Engineers and other scientific bodies. He has signed a contract with the government for three years at a salary of $50,000 a year.

Work Progresses on Muscle Shoals

Under the $7,000,000 appropriation granted by Congress in the last session construction has started again on the Muscle Shoals work, under the direction of the Corps of Engineers, U.S.A. Every effort is being made at Wilson Dam to complete the excavation in cofferdam No. 2 and get the concrete in before high water. At present the work is being delayed somewhat by the difficulties of securing cement, sand and gravel. Progress would have been halted almost entirely had the Corps of Engineers not owned some eighty box cars. These box cars were handled in solid trains accompanied by convoys of army men and used exclusively to bring in cement supplies. In this way it has been possible to avoid any serious slowing down of the cement work. Sand and gravel for this job come from a point down the river. Owing to the unusually low stage great difficulty has been experienced in getting the floating equipment over the shoals.

As early next season as the water will permit, it is planned to close the south channel and work actively in that cofferdam and in the powerhouse cofferdam. Unless unforeseen difficulties should arise, it is believed that the dam will be completed early in 1925.

Illinois Central R.R. to Install Direct Current at 1,500 Volts

President Markham of the Illinois Central R.R. has announced the adoption by that road of the direct-current system at 1,500 volts for the electrification of its lines within the city of Chicago. This decision embodies the recommendations of a committee of engineers who have been studying the proposal since 1920 and is expected to exercise considerable influence on future terminal electrification in Chicago. The announcement of the decision was delayed by the death of A. S. Baldwin, vice-president in charge of terminal electrification, who had just returned from a detailed inspection of European installations. His duties have been assumed by D. J. Brumley.

The Illinois Central problem involves a heavy suburban passenger service, freight transfers between yards, switching in congested yards and eventually through passenger movements, all within terminal limits only. It is quite different from any electrification so far undertaken either in this country or abroad. The suburban passenger service will cover the main line from Chicago to Matteson, 28 route-miles; the Chicago branch, 4½ route-miles, and the Blue Island Branch, 4.4 route-miles. The track-miles involved are 125.

The suburban service is to be electrified by 1927, the freight service between 1930 and 1935, and through passenger service by 1940. Track depression now under way at a cost of $1,000,000 is to be followed by rearrangement of suburban tracks and construction of a new main passenger terminal and separate suburban terminal.

In a short time after the electrification is completed it is estimated that 240 cars electrically equipped will be required. The number of trains per day will be about 350 and the total suburban train movement will amount to about 5,000 train-miles per day.

The freight service north of Roosevelt Road, next on the program, will cover more than 40 miles of track, and as this is mainly yard trackage it involves difficult electrification problems.

Engineers Confer on Paving for Streets Having Railways

Pavement construction for streets having street railways and the character and the amount of pavement deterioration due to street-car traffic were considered at a conference of street railway and paving engineers held at the Philadelphia Engineers Club, Oct. 9. Location of utilities in streets; design of street railway structure; paving and drainage of streets for street-railway traffic; and to what extent pavement is affected by street railway traffic, were the nominal subjects for discussion. As a matter of fact remarks often wandered afield into pavement design in general and the effect of heavy truck traffic on pavement.

Theoretically the perfect location of utilities is: street railways in the center and all other utilities at the sides or under the sidewalks. It was agreed that wherever possible this plan should be followed in new construction. In extensions of streets into outlying territories being developed, many cities are now locating also subsurface utilities at the sides leaving the center clear of other structures than the railway track. This clean-cut separation is less practicable in built-up sections and particularly in the older heavily built-up business sections of the larger cities, but even here consistent effort can do much. In Philadelphia, even in the older and narrower streets, many of the utilities other than street railways as they are rebuilt are being relocated at the street sides; on occasions space has been condemned to accomplish this relocation.

Opinion on truck design ranged from the advocacy of perfectly rigid construction on a massive concrete base to flexible construction on ties and ballast, with the street-railway engineers reluctant to concede that the track or car traffic had any considerable deteriorating effect on the pavement and the city paving engineers contending that they were prime causes of pavement destruction. Many examples of pavement failure attributed to the action of street railway track were cited and shown by pictures. Failures developed first at joints and more particularly at crossings which were approximately at right angles. From these points they progressively spread. As explained by the city paving engineers, the vibration of the rails at joints and crossings are the causes.

While assenting to the claim that poor track construction contributed to pavement failures the street-railway engineers pointed out that many of the poor details of such practice had been or were being corrected and there was considerable promise that the future would show decidedly improved results. They insisted, however, that correspondingly better paving structure was needed. With modern truck loads, there should be thicker pavement, better foundations and far better drainage. Indeed it was the general attitude of the conference that paving practice generally had to be materially advanced to meet the present traffic loads and speeds.

Engineering Societies

Calendar

Annual Meetings

RAILWAY BRIDGE AND BUILDING ASSOCIATION, Chicago; Annual meeting Cincinnati, Oct. 17-19.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Convention, Cleveland, Oct. 16-19.

The Western Society of Engineers was addressed Oct. 2 by Jacob L. Crane, Jr., municipal development engineer, on "What Chicago Can Do Under the City Plan" and Oct. 9 by Floyd W. Parsons, editor-director *Gas Age Record*, on "Looking Ahead in the Fuel Industry." The program for the remainder of the month is as follows: Oct. 16, "Radio Broadcasting" by W. R. G. Baker, General Electric Co.; Oct. 23, a symposium of four papers on train control; Oct. 30, "Material Handling" by K. A. Wood, Cowan Truck Co.

The Minnesota Section of the American Water Works Association will hold its fall meeting Oct. 27 in Minneapolis at the University of Minnesota.

The Iowa Section of the American Water Works Association will hold its annual meeting Nov. 1, 2 and 3 in two cities, the first day in Iowa City and the two following at Cedar Rapids. An exhibition of water-works equipment and supplies will be held at the latter city. Jack J. Hinman is secretary-treasurer of the section but H. F. Blomquist, superintendent, Cedar Rapids Water Works, has charge of the exhibition.

The American Society of Civil Engineers at its meeting of Oct. 4 in New York discussed two papers, one on "Experiments with Models of the Gilboa Dam and Spillway," by R. W. Gaussmann and C. M. Madden and another on "Engineering Geology of the Catskill Water Supply," by Charles P. Berkey and James F. Sanborn. Both papers were printed in the September *Proceedings*.

Personal Notes

RUHLING & HOLDSWORTH, consulting civil and and municipal engineers, Detroit, Mich., announce the admission to partnership of HARRY L. HUDSON, formerly of the Detroit city engineer's office, and recently associated with the above firm. The business will be conducted under the firm name of RUHLING, HOLDSWORTH & HUDSON.

FRANK KESSING has severed connections with Kopf & Wooling, architects, Indianapolis, Ind., and has been appointed engineer for the Keynote Manufacturing Co., Indianapolis, manufacturers of septic tanks.

C. O. TALCOTT was elected highway commissioner of the Town of Glastonbury, Conn., at the annual town election held Oct. 2.

CARL CHRISTIANSON, who has been superintendent of construction for Grant Smith & Co., on the Washington Water Power Company's new Upper Falls power plant since January, 1921, has accepted a position as superintendent on the Skagit River power plant, being built by the City of Seattle.

CARL R. CAMP has resumed the business of general contracting and engineering, with offices in the Fuller Building, Philadelphia, which he engaged in prior to the World War.

THE HEFFNER ENGINEERING CO. is opening an office in Pikeville, Ky., to engage in mining and civil engineering. The chief engineer and president of the company is Earle B. Heffner, formerly chief engineer for the McKinney Steel Co., Wolfpit, Ky.

WALTER A. SPERRY, chief chemist at the Grand Rapids filter plant, has been appointed by City Manager Locke to be director of public service, succeeding GERALD J. WAGNER, who has resigned. LLOYD BILLINGS, assistant chief chemist, has been appointed to the position vacated by Mr. Sperry.

JAMES E. HANLON, formerly with Lockwood, Greene & Co. of Boston for many years, has opened an office in Boston, as an architectural engineer.

R. E. KELLER, of Crockett, has been appointed county engineer of Johnson County at Cleburne, Tex.

M. B. HODGES has been appointed county engineer of Uvalde County at Uvalde, Tex. Mr. Hodges formerly was state resident engineer at Griggs, in Burnet County.

C. M. HOWARD, a graduate of the University of Washington in the class of 1913, has accepted the position of assistant engineer with the Upper Columbia Orchard Co., Walla Walla, Wash.

HARVEY DEEN, of Austin, Tex., a state highway resident engineer recently in Van Zant County has been appointed superintendent of federal aid projects, Texas highway department.

E. BRYSON TUCKER has resigned from the power and mechanical department of the Consolidation Coal Co., Fairmont, W. Va., and is now with the A. S. Aloe Co. of St. Louis, Mo., importers and manufacturers of engineering instruments and supplies.

BEN F. DUPUY has succeeded as city engineer of Glendale, Calif., C. L. HILL, who has resigned to enter private practice.

A. J. HAMMOND has resigned as assistant chief engineer of the Chicago Union Station Co. and has become associated with James O. Heyworth and O. M. Strehlow in the engineering and contracting business. From 1891 to 1898 he was engaged in municipal engineering. After three years as assistant engineer on the Vandalia Ry. he returned to municipal work for eight years as city engineer of South Bend, Ind. During this period he was also chief engineer of the Northern Indiana Ry. and Southern Michigan Ry., and bridge engineer for the St. Joseph Co. In 1910 he became consulting engineer for Chicago on water tunnels and remained in the service of the city the three following years as engineer of bridges and harbors and chief engineer of the bureau of public efficiency. Mr. Hammond is president of the Illinois section of the American Society of Civil Engineers.

OBITUARY

ALAN TIMBRELL, resident engineer of the Ontario provincial highways department, died at Simcoe, Ont., on Oct. 3. Mr. Timbrell was born in England and was a member of the Engineering Institute of Canada.

THOMAS KING, a retired civil engineer, died at Wichita, Kan., on Sept. 25, aged eighty-nine. For twenty-five years he was with the A. T. & S. F. Ry. at Galveston, Tex.

FRANK S. WASHBURN, chairman of the board of the American Cyanimid Co., and a former trustee of Cornell University, died Oct. 9 at Rye, N. Y., aged 62 years. Mr. Washburn was graduated from Cornell in 1883. After considerable railway engineering in the Middle West he engaged in engineering construction work incident to the development of New York City's water supply. He was a member of the American Society of Civil Engineers and other technical bodies.

From the Manufacturer's Point of View

Lumber Industry Adopts Program for Standardization

Agreement has been reached by the central committee on lumber standards, which was appointed by the several branches of the industry last July, to formulate a program for simplification of the industry. It is planned (1) to collect and analyze all information that will aid in the simplification of sizes, grades, and names of lumber products; (2) to submit these findings to the producers, distributors, and consumers by means of the associations in these fields; (3) to promote discussion of the questions involved and to harmonize differences of opinion; (4) to establish a grade-marking and inspection service that will guarantee to the consumer the quality and quantity of his lumber purchases; and (5) to arrange a national conference of representatives of all branches of the industry which would finally adopt specific practices in these fields that will conform to the requirements of the Department of Agriculture and the Department of Commerce.

Contractors and Manufacturers Discuss Equipment Problems

Service on repair parts and standardization of equipment were discussed at a conference in Detroit, Oct. 3, of the executive and advisory boards of the Associated General Contractors and representatives of a score or more of prominent equipment manufacturers. The purpose of the conference was to arrive by frank discussion at a mutual understanding of the problems of the maker and the user of construction plant and materials and to create a joint committee to work out their solution.

An afternoon and an evening dinner session were held and a committee of fifteen was appointed to prepare a program for a future meeting and to formulate plans for investigation and research. The committee expects to call a second conference and present a preliminary report within the next two or three months.

Metal Lath To Be Standardized

Following the reduction in standard sizes of paving brick and lumber initiated by the Department of Commerce, work is now under way in the standardization of metal lath. A reduction from seventy-one to nine in the number of weights and styles of lath was recommended at a preliminary conference held at the Department of Commerce Oct. 2. The manufacturers have worked out a plan for this reduction which they believe will be acceptable to contractors and other consumers.

A general conference will be held Dec. 12 to which manufacturers, distributors and consumers will be invited. At that conference, it is expected that a definite conclusion will be reached.

Engineers Endorse Reduction of Asphalt Grades

Thomas H. MacDonald Chief of U. S. Bureau of Public Roads, for Greater Uniformity

FURTHER comment on the subject of fewer varieties of asphalt for road and paving work, presented in an article in *Engineering News-Record*, Sept. 28, p. 539 follows:

THOMAS H. MACDONALD
Chief, U. S. Bureau of Public Roads, Washington, D. C.

With reference to the article in the Sept. 28 issue of *Engineering News-Record* entitled, "Too Many Grades of Asphalt Specified, Say Producers," we are in agreement with the idea that a comparatively limited number of grades of hardness of asphalt should be satisfactory for the standard types of bituminous road construction in this country. The penetration limits mentioned in this article agree with our present typical standards except that we now have a grade ranging from 70 to 80 penetration for one-size stone bituminous concrete construction in the South and coarse graded bituminous concrete in the North, and at the present time we do not specify a lower limit of 30 except for joint filler.

It is quite natural that there should be a wide difference of opinion as to what specification limits are best adapted for different classes of construction in different parts of the country through a wide range of climatic conditions. The differences noted in the various specifications to some degree reflect the views of individual engineers who have studied their particular local conditions. In many cases the variations are so small that the same grade of asphalt would satisfy all of the specifications notwithstanding these variations.

The technical committees of the American Association of State Highway Officials are now working on various specifications including those for asphalt for construction, and no doubt standards will result from their work which will require the production of a comparatively limited number of grades of asphalt if these standards are universally adopted by the states. Attention, however, should be called to the fact that the specifications of the various specification-producing organizations are not mandatory, but are merely expressions of collective opinion from which there may be many dissenting views.

F. W. SARR
First Deputy Commissioner, New York State Highway Department, Albany, N. Y.

Commenting on the range of penetration suggested in *Engineering News-Record* of Sept. 28 for the proposed 7 standard grades of paving asphalt, I am of the opinion that the proposition of standardizing has considerable merit and the range of penetration of each of the grades would appear to be sufficient

from the engineer's point of view. Providing the refiners can produce material within the narrow limits specified for the lower penetration material, it would seem that the engineer should be satisfied to specify such limits.

It is respectfully suggested that the standardization proposed in the article be brought to the attention of the proper committees in the American Society for Municipal Improvements and the Association of State Highway Officials. It would seem that there should be no objection to the adoption by such committees of the proposed standardization of the several grades of paving asphalt.

A. W. DEAN
Chief Engineer, Division of Highways, State Department of Public Works, Boston, Mass.

I am heartily in accord with the idea of having fewer grades of asphalt called for by specifications. It is my belief that the users of asphalt would derive much benefit if either the 7 grades suggested by the asphalt manufacturers or those suggested by the American Society of Testing Materials were adopted.

The manufacturers could, if they would, furnish material at a lesser price, and I cannot conceive of any highway specifications that would not admit one of the 7 grades mentioned and give satisfactory results.

I believe that your magazine would be doing a public good if it contributes toward bringing about greater uniformity in asphalt specifications.

R. A. MACGREGOR
Assistant Engineer, Department of Public Works, Manhattan, New York City

It would seem to be a highly desirable attainment to reduce the variations in required characteristics of asphaltic cements. Standardization to a reasonable extent will always tend to economy and it is no doubt due to failure on the part of engineers to appreciate the difficulties of producers and the added costs that so many and so slight variations are called for.

From the table accompanying the article on p. 540 of your issue of Sept. 28, it is evident that the difference between two specifications for, say, penetration is often less than the tolerance that must be allowed above and below a given penetration. The same remark would apply to most of the other columns.

The argument is good that the variations in aggregates which constitute about 90 per cent of the pavement, are necessarily much greater than can easily be obtained in the asphaltic cement and that therefore it is a waste to attempt to control the asphalt cement so closely. This applies especially to the bituminous concrete composed of crushed stone or gravel for which the specifications tabulated are drawn.

The A. S. M. I. is now working toward fewer and simpler specifications and the article is timely, in view of the meeting of that society last week.

Further discussion of grades of asphalt, by Major F. S. Besson, Washington, D. C., and Julius Adler, Philadelphia, will appear in next week's issue.

Manufacturers Plan for Next Good Roads at Chicago

As a result of conferences between representatives of the Highway Industries Exhibitors Association and the American Road Builders Association, a convention committee composed of Charles M. Upham, state highway engineer of North Carolina; James H. McDonald, consulting engineer, Hartford, Conn., and S. F. Beatty, vice-president and general manager, Austin-Western Road Machinery Co., Chicago, has been named to control the next Good Roads Show to be held in Chicago, Jan. 15-19, 1923. Arrangements for the show are to be entirely in the hands of the exhibitors' committee. C. W. Kelley has been appointed director of exhibits, with offices in the Wrigley Building, 400 North Michigan Boulevard, Chicago, and all negotiations for space will be conducted through him. Allotments will be made in November.

The Good Roads Show will be staged in the Coliseum, but the convention sessions will be held elsewhere to avoid the necessity of shutting down the machinery on exhibit while the technical meetings are in progress.

Business Notes

REPUBLIC MOTOR TRUCK CO., Alma, Mich., has issued the following statement regarding the appointment Sept. 28 of the Security Trust Co. of Detroit, as receiver for the company: "The appointment by Judge Tuttle of the Federal Court at Detroit, was with the concurrence of the company and its largest creditors and is a step necessary in connection with the carrying out of a plan of reorganization. The business will be continued with Colonel Smith in charge of operations, and the details of the proposed plan of reorganization will be made public as soon as practicable. The REPUBLIC TRUCK SALES CORP. is in no way affected by the receivership of the parent company and will continue to handle its business as previously, in charge of the same management."

THE BROWN HOISTING MACHINERY CO., Cleveland, announces the appointment of E. P. Sawhill to take charge of its conveyor sales. Mr. Sawhill has had 30 years' engineering and selling experience on this type of equipment. The line he will handle for the Brown company includes belt conveyors, chain conveyors, coal crushers, screens and apron conveyors.

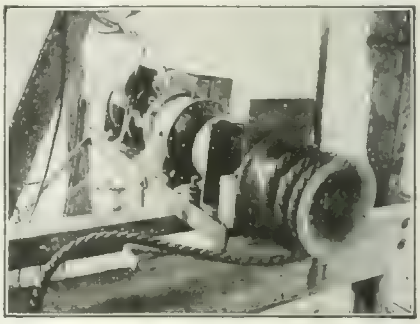
JOHN A. ROEBLING'S SONS CO., Trenton, N. J., put into effect Sept. 1 an employees' group life insurance and pension plan, graded according to length of service up to a maximum of $1,500 for eleven years of service or more. All employees more than one year in the company's service are insured for $500, this amount increasing by $100 for each additional year of service.

FOUGNER CONCRETE STEEL CO., New York, has sold its business to the Paul J. Kalman Co., Chicago, which will continue under its own name the business of engineering, manufacture and sale of reinforcing steel and allied products. The New York office, of which L. O. Helgesen is manager, will be moved from 29 Broadway to 110 East 42nd St. The entire organization of the Fougner Co. will be retained by the Kalman Co.

Equipment and Materials

Electric Caisson Hoist Unit

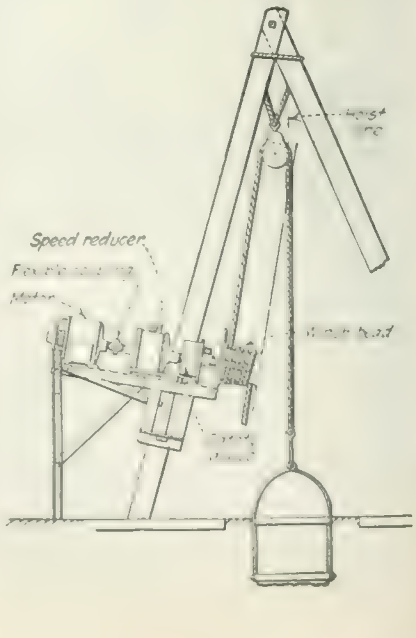
Unit hoists electrically operated for raising material from trenches, tunnels or open well caissons for building foundations are being used in Chicago instead of the usual endless cable operating a nigger-head at ten or twelve caissons. Should any difficulty with the cable arise, such as engine trouble, stranding or a worn shear, the entire



operation is at a standstill. Until all of the caissons are complete the power plant and operator for the whole work must be maintained.

By the unit system tripods are equipped with individual machines each operated by a 2-hp. motor controlled by the man on top. The machine has the necessary nigger-head with normal speed of 55 r.p.m., safety back-up device and a speed regulator for use in case wet wells are encountered and greater than normal speed is desirable.

Assuming the normal 6-weeks period for an ordinary caisson job, Falzer & Webber, equipment engineers, the makers of the machine, on which patents are pending, claim a monetary saving of $1,700. The machine has been used on trench work by the Henry Ericsson Co. on the Illinois Merchants Bank Building, by the W. J. Newman Co. on a caisson foundation job and by



the R. C. Wieboldt Construction Co., on tunnel operations on the Chicago Union Station job.

Light Weight Trailer Mixer

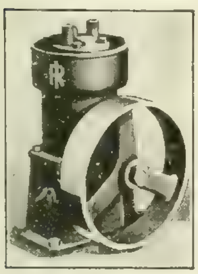
A light weight trailer-mixer in two types, two-wheel and four-wheel, equipped with pneumatic tires has been

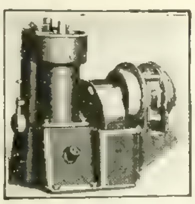
developed by the Jaeger Machine Co., Columbus, Ohio. The two-wheel type is simply the standard Jaeger 3-E mixer designed for trailer use. Its weight is 985 lb. In place of front wheels there is a steel support to hold the machine level while mixing.

Mobility is one of the chief features of this mixer. When ready to move it is merely necessary to attach the trailer to a truck or automobile and, with the pneumatic tire equipment, speeds of 20 to 30 miles an hour can be made. The mixer itself is of the revolving-drum batch type, driven by a 2-hp. gasoline engine. The capacity per batch of the 3-E two-wheel model is 2½ cu.ft. and of the 4-E model, four wheels, 4½ cu.ft. of mixed concrete.

Small Vertical Belt-Driven Air Compressors

A new line of small vertical belt-driven air compressors, known as Type 15, is announced by the Ingersoll-Rand Co., New York. In addition to the





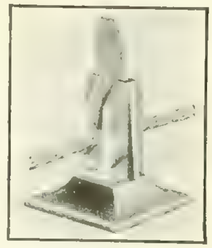
plain belt-drive design, each size is built as a self-contained electric motor outfit driven through pinion and internal gears by a short belt-drive.

Among the features of these compressors are a constant-level lubrication system, a constant-speed unloader for the plain belt-drive machines, a centrifugal unloader for start and stop control machines, and an increased size of water reservoir cooling pot.

The smallest size compressor is built with either ribbed cylinder for air cooling, where the service is intermittent, or a water-jacketed cylinder of the reservoir type for constant service. All other sizes are water-jacketed.

Wire-Rope Cutter for Field or Shop Use

For cutting wire rope quickly, cleanly, cheaply and without the use of heavy and expensive equipment, the A. Leschen & Sons Rope Co., St. Louis, announces the Burch patented wire-rope cutter, shown in the accompanying illustration.



The device consists of a body and a base casting, both of high grade steel, guaranteed not to break. High-carbon steel is used for the cutter blade and the lower cutting die and is properly tempered to insure long life and clean cut ropes.

Equipped with the base plate, the cutter can be used out on the job, although the stem of the body casting is made to fit the hardy hole of an anvil, thus permitting the use of the device in shops. Two cutting edges are a feature of the dies, so that when one is dulled the die can be reversed and its service doubled. The gross shipping weight of the complete cutter, with base, is 32 lb. It may be employed to cut wire hoisting and haulage ropes of all sizes up to 1-in. diameter.

Publications from the Construction Industry

Surveying Instruments—WARREN-KNIGHT CO., Philadelphia, has issued a 32-p. illustrated catalog of its engineering field instruments, drafting-room furniture and drawing materials. Sterling transits and levels are featured. For combined level and stadia work the company recommends its new disappearing stadia arrangement which permits the cross wires to be focused either with or without the stadia. The transit types include precision, light mountain, surveyors and contractors, and reconnaissance types. There is also a builder's level convertible into a sighting transit.

Gypsum Roofs—H. E. MARKS CORP., Pittsburgh, in a 16-p. illustrated booklet, sets forth construction details of gypsum roofs of both the poured-in-place and the pre-cast slab types. The outstanding feature of the Marks system, it is pointed out, is the production of a monolithic, poured-in-place slab, eliminating drip during erection and the necessity of building temporary forms and their supports in which to contain the aggregate. The centering is composed of steel T's and gypsum board. Reinforcement is supplied by welded wire. One of the chief claims for this type of construction is its light weight. The use of pre-cast gypsum slabs is recommened for use on extremely steep roof pitches where poured-in-place methods are not practicable. Tables are given showing safe loads for various slab sizes.

Crane Excavators—KOEHRING CO., Milwaukee, has issued two bulletins in the form of 4-p. folders illustrating and giving specifications for its No. 2 and No. 3 crane excavators, which are operated by gasoline engines. They may be equipped with either clamshell or dragline buckets. The No. 2 machine has a capacity of 12 tons at a 12-ft. radius and is equipped with a 40-ft. boom. The No. 3 unit has a capacity of 20 tons at a 12-ft. radius and also is equipped with a 40-ft. boom. The gasoline-engine capacities are, respectively, 70 and 100 hp.

Runoff and Discharge Diagrams—CLAY PRODUCTS ASSOCIATION, 133 West Washington Street, Chicago, has published a folder of runoff and discharge diagrams for drainage work. One diagram shows the runoff in cubic feet per second from areas of from 10 to 100,000 acres with various drainage coefficients, and the other diagram covers velocities and discharges for salt-glazed vitrified clay sewer pipe and drain tile.

Ventilating Equipment—B. F. STURTEVANT CO., Boston, has issued a new 44-p. illustrated catalog on air washers. It shows the various details of construction by which the air for any building or for any industry is washed and tempered before entering the building. The motors and pumps are also described and illustrated. Installations are shown in a city hall, a chocolate factory, a customs house, a theatre as well as other types of buildings. More than 12 p. are devoted to various tables giving dimensions psychrometric charts, diagrams, relative humidities and other useful data.

Rubber Products—GOODALL RUBBER CO., INC., Philadelphia, presents descriptive text and illustrations in a new 138-p. catalog dealing with a wide variety of rubber products used in construction work. These include semi-metallic and rubber hose, power transmission and conveyor belting, molded rubber products such as pump valves, diaphragms and packings. Flexibility in the semi-metallic hose is insured by the use of a special joint. Many different types of hose are manufactured for such purposes as steam and air drill work, grouting, pile-driver use and pumping. One section of the book is devoted exclusively to fire hose.

Line Shafting Equipment—MEDART CO., St. Louis, has issued a 193-p. illustrated catalog of its line shafting equipment, pulleys and other accessories relating to the mechanical transmission of power for manufacturing plants.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Production and Materials Stocks in Nine Cities

Lumber Output Within 2 Per Cent of Normal—Steel Improving—Cement Stocks Low—No Winter Brick Reserve

Steel—Production of steel ingots, proceeding at an annual rate of about 32,000,000 tons as against 19,000,000 tons in 1921; 41,000,000 tons in 1920 and 30,000,000 tons in both 1912 and 1913, the two best pre-war years for steel tonnage. The steel output has increased perceptibly during the last two weeks, and the industry as a whole is operating at about 65 per cent of capacity as against 50 per cent in August and 75 per cent in June. Sheet mills have accumulated stocks equal to three weeks of production, owing to shortage of closed cars; but mills shipping structurals, etc., movable on flat cars, have small reserves on hand.

Lumber—An average of 371 mills reporting weekly to the National Lumber Manufacturers' Association, for the four weeks ending Sept. 23, show 927,166,273 ft. cut, 807,507,615 ft. shipped and orders for 756,224,606 ft. b.m. Production fell off one per cent; shipments 3 per cent and orders over 14 per cent as compared with the first four weeks of August. Production, according to latest reports, is 2 per cent; shipments 14 per cent and orders 17 per cent below normal.

Cement — Output during August amounted to 11,664,000 bbl. as against 11,557,000 for July, an increase of 107,000 bbl., according to the Geological Survey. Shipments increased 511,000 bbl. despite the rail tie-up, leaving a reserve of 5,737,000 bbl. on Sept. 1 as compared with 8,433,000 bbl. available Aug. 1, 1922.

Brick—Ninety-two firms reporting to the Common Brick Manufacturers' Association of America as of Sept. 1, show production, 48,000,000 brick behind orders on books, with shipments 2,000,000 in excess of production. This condition indicates a danger of again going into the winter months with no reserve stocks.

San Francisco—Plenty of sewer pipe, brick, hollow and clay drain tile and other clay products. Stocks low on cement, track supplies, wire nails and structural rivets. Large supplies of native road oils and asphalt. Fair stocks of structural steel.

Denver—No important changes during month except in cement. Car shortage causing falling off in cement supply; further delays anticipated.

Minneapolis—Stocks of various building materials fair, with the exception of cement, which is reported "sold out." Railroad situation slightly improved; stocks of sewer pipe, brick and hollow tile replenished. Empty cars holding back shipments of many commodities. Lumber situation improving.

Detroit—Cement shortage being relieved by shipments from nearby mills. Plenty available for early deliveries. Ample reserves of lime, brick and sewer pipe. Lumber supply, moderate. Large deliveries of hollow tile take several days. Very little asphalt at hand.

New Orleans—No market for asphalt and crushed stone; stocks of common brick and dynamite, small. Deliveries in hollow tile also slow. Fair demand for lumber but mills are unable to fill orders, owing to shortage of flat-cars. Yellow pine about 25 per cent normal.

Atlanta—Delays in obtaining supplies, though close at hand, owing to car situation. Deliveries in sand, gravel, sewer pipe and hollow tile take three to ten days. Plenty of common brick and pine lumber. Only two cars of steel structurals, five cars of lime and ten of cement, on sidings.

Philadelphia—Some sizes of sewer pipe still to be had in small quantities; but on most sizes market is depleted and orders are being filled from cars on sidings. Asphalt being shipped at brisk rate. Paving blocks, wood blocks, sand, gravel and crushed stone being delivered as rapidly as produced. Cement, lime and hollow tile stocks, depleted. Brick producers will not accept orders for delivery in less than sixty days. Stocks of structural timbers scarce but finishing grades of lumber, fairly plentiful. Plenty of explosives and manila rope.

Birmingham—Stocks of all construction materials larger than usual, owing to lack of cars for shipping out orders.

New York—Car, labor and fuel shortages have combined to create a scarcity of sewer pipe, at sources supplying New York City. Lime and brick shortages have been completely overcome. Impossible to get lumber from mills under seven to nine weeks.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example (common brick, Denver, 2,000,000), time required for delivery of carload lots to city job, example (sewer pipe, Atlanta 10 days); and stocks on hand in general terms, example: (cement, Minneapolis, sold out)

	San Francisco	Denver	Minneapolis	Detroit	New Orleans	Atlanta	Philadelphia	Birmingham	New York
Sewer pipe	Plenty	Del. 24 hr., local plant	Improving	Ample	Enough	Del. take 10 days	Depleted in principal sizes.	Large	Shortage in certain sizes
Cement	Low	Stocks dwindling; car shortage.	Sold out	Shortage relieved.	Meeting demand.	10 cars	Low; but shipments improving.	Plenty	Stocks low.
Lime	Fair	Plenty	Ample	15 cars	Ample	5 cars	Depleted better shipments	Extensive	Plenty; shortage overcome.
Common brick	Enough	2,000,000	Improving	Plenty in local yards.	Insufficient	Plenty	No. del. under 60 days.	Larger than usual.	Enough, demand still good
Hollow tile	Fair	Sufficient	Enough	Moderate; del. take several days.	Low	Del. take 10 days.	Depleted	Unusually heavy.	Not affected by car situation; del. by water.
Lumber	Delayed mill shipments	Dealers' stocks ample	Normal for season	Moderate stock	About 25 per cent of normal.	Plenty pine	Structural timbers scarce.	Plenty pine.	Not under 7@9 weeks from mill.
Asphalt	Large reserves	10 cars		Small	No market		Heavy	Ample	Refineries well stocked.
Structural steel	Fair; low on rivets.	....	....	....	....	2 cars shapes	Del. slow from Pittsburgh.	Heavier than usual.	Mill. del. affected by car shortage.

Foreign Construction Being Done By New York Firms

Three more important foreign construction projects are here added to the lists as published in *Engineering News-Record* on April 20 and June 15, respectively. The dredging project is located in South America, with the two buildings in the West Indies. The first group of contracts, published on April 20, consisted of projects under way in Cuba, Belgium and Japan. The second list, in the issue of June 15, was confined exclusively to South America. This, together with the accompanying table, showing the three latest and most important foreign jobs awarded to New York contractors, indicates the tendency of American construction forces to incline toward the tropics.

Name and Address Of Contractor New York City	Kind of Work	Where Work Is Located	Cost	When Started	Expected Completion	Name of Owner
Purdy & Henderson 45 E 17th St	Yacht Club	Havana, Cuba	$500,000	May 22, 1922	Jan 1, 1923	Havana Yacht Club, Havana, Cuba
Purdy & Henderson 45 E 17th St	Hotel	Nassau, Bahamas	$1,000,000	June 22, 1922	Feb. 23, 1923	Munson Steamship Co., N. Y. C.
Foundation Co 120 Liberty St	Dredging Canal	Cartagena Colombia, S. A.	$500,000	Aug 22 1922	Aug 22, 1923	City of Cartagena, Colombia, S. A.

Federal Aid Road Bids Compared by Geographic Divisions

Average accepted bids on Federal Aid road projects, during August, showed rates for rein. concrete construction ranging from $1.85 in New England to $2.26 per sq.yd. in Ohio. The average rate for New York was $1.08, and did not include state furnished cement, at $2.93 per bbl. The average rate, therefore, for the nation would be about $1.36 per sq.yd. for rein. concrete surfacing. Rates for plain cement concrete ranged from $1.40 in Alabama to $2.81 per sq.yd. in North Carolina, with an average for the country of $2.30 per sq.yd. The only work involving bituminous concrete surfacing was located in North Carolina at the rate of $2.70 per sq.yd. Bituminous macadam, however, cost $1.49 per sq.yd. in Virginia as against $1.84 in Ohio, 45c. in New York and 41c. in Maine, giving an average rate for the nation of $1.08 per sq.yd. Steel structurals ranged from 4c. in Ohio to 6c. in New York, with reinforcing steel at 4c. in New York and Ohio; 6@7c. throughout the South and 9c. per lb. in South Dakota, an average of 5c. per lb. for steel generally.

In the accompanying table unit-bid prices are given for items and materials furnished in place on the job. Gravel bids are listed by square or cu.yd., depending on the specifications of the various states. About $3.30 per sq.yd. represents a fair average for brick paving, throughout the country.

Car Shortage Affects Pennsylvania Highway Construction

Grave concern is felt by the Pennsylvania State Highway Department over the situation now confronting it, on account of transportation difficulties which will make it impossible to complete roadways, now in course of construction, during the present season unless some relief is afforded. The Governor conferred, on Oct. 3, with officials of the State Highway Department and members of the Public Service Commission on measures of relief.

Assistant State Highway Commissioner George H. Biles in a recent interview said:

"The progress of State Highway construction has been seriously impeded for several weeks, due to strikes, labor and car shortage and embargoes and, at the present time, the situation is very acute. On only two-thirds of the one hundred and sixty contracts now in force was paving work carried on, the past week. Reports received at the main office today indicate that contractors on over half of the program are about to the point of exhaustion in the supply of materials.

"One week ago there was only sufficient material stored on these contracts to take care of about twenty-two miles of pavement. When it is considered that this is distributed among a large number of contractors, it will be but a few days until they will be entirely out of material resources and unable lay pavement.

"Everything is being done to alleviate the situation but under these abnormal conditions efforts are apparently of no avail. If there is no early change for the better, sections of highways on our main thoroughfares, in which are included many borough streets now under construction, will be in practically an impassable condition during the winter months."

Next week—résumé of recent public bond sales, showing rate, yield, price and by whom handled.

STATEMENT OF AVERAGE ACCEPTED BID PRICES ON FEDERAL AID PROJECTS DURING AUGUST, 1922

ITEMS AND MATERIALS FURNISHED IN PLACE ON PROJECT

	Surfacing										Steel				Cement Furnished by State	
	Gravel		Bit. Macadam		Bit. Concrete		Pl. Cement Conc		Re. Cement Conc.		Reinforcing		Structural			
Geographic Divisions and States	Sq Yds	Rate	Sq Yds	Rate	Sq Yds	Rate	Sq Yds	Rate	Sq.Yds.	Rate	Lbs.	Rate	Lbs	Rate	Barrels	Rate
Totals for all States	161,460	0.43	365,026	1.08	168,890	2.70	393,145	2.30	131,077	1.36	3,593,903	0.05	421,040	0.05	56,980	2.93
New England			38,505	0.41					39,924	1.85	345,400	0.05				
Maine			38,505	0.41					39,924	1.85	345,400	0.05				
New Hampshire																
Vermont																
Massachusetts																
Rhode Island																
Connecticut																
Middle Atlantic			133,056	0.45			7,875	*1.46	85,885	*1.08	777,200	0.04	11,750	0.06	56,980	2.93
New York			133,056	0.45			7,875	*1.46	85,885	*1.08	777,200	0.04	11,750	0.06	56,980	2.93
New Jersey																
Pennsylvania																
East North Central			82,382	1.84			30,196	1.47	5,268	2.26	1,207,048	0.04	320,890	0.04		
Ohio			82,382	1.84					5,268	2.26	1,177,153	0.04	320,890	0.04		
Indiana																
Illinois																
Michigan																
Wisconsin							30,196	1.47			29,895	0.05				
West North Central											386,004	0.05				
Minnesota											384,367	0.05				
Iowa																
Missouri																
North Dakota											1,637	0.09				
South Dakota																
Nebraska																
Kansas																
South Atlantic	23,100	0.50	111,083	1.49	168,890	2.70	315,857	2.44			314,550	0.07				
Delaware																
Maryland	23,100	0.50					166,250	2.14			64,016	0.07				
Virginia			111,083	1.49							22,944	0.07				
West Virginia																
North Carolina					168,890	2.70	132,770	2.81			227,590	0.06				
South Carolina							16,837	2.43								
Georgia																
Florida																
East South Central							617	1.40			206,771	0.05				
Kentucky																
Tennessee																
Alabama							617	1.40			206,771	0.05				
Mississippi																
West South Central											261,750	0.06				
Arkansas											74,700	0.07				
Louisiana																
Oklahoma																
Texas											187,050	0.05				
Mountain	138,360	0.24									83,180	0.07				
Montana																
Idaho																
Wyoming											83,180	0.07				
Colorado																
New Mexico																
Arizona																
Utah																
Nevada	138,360	0.24														
Pacific							38,600	2.08			12,000	0.06				
Washington																
Oregon							38,600	2.08			12,000	0.06				
California																

Prices of items or materials containing State furnished cement and bitumen which was not included in total cost of the item are marked thus—*

Projects Under Consideration at Vancouver

Staff Correspondence

In the city of Vancouver, B. C., several engineering projects have been receiving detailed attention of late and are frequently accorded front page treatment in the daily press. Prominent among these are: (1), the decision to investigate the development of a municipal hydro-electric project for which purpose the city has selected a consulting engineer, as noted elsewhere in this issue; (2), the proposal of the McClintic-Marshall Co. of Pittsburgh, Pa., to build a bridge for $1,240,000 across the second narrows to connect Vancouver and North Vancouver, and preliminary plans for which have been approved by the Dominion engineer of public works; (3), the recent sale of a $300,000 sewer bond issue with the proceeds of which extensions to the greater Vancouver joint sewerage system in the south part of the metropolitan district are to be made; (4), the proposal to form a Greater Vancouver Joint Water Commission so that the seven adjoining municipalities who share the Vancouver water supply may participate in financing needed extensions of the main supply system; (5), the proposal to pave the highway from Vancouver to the international line so the city may share in the business brought by the rapidly increasing number of automobile tourists that come from eastern points to all parts of the Northwest that are accessible on good roads; and (6), ways and means of replacing or maintaining a considerable part of the 800,000 sq.yd. of wood block paving in the city which has given considerable trouble due to swelling and buckling of pavements when wet weather comes after periods of drought.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of October 5; the next, on November 2.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb.	+$3.14	$3.65	$4.20	+$3.02½	+$3.15	$3.80	$3.25	$3.75	$3.75
Structural rivets, 100 lb.	3.85	4.35	6.00	3.35	+3.77½	4.80	4.50	+5.00	6.50
Reinforcing bars, ¾ in. up, 100 lb.	+3.04	3.50	3.50	+2.92½	+3.05	3.97½	3.00	3.75	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	57%	61.15%	45%	59½%	58.9-5%	43%	47.9%	45%	30.00
Cast-iron pipe, 6 in. and over, ton	55.30	49.00	51.50	+48.70	+55.50	60.00	51.00	+54.00	+55.00
Concreting Material:									
Cement without bags, bbl.	2.60	2.54	2.25	2.20	2.39	2.85	2.71	2.90	+2.88
Gravel, ¾ in., cu.yd	1.75	2.00	2.25	2.00	1.75	1.75	2.25	1.00	1.50
Sand, cu.yd	1.00	1.35	2.25	2.00	1.00	0.75	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	1.65	1.60	2.25	3.50	2.25	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59.00	42.00	40.00	+51.00	+41.00	39.75	+35.00	24.50	50.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.14½	+1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	18.00@—19.10	12.00	10.90	11.00	18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	.09	.065	....	.11	.08
Hollow partition tile 4x12x12, per block	+.1230	.0776	.115	.0808	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	+.93	—.97	1.13	.97	1.00	—1.08	1.04	.86	—1.06
Common Labor:									
Common labor, union, hour	.60	35	....	....	......	.50@.55	56¼	.50@.60	....
Common labor, non-union, hour	.44@.60	.30	.25	72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding, brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par.) Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Steel shapes and reinforcing bars up 10c. per 100 lb. in New York, Chicago and Minneapolis warehouses, during last fifteen days. Seattle advanced structural rivets to $5 as against $4 per 100 lb. last week. Shapes and bars, $2@$2.25 f.o.b. Pittsburgh, on ordinary business, for indefinite deliveries; $2.50 per 100 lb. quoted on structurals, however, where deliveries are specified at earliest possible time consistent with rail embargoes, now holding up all but food and fuel shipments. Railroads doing the bulk of steel buying; 113,000 cars, purchased thus far this year as against 28,000, last year.

Connellsville foundry coke up 50c. per ton. Advance of 50c. per ton in No. 2 foundry pig iron at Birmingham and the same on basic at Pittsburgh. Following rise in pig iron comes the quotation of $48.70, as against $46.86, on 6-in. c.i. pipe in Chicago; $54, advanced from $53, in Seattle; $55.50, up from $52, in Minneapolis, and $55 as compared with $50 per ton in Montreal.

Structural timbers, long-leaf yellow pine, up $2 in Chicago; Douglas fir advanced $1 in Minneapolis and $2 per M ft. b.m. in San Francisco.

With slight improvement in the fuel situation and a seasonal slackening in demand, common brick quotations are now at $15@$16 wholesale, alongside dock New York, as against $15@$17 per M, last week.

Common lump lime, however, rose 5c. per bbl. in Atlanta and hollow tile advanced $11.80 per M in New York.

Raw linseed oil up 2c. in New York; down 2c. in Atlanta, 4c. in Denver and 6c. per gal. in Montreal.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—James H. McGraw, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren *Editor*

Volume 89 NEW YORK, OCTOBER 19, 1922 Number 16

A Good Technical Meeting

REPORTS from the San Francisco meeting of the American Society of Civil Engineers indicate a repetition of the success of the one at Dayton last spring. Evidently these quarterly sectional meetings have taken hold. They afford opportunity for the members in different sections of the country to get together under the auspices of the society itself, with the society's general officers and with a certain number of members from outlying districts—all of which have attractions superior to a local meeting which is frankly local and draws only on local attendance. Then, too, at both Dayton and San Francisco the technical sessions were centered around a single subject, with accompanying increase in interest over the scattered subject matter typified by the rather dull technical sessions of Portsmouth last June. Careful attention to location and subject should serve to prolong the success of these meetings indefinitely.

Pavement Explosions

A REPETITION of pavement failures all alike and all apparently from the same cause, such as are described in this issue in the brick and concrete road in King County, Washington, is seldom recorded. The occurrence is not unique, except perhaps in respect to the explosive violence of the ruptures. On a bituminous road on a concrete base, recently observed, a substantially similar repetition of surface and base ruptures has occurred. Other examples are remembered. In all the explanation has been: difference in the rates of expansion of base and top and lack of expansion joints—which is no explanation. All pavement slabs expand and contract and except here and there they are serving their purpose without repeated ruptures, both with and without expansion joints and over a period of years. There is some more obscure condition than exists in the ordinary brick or bitumen or concrete road, which induces the disastrous results from expansion that are recorded on the King County road. It would be interesting to learn what it may be. As a matter of fact, however, the importance of getting the secret is not particularly great. Too few brick or concrete roads fail in the manner described to make the knowledge why they fail worth much. Nor is it of much significance that an occasional failure of this character is experienced and it should by no means be accepted as a reason for passing judgment on any type of pavement.

The Stadium—An Economic Anomaly

OHIO STATE UNIVERSITY has done well in attempting to utilize some of the space in and around its new athletic stadium for full-time service. Gymnasiums, swimming pools, indoor tracks, offices, drill halls, are all part of the necessities of a college which might be housed under the ample roof formed by the sloping stands and thus make these popular structures somewhat less of an economic anomaly than they now are. At Columbus this week fifty or sixty thousand enthusiastic rooters will witness the dedication of the new stadium. Once a year, probably, certainly not more than four or five times a year, will the sixty-odd thousand seats be filled, but no doubt in common with most other college stadiums its cost will be paid by the admissions to the first few games staged. So long as the books show a profit it would be quixotic to protest against such waste of use or to note that for a few hours' amusement the community is paying out a sum which would endow many chairs in the college or maintain a hospital. Only a misanthrope would deny the right, and probably the duty, of man to spend some of his substance in vicarious recreation; the ball park needs no moral or economic justification. The crime of the stadium is its occasional use and that might be averted by a more extended application of the Ohio plan. Thus may be partly obscured the reproach of a million or more lying idle three hundred and fifty days in the year in a community which finds it difficult to pay its leaders a living wage.

Planning for Efficiency

WHAT has been done at Ohio State University toward developing at some future time the indoor-space possibilities of the stadium is but one phase of exceptionally careful planning that preceded its construction. Without deprecating the kind or amount of thought embodied in earlier college stadiums we may give the Ohio structure special distinction for the degree to which efficient and economical construction were made the objects of detailed study in the course of its design. The plan which resulted from this study was worked out, not conceived in a flash of creative imagination. The engineer's method rather than that of the architect was followed. Yet it does not appear that any loss of architectural effect was suffered, for in point of harmony, dignity and impressiveness the Ohio stadium is second to none—to our own taste, we hasten to add, since esthetic appreciation is notoriously variable. Fortunately, individual judgment can be based on the drawings reproduced in this issue. They also supply the data for judging of the success or lack of success of the planning for efficiency in space and structure. Against all college field traditions a two-deck arrangement was adopted—a feature likely to become the regular thing in very large stadiums. An interesting composite construction of part steel frame and part reinforced-concrete frame was used to save time and money, and it is worth special note that its economy was checked by bids on an all-concrete design. The anticipated advantage of being able to hasten construction by erecting the steel frame during the winter was fully realized in actual execution. The expansion problem, which has been a source of many troubles in the past, was dealt with in radical fashion, by putting in

full cross-joints every 60 ft. and closing them off with an elastic seal. Practically all prior stadiums have proved seriously defective in their treatment of expansion, and the Ohio solution was adopted only after the designers had visited nearly all of them, to study the practical working of other methods. In fine, the Ohio stadium is noteworthy in many ways, and unless its service performance belies all present promise, it will create precedent in stadium design.

An Innovation in Arch Centering

FALSEWORK for engineering construction is marked usually by an extravagant use of material rather than by intelligent design. The practice is a relic of the day when timber cost little and neither economy of use nor salvage after use was an object of much monetary significance. Then arches were "filled with timber" and the contractor proclaimed the safety of his centering by asseverating that "you couldn't chase a rabbit through it." It is the recollection of this ancient practice, which has been by no means discontinued in modern times, that gives the precisely designed timberwork of the Beechwood Avenue Bridge center, described on another page, the appearance of supreme boldness. What the contractor did here was to design a framework without superfluous members to carry a determined load, combining timber and steel so as to put each material to its most economic service. Timber was used for posts and struts and steel for ties and beams and for the connections of the two materials at joints. In fact the designer did no more than produce in steel and wood instead of steel altogether the type of structure commonly known in its early days as the railway viaduct, represented first by the Kinzua Viaduct and later by the Pecos Viaduct and since by scores of similar structures all over the United States. The centering was bold in no greater degree than were its prototypes in steel so long as the designer kept safely within the strength properties of the materials which he employed and fabricated his combined timber and steel structure with approximately the precision with which all-steel structures are fabricated.

Water Supply at Panama

IN VIEW of misgivings, rarely voiced but widely circulated, as to the water supply of the Panama Canal, Mr. Baxter's discussion elsewhere in this issue is of particular interest and value. Especially is it helpful to learn that of the water flowing into Gatun Lake during 1920, the driest year of record since the lake was formed, 12 per cent only was used for locking, while 26 per cent developed power and 47 per cent was wasted. Further development of the watershed, already projected, will save much of the waste and will provide for power generation without diverting the flow from lockage use. Meanwhile the reserve steam-plant at Miraflores stands ready to release some of the water used for power whenever it is needed for lockage. All things considered, Mr. Baxter concludes that with the projected development of the Chagres watershed the operating capacity of the locks will become the limiting factor rather than the water supply. The date on which this limit may be reached cannot, of course, be estimated with precision but the conclusion to await a more evident trend of traffic growth is sound and conservative. Mr. Baxter performs a service in reminding us that the narrow and tortuous sea-level channel considered fifteen years ago could not begin to meet present and prospective needs, and that a genuine "Straits of Panama" would involve difficulties and expenditures quite unwarranted by any demands now in sight. His article deserves a thoughtful reading not only by engineers but also by all those who may be seeking an antidote for the alarms as to the canal's future.

A Significant Resignation

IN DR. S. W. STRATTON the Massachusetts Institute of Technology is getting something more than the scientist it has been its custom to select for president. Trained though he has been as a physicist Dr. Stratton's greater reputation rests on his remarkable success as an administrator of that government bureau which he developed from a mere office of weights and measures to a research institution with personnel and equipment rivaling many a university. The Bureau of Standards is Dr. Stratton's work. That after twenty-one years service to it he should leave for other fields, however attractive, is significant evidence of what is happening in the technical service of the government. It is reported that he is to receive a salary three times what he has been getting at Washington, which, coupled with the honor and opportunity for service in the new position, is enough to influence any man's decision. But we believe more potent than the personal element has been the realization of the hopelessness of getting Congress to provide adequately for the enormous research plant that has grown up on Cleveland Heights. The institution which Dr. Stratton has fairly wrung from a reluctant Congress has enormous potentialities of service, but so niggardly have been the appropriations since the war that one by one the experts who serve it have been leaving, like their chief not so much because of the greater pecuniary rewards elsewhere—for to men of the true research spirit pay beyond a competence is not irresistible—but because the lack of money for assistance and equipment makes of their work a drudgery which is the breaking straw added to the low pay common to all government technical service. Dr. Stratton's resignation is a protest that Congress cannot well afford to disregard.

The Direct-Oxidation Process

CONSIDERING the time, money, oratory and printers' ink lavished upon it, no method of sewage treatment yet commercially promoted in the United States has been so coldly received by engineers as the Landreth direct-oxidation or lime-electrolytic process. The reasons are not far to seek. The electrolytic processes (without lime) of Webster, L'Hermite, Woolf and Harris had been tried and found wanting during the quarter century of promotion effort in England, France and America before lime treatment and electrolytic action were joined. Lime treatment, after decades of wide use in various countries, had been passed by in the case of new sewage-works and given up at many old plants because it increased the sludge problem—long ago characterized as the crux of the whole matter of sewage treatment. These two facts made engineers skeptical as to the proposed combination of two processes, one regarded by them as never successful and the other largely superseded.

That skepticism was far from dispelled by the small Landreth test plant at Elmhurst, Borough of Queens, New York, and by the larger demonstration plants of the same type at Decatur, Ill., and Easton, Pa. The

report on the Easton plant by the Engineering Division of the Pennsylvania Department of Health left the lime-electrolytic process still in doubt, as regards cost and the sludge problem. The Franklin Institute test at Easton—and its gold medal award—was not taken seriously by well-informed engineers, except as they thought it a serious matter for the Franklin Institute to award a medal in the light of the facts, existing or lacking.

The conditional permits granted by the New Jersey and Pennsylvania Departments of Health for direct-oxidation plants at Phillipsburg, N. J., and Allentown, Pa., the former after an application had been denied, did not add to the confidence of engineers in the process, nor did attempts to exploit the results at the two plants when being operated at only a small percentage of their capacity. Although the Phillipsburg plant has been nominally in operation for some two years, it was not until a few months ago that the New Jersey Department of Health began the long-expected test called for by the conditional permit (report on which has not yet been made public), while the Pennsylvania Department of Health has not yet passed upon the Allentown plant.

In the light of the foregoing statements it is not strange that when the direct-oxidation process came before a considerable number of consulting and municipal engineers at the recent Cleveland meeting of the American Society of Municipal Improvements (see abstracts of papers and discussion elsewhere in this issue) no warmth for the process was shown by anyone except the engineer of one of the two cities where there is a Landreth plant in use and by the only consulting engineer who, so far as we can recall, has ever recommended to a city the adoption of the direct-oxidation process.

Meager indeed were the data offered by either of these engineers in support of the physical or financial efficiency of the direct-oxidation process, although reference was made to a test of the Allentown plant extending over some weeks. Presumably these test figures will be made public before long. It is also to be hoped that the results of the Phillipsburg tests, already mentioned, will be given out by the New Jersey Department of Health as soon as it takes official action on the plant.

The skeptical opinion on the Landreth direct-oxidation process, both as expressed at and before the Cleveland meeting, has not been due to the fact that the process was being commercially promoted as one of the speakers at Cleveland held, but rather that it was being over-promoted and that on meager data and with too little regard to the teachings of the past and the rational demands of the present in the art and science of sewage treatment.

Reaction Against Standardization

ONE need not lack faith in the benefits derived from industrial standardization to recognize that the process is, in a measure, at odds with progress. Progress depends upon original endeavor, upon doing things differently; standardization forbids doing things differently and asserts that original endeavor is quite unnecessary and disturbing. When one shape, one type, one way of doing a thing has officially been decreed best, and mass momentum is brought into action to make it exclusive, progressive thought on the subject matter will largely be paralyzed, or else diverted to other fields. Also, directed study in connection with the standardization object will shrink to a minimum. Research is antipodal to standardization.

These reflections are awakened by an English contemporary's plaint over the lack of originality, the mental deadness, which (it charges) characterizes bridge engineering. Standard designs, it asserts, are welcomed by men who lack imagination, and these men will make no effort to change such designs or develop original designs. This statement seems to refer primarily to conventional bridge types that have become established through commercial processes, but to some extent also to standard specifications for bridge design, for in another sentence there occurs a sharp allusion to the doubtful wisdom of framing such specifications. The remark is meant for English conditions, presumably, but it might furnish food for thought west of the Atlantic as well, were our bridge engineers not somewhat touchy just now on the subject of time-honored design practices, as in the case of the Cooper loading.

The complaint probably has more of a temperamental than a real basis, so far as the bridge engineer's special art is concerned. It is a matter of common knowledge that no branch of civil engineering displays as much originality and creative thought as this one. The real significance of the complaint lies in the fact that it reasserts the old truth known to all, but often ignored, that engineering design and construction are creative processes, and as such are at war with conventions and standards.

Protest usually is the expression of a hurt, somewhere or other. In the present case it is pertinent to observe that the complaint comes from a land where uniformity of practice in engineering or its allied industries has ever been abhorred and everyone has gloried in doing things differently, and where, as an offset to this condition, standardization in the mechanical industries was first put on a wholesale basis. The work of the Engineering Standards Committee, recently re-formed as an association, has extended over an almost unlimited range, and, far from being confined to matters involving interchange or economy of production, it has gone into fields where uniformity of practice is little more than an ideal objective. Hitherto the prevailing sentiment of industrial and engineering circles appears to have supported the work. The present protest, whose real point is directed against this all-embracing standardizing movement, is the first open demand that engineering originality, creative design, be left undisturbed.

Is it an early symptom of a reaction against the standardization movement? The two points of originality and research are brought to the fore as they inevitably must be whenever free, active development is contrasted with routinized procedure and the stagnation which it entails. Even in bitterly unjust assertions, as in the charge that engineers build bridges "with as much regularity as a baker turns out standard buns," the English protest voices the exasperation caused by the attempt to make engineering creation subject to standardized method.

Here in the United States we are only beginning to standardize. Discussions have dealt chiefly with industrial standardization, but already the attractive and promising process is extending to matters of engineering design, where judgment and individuality are decisive factors, as they are in bridge construction. For this reason it can be of much value for us to observe that attention has been called to the essential antagonism between engineering and fixed convention, and that a call is voiced for return to originality of effort and resumption of research inquiry.

Ohio Stadium, a Double-Deck Steel and Concrete Horseshoe

Structure of Novel Design Planned for Compactness and Quick Construction—Space Under Seats for Indoor Activities—60-Ft. Expansion Sections—Outside Steel Covered with Concrete

THIS week one of the important football games of the Mid-West College Conference will be played in the new stadium of Ohio State University, which has just been completed. This latest addition to the great college arenas is unique both in its general planning and in its structural features. The design represents an original answer to the question of how the most efficient arrangement of seating for the vast crowds which witness large college games is to be secured and how the structure should be designed for most impressive appearance as well as for economy of construction and permanence.

Horseshoe shape with bowed sides and double-deck arrangement—in which latter point the Ohio stadium differs from all other college athletic stadiums—are the striking elements of the design as regards best adaptation to purpose. Steel framing and reinforced concrete were used in skillfully arranged combination, for economy and for most rapid construction, as the steel framework permitted uninterrupted erection during the winter. The structure has been designed, further, to permit of extensive use for indoor athletic activities of the students, by developing the inclosed space under the seat banks. A thorough treatment of the expansion-joint difficulty is believed to eliminate all future trouble from the destructive and annoying expansion and contraction effects experienced in earlier stadiums. This feature, and the protection of all steelwork open to the weather by concrete inclosure are believed to insure permanence and minimize the cost of maintenance.

Location and Plan—The stadium is located in the valley which separates the main group of buildings of the university from the Olentangy River. Its axis was laid out practically north and south, the open end of the horseshoe facing the south. The site was submerged in the flood of 1913, but subsequent river improvement work in Columbus has reduced this flood hazard to a minimum; during the flood of last April, when more water passed through the river channel than at any time since 1913, the playing field (el. 725) would again have been overflowed had the river improvement work not been completed. It will be further protected by a boulevarded dike along the river bank.

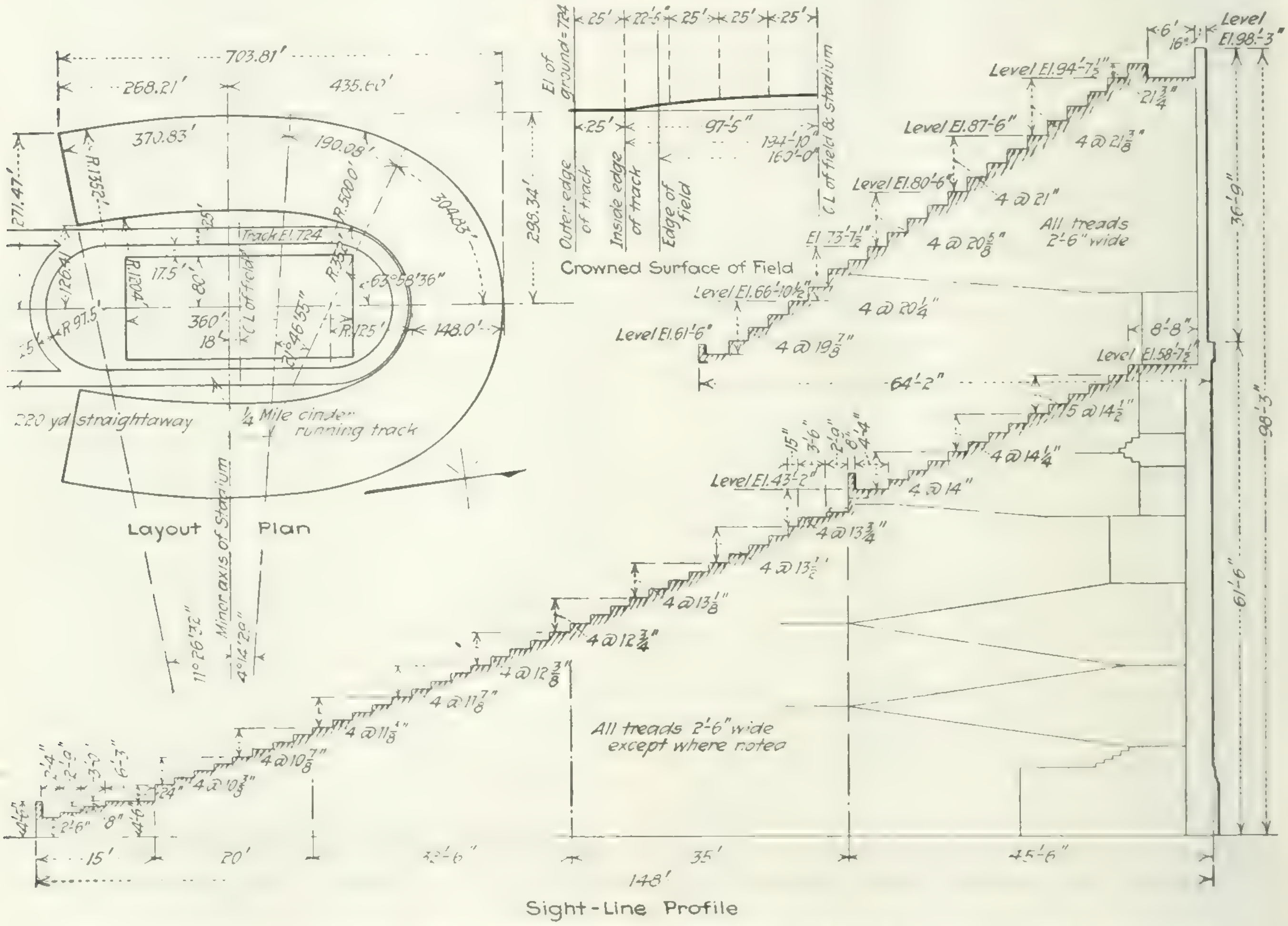


FIG. 1—GENERAL LAYOUT AND SIGHT LINE PROFILE OF THE NEW STADIUM AT OHIO STATE UNIVERSITY

The general arrangement of the structure embodies what the designers have called the Ohio plan, comprising an open-end horseshoe shape of structure with bowed sides, and double-deck seat banks. The bowed sides give the double advantage of a slightly better angle of vision and a comprehensive view of the entire crowd, and are

expected to enhance greatly the inspirational effect of the great assemblages of people in holiday spirit. The double-deck idea is not new in baseball grandstands, but has never before been used in a college athletic stadium. It brings one-third of the seats about 50 ft. nearer to the playing field without materially increasing the height of the structure; in addition it reduces the ground area covered and provides protection from the weather for about one-third of the seats.

A plan of the stadium is shown in Fig. 1. The structure is about 704 ft. long by 597 ft. wide over all, and incloses a space 556 ft. long by 294 ft. wide. The gridiron field of 170 ft. by 360 ft. is surrounded by a quarter-mile track 25 ft. wide, with straightaway extentions at the open end of the horseshoe. The profile of the seat banks is hollow, to give the upper seats full command of the field; it was so worked out as to enable every spectator to see the middle of the track, over the heads of those in front of him. By arranging the aisles and entrance stairs at the columns, obstruction of view by the columns has been almost eliminated.

The stadium will seat about 62,000 persons (3,100 box chairs, 59,000 regular seats). The total length of seat bank exclusive of aisles is about 90,000 lin.ft.

Adapting the space under the seat banks for future development for indoor athletic activities increased the cost of the structure somewhat, chiefly by necessitating wider column spacing than would have been most economical and by making it necessary that the seat banks should be watertight. By closing the arch openings in the outside walls with steel sash and glass at some future time the interior will be fitted for use for intramural sports such as basketball, handball, squash, winter trackwork, and the like. Under the west seat bank a six-lap cinder track and a 100-yd. straightaway have

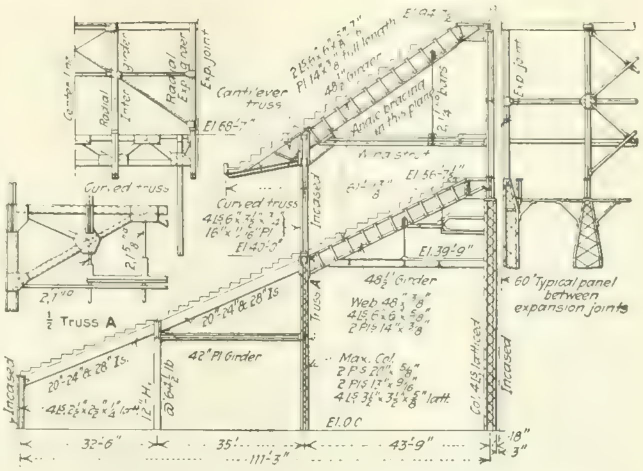


FIG. 3—STEEL COLUMN-AND-GIRDER STRUCTURE PERMITTED WINTER ERECTION

been laid out, also for future construction. Ornamental rectangular towers which form the south termination of the end of the horseshoe will provide space for offices for the athletic department of the university, as well as shower and locker rooms for the athletes; each south tower will accommodate about 500 lockers, so that not only the regular athletic teams but also other students registered in intramural athletics can be taken care of. There are frequently as many as 1,000 men participating in intramural sports at Ohio State, and the hope of the authorities is that all students may ultimately join in the athletic work in some degree.

The wide spacing of the columns necessary to accommodate these various activities made a steel frame more economical than a reinforced-concrete frame. Also, the time necessary for building the stadium was shortened

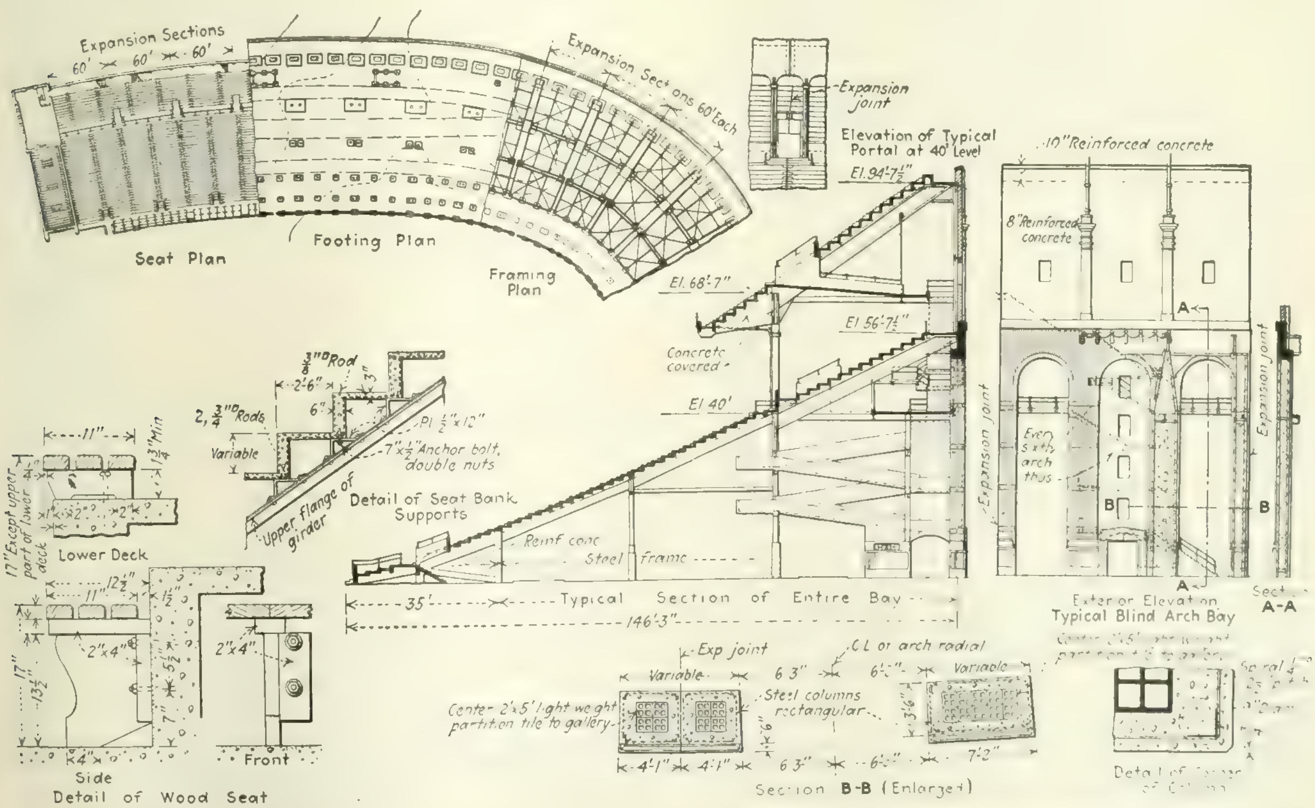
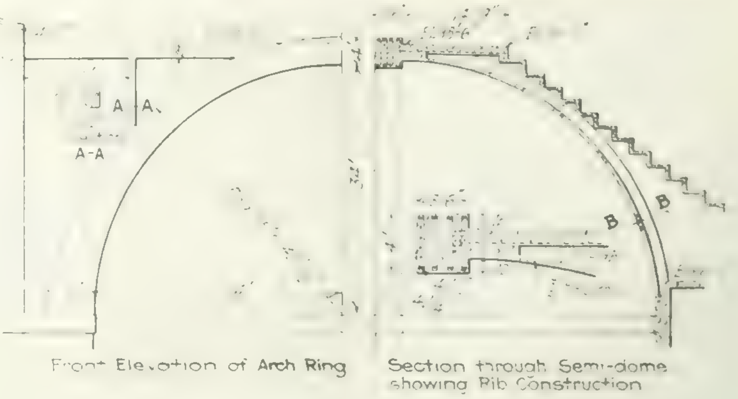


FIG. 2—GENERAL DETAILS OF OHIO STADIUM—REINFORCED-CONCRETE SEAT-BANK SLABS SUPPORTED ON STEEL FRAME INCLOSED WITH CONCRETE WALLS

by about a year through the use of the steel frame, because the steelwork could be erected during the winter months, when concrete could not conveniently be placed. The structure of the stadium therefore is a somewhat unusual composite of steel and reinforced concrete, as may be seen from the sectional drawings in Fig. 2. The lowest portion of the seat-bank structure, comprising space for boxes and eight rows of seats, is wholly of reinforced concrete. The structure beyond this point consists of a series of radial steel bents built up of columns, girders and beams, spaced 20 ft. apart along the outer circumference, topped by a reinforced-concrete seat-bank slab spanning from bent to bent, and closed off at



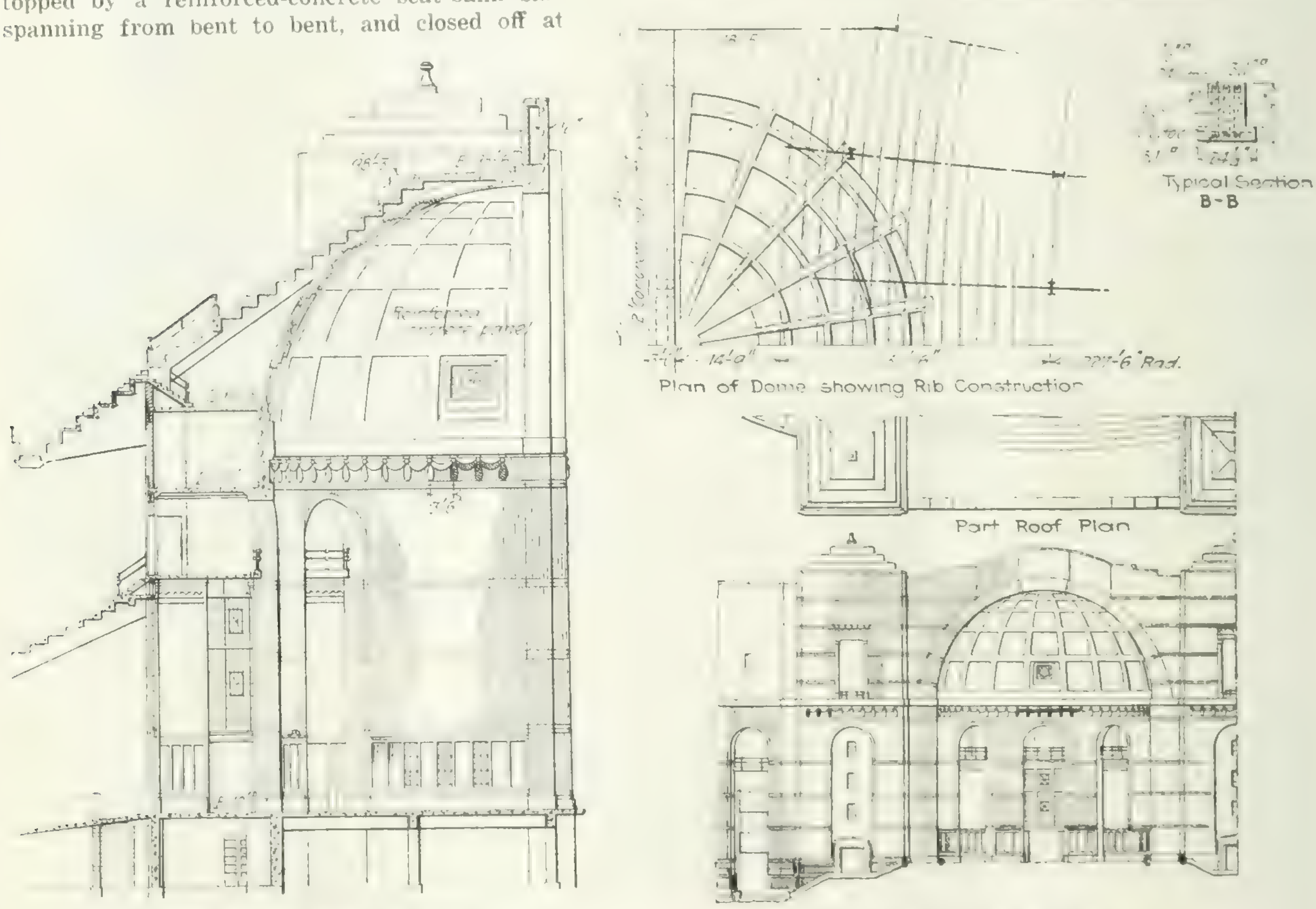


FIG. 1—CONSTRUCTION ELEMENTS OF HALF DOME AT CROWN OF HORSESHOE

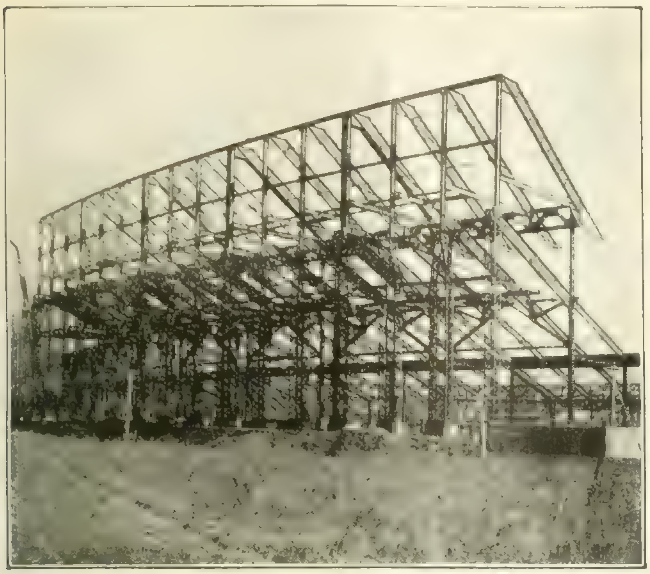
the outer circumference by a concrete wall pierced by high arch openings. The bents on 20-ft. spacing have direct column support only at their outer and inner ends, while at the intermediate lines of support they rest on trusses or girders spanning between columns placed only at every third bent, or approximately 60-ft. spacing.

Detail Points of the Structural Design—Plate girders and rolled beams were used for the supporting members not entirely covered by concrete, in order to reduce the deterioration due to rusting and to facilitate painting. No unprotected steelwork is exposed to the weather, all outside columns and girders being incased in concrete. Doors, walls, seat banks, stairs and passageways are of reinforced concrete.

Designing the steelwork to support the forms for the concrete work made it possible to eliminate most of the shoring and scaffolding that would otherwise have been required. The steelwork also served for carrying the necessary hoisting engines and travelers for handling the concrete and forms (see Fig. 6).

A live-load of 80 lb. per horizontal square foot, with 25 per cent added for impact, was assumed in designing the frame. This figure corresponds to a total live-load of 250 lb. per lineal foot of seat (30-in. length of step from riser to riser).

Expansion Provisions—At intervals of 60 ft. along the length of the stadium a transverse expansion joint cuts through the structure from top to bottom. The steel frame as well as the concrete slab, floor, and wall construction of each 60-ft. section is independent of the neighboring sections. The expansion joints are so detailed that there is no sliding of one part upon another, but the adjoining slabs and members are supported by twin columns and girders (the separation in the steelwork may be seen in Fig. 5). The concrete of adjacent



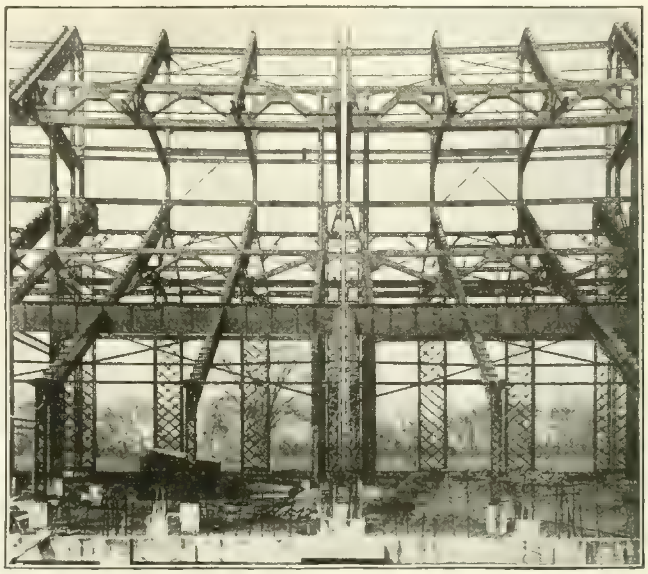


FIG. 5—TWO VIEWS OF THE STADIUM STEELWORK AS IT APPEARED LAST SPRING

sections is separated about ¾ in., the thickness of an ordinary form board, and this opening is closed by a U-shaped lead sheet bedded in the concrete, over which the joint is filled with asphalt mastic. Where the joint goes down through the outer wall, no lead strip is used but the joint is filled with ¾-in. premolded bituminous joint filler. This feature is clearly shown by the details in Fig. 8.

Foundations—Excellent boulder gravel for the foundation occurs near the surface on the east side of the structure and 10 to 14 ft. below ground level (or about 4 ft. below ground-water level) on the west side. All footings were built as spread footings on this gravel, except in a few small isolated footings where it was simpler to stop the structure at a higher elevation and drive concrete piles through the upper strata to gravel.

Soil bearing tests showed gratifying results; a pressure of 7½ tons per square foot on the gravel, maintained for a week, showed no settlement after application, although water was allowed to rise in the hole and was pumped out repeatedly. The footings were proportioned for a maximum dead- and live-load pressure of 4 tons per square foot. All footings were proportioned on the basis of the dead-load bearing area, for a unit pressure slightly under 2 tons, fixed by the maximum of 4 tons per square foot.

Main Entrance—At the north end of the structure is the main entrance, a great half dome 70 ft. in diameter and 85 ft. high, flanked by towers accommodating ticket offices, rooms for spot lights, flood lights, radio apparatus, etc. The design of this half dome was an interesting problem because of the necessity for providing for the outward thrust at the crown. The thrust is taken care of by a horizontal slab directly over the crown of the dome, at the top of the upper deck, which is designed to act as a horizontal girder capable of carrying this thrust.

The dome is framed with a face arch of semi-circular intrados of 68 ft. diameter supporting radial half ribs of generally T-shaped cross-section, joined by horizontal ring girders of concrete. The panels between ribs and ring girders are filled by separately molded concrete slabs of ornamental design. At two points the upper ends of the seat-bank girders of the upper deck had to be supported on the dome, for which purpose a short horizontal I-beam was placed so as to span between adjacent ribs, and the seat-bank girder was supported on this beam. Two other seat-bank girders which project over the dome area were carried by columns just back of the springing line of the dome, cantilevering backward over these columns.

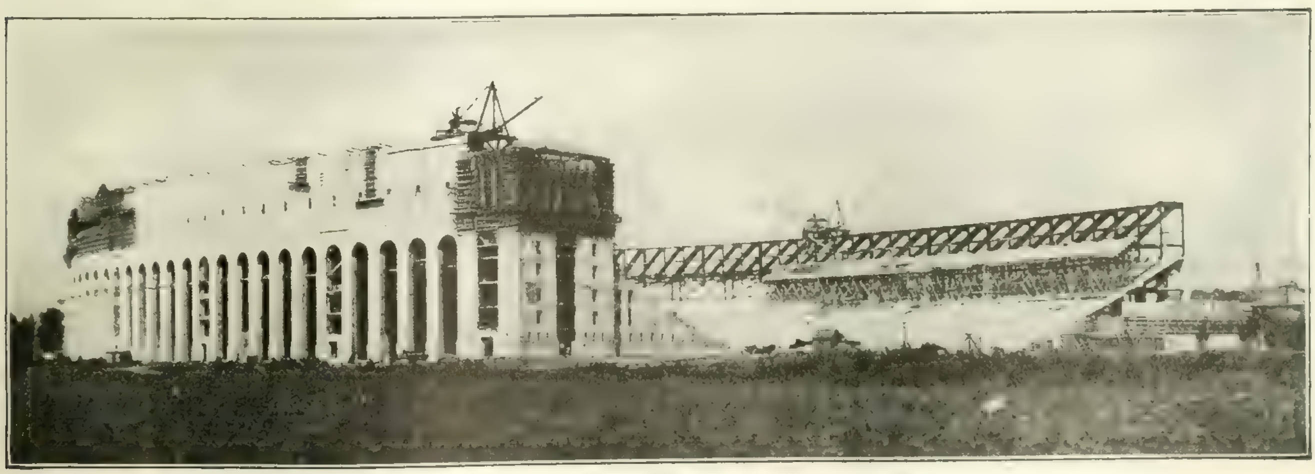


FIG. 6—CONCRETING IN PROGRESS; TRAVELERS ON UPPER DECK HANDLING FORMS AND CONCRETE

Seats and Ramps—The concrete steps which form the seat banks are uniformly 30 in. wide radially but vary in rise; those on the lower deck have rise increasing from $10\frac{3}{8}$ in. at the bottom to $14\frac{1}{4}$ in. at the top, while those of the upper deck have a rise increasing from $19\frac{1}{2}$ in. to $21\frac{3}{4}$ in. Wooden seat benches without backs are built on these steps. The bench seats are made of $1\frac{5}{8}$ x 3-in. oak strips, spaced 1 in apart for drainage. The provision of free drainage and opportunity for air circulation are expected to prevent warping and decay

Entrance to the structure is afforded at six points on each side of the horseshoe. As tickets are to be taken at each entrance, the distribution of the crowd will largely occur outside the structure itself, and the need for distributing passages within the stadium is minimized. A combination of stairs and ramps at each entrance gives access to two circulating galleries in the rear of the structure, one, at El 39 ft. 9 in., to feed the upper half of the lower deck, the other, at El. 67 ft. $10\frac{1}{2}$ in., to feed the upper deck. The lower half of the lower deck will be fed direct by entrances from the field side of the structure. The passageways and ramps are $5\frac{1}{2}$ ft. wide, and generally they are U-shaped structures with the vertical handrail portion serving as longitudinal girder.

Position of Forms Prescribed by Designer—No effort has been made in construction to obliterate or rub out

FIG. 7—INTERIOR OF NEARLY COMPLETED STADIUM

the form marks on the concrete surfaces. The design predetermined the location and direction of all joints in the forms, which was shown on the contract drawings. The joints were planned in each case to give the desired architectural effect. As concrete is generally appreciated to be a molded material, it was believed that the marks of the molds would be a frank expression of the material. The results obtained in the field are very gratifying, the effect produced being satisfactory in every respect.

Playing Field—The field inclosed by the stadium is surfaced with 2 ft. of top soil drained by 4-in. tile in herring-bone arrangement 6 ft. apart, 18 in. below the surface. The fill below this level is cinders and miscellaneous excavation soil. As shown in a small sketch in Fig. 1, the football gridiron is crowned 12 in. in its width. The quarter-mile running track around the field

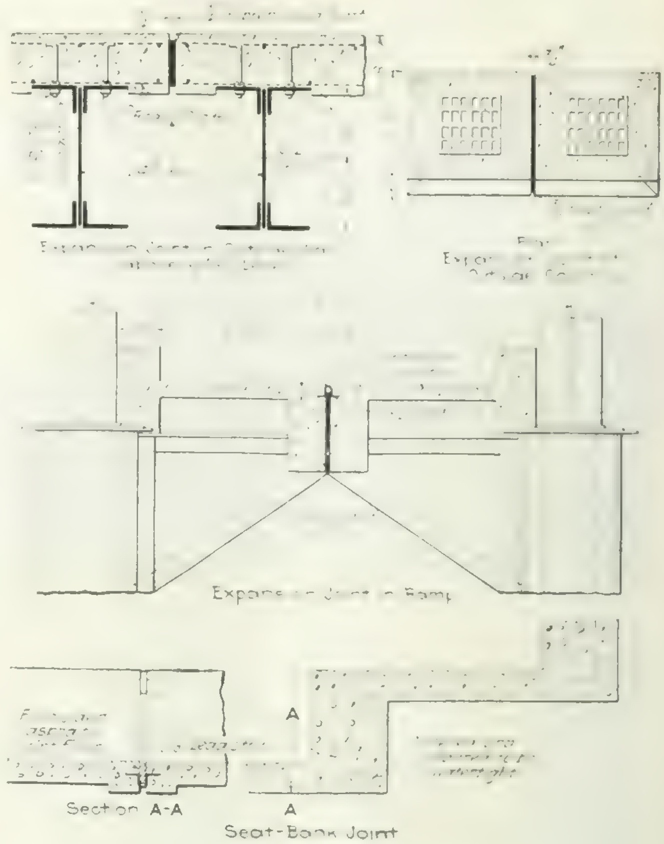


FIG. 8—EXPANSION JOINT DETAILS

consists of the usual gravel base and cinder surface.

The stadium is being built by the Ohio Stadium Building Committee, with Clyde T. Morris, professor of structural engineering at Ohio State University, as engineer, and Howard Dwight Smith as architect. W. F. Hindman is assistant engineer in charge of the field work. The contract for the construction was taken by the E. H. Latham Co., of Columbus, on a lump-sum profit-sharing basis. The total cost of the stadium, the surfacing of the playing field, and all auxiliary items will be about $1,500,000.

About 4,300 tons of structural steel and 25,000 cu.yd. of concrete were required for the Ohio stadium. The contract for construction was signed July 7, 1921, and ground was broken Aug. 3. Dedication of the completed stadium is to be celebrated at the football game between Michigan and Ohio State on Oct. 21.

To Build Elevators in Bulgaria

According to information reaching this journal from Sofia, Bulgaria, an agreement has been arrived at between the Agricultural Bank and the MacDonald Engineering Co., Chicago, regarding the construction of a line of 60 grain elevators throughout Bulgaria. The agreement is now before the government's legislative body for consideration. It is planned to construct during the first five years elevators of a total capacity of 160,000 tons with a view ultimately to doubling the capacity. Funds are to be obtained by a loan of £2,000,000 (English) placed through the Agricultural Bank abroad. Present plans contemplate the construction of two elevators and two dryers at Black Seaports, 12 elevators on Danubian ports and 46 elevators in the interior.

Lost Time in Construction—3

Rain and Mud Delays

Delays Analyzed Remedies Enumerated Drainage, Machine Design, Trackways, Housing, Waterproofing, Drying Methods Offer Possibilities — Problem Calls for Research

By C. S. Hill
Associate Editor, Engineering News-Record

Third of a Series of Four Articles

RAIN and the consequent result, mud, in all operations where the condition of the ground surface is a factor in construction, are, next to winter idleness, the principal causes of lost time. The amount of time lost annually because of rain and mud delays is difficult to estimate. There are few statistics. Indeed except for highway construction they are non-existent. This makes it extremely difficult to appraise the problem. In fact about all that can be done is to visualize it by inference from occasional records and general knowledge.

Delays caused by rain are of two sorts:

1. Interruption due to storm itself: i.e., violent or persistent fall of rain or combined wind and rain, and

2. Waiting to recover from the effects of rain, i.e., waiting for the mud to dry, for flooded workings to be pumped out, for washing or scouring to be repaired, and for equipment to be cleaned and dried.

The weather and the character of the work determine the magnitude of both kinds of delay and the relative importance of each. It is plain for example that rain counts for little in hydraulic dredging and is a great hindrance in building a concrete road. Other contrasting examples are readily called to mind. In all, one outstanding fact is evident; it is the consequences of rain and not the stormy condition itself which are responsible for the greater loss of time. This truth will be more evident as the argument proceeds. It is important to get it clearly in mind because it indicates the only possibility of solving the problem.

Obviously prevention cannot be considered. The rain will come as it happens. Whenever it comes it will bring certain consequences. Most disturbing of all, it soaks the ground and makes mud. But it also damages materials, as for example cement; it runs into the workings, like footing pits and trenches; it makes objects slippery and awkward to handle; it washes and gulleys embankments and finished grades; it injures structure, like newly laid concrete; it wets the work going on and prevents construction until the moisture has been dried—a brick pavement, for example, rained on has to be dried before the bituminous filler can be applied; it makes it necessary to clean and dry tools and machinery to prevent rust and keep them in good condition. Finally, of course, men object to working, and sometimes cannot work, when the rain is falling.

Ordinarily the storm conditions themselves do not often completely stop work and less often do they stop it for any considerable period. Rain in the summer comes usually as showers. The showers may be frequent and rather violent while in progress but they do not last long. Could we imagine the dry condition just before the rain to be restored immediately after it ceased to fall, rain would not greatly delay construction processes. Of course in the early spring and late fall rains are more continuous, and the delays due strictly to storm are more protracted, but even then, were the effects eliminated, work would not often have to be altogether abandoned. As a hard-bitten old earth mover once put the fact to the writer, "We don't stop work because it rains but because the rain is wet."

All that has just been said is distinctly elementary but a clear understanding of the facts in detail is vital to a definite statement of the problem to be solved. This problem is essentially to guard against and moderate the *consequences* of rain. Four general methods suggest themselves for consideration:

1. Employ equipment and methods unaffected by rain.
2. Modify engineering requirements for wet weather construction.
3. Employ means for diverting or shedding rain water or for drying wet surfaces.
4. Housing or sheltering the work from rainfall.

Contemplating these several methods broadly it is evident that their possibilities depend upon the conditions and character of the operation. Altogether, however, there are not many kinds of construction where some protective or defensive measures of the sort enumerated are not to some extent practicable. This requires, however, that the operation be planned for the probability of wet weather as well as for sunshine. It is the contrary practice that largely causes a rainy season to be so completely upsetting when it occurs.

Construction operations, in respect to the disturbance caused by rain, may be grouped under (1) earth moving, (2) road building, and (3) general construction. In fact, in operations (1) and (2) are included substantially everything. We do not need, ordinarily, to consider dredging, tunneling or interior building work. The building of concrete structures, steel erection, timber work and structural work generally are affected by rain only as storm affects the comfort and safety of the erecting crews and consequently their efficiency and as wet roads may interrupt the delivery of materials.

Earth Moving—Water-soaked soil and mud hamper earth moving operations by increasing the weights to be handled and by clogging buckets and other excavating tools, but chiefly by hindering the movement of men and teams or machinery over the ground. Saturation affects soils differently. Sand and gravel give a firmer footing when they are wet. Clayey soils, gumbo and alluvial silt, turn into mud. All soils are made heavier by saturation.

Among the possible remedies previously enumerated it is evident that housing is not widely possible and that drying processes are ordinarily impracticable.

Drainage first and, second, the use of machines and hauling methods unaffected by soft ground are the obvious procedures.

Drainage is logically the first resort of the earth mover in protecting his work. It has a considerably different purpose than ordinary ground-water drainage of pits, and cuts. Its primary object, for the purpose here considered, is to divert run-off or surface water from the workings and its second is to get quickly out of the workings the undiverted surface water; it is only its last purpose to care for seepage. The first step in improving methods of wet weather earth moving requires us then to:

1. Study of methods of diverting surface water from pits and cuts by ditches and of removing undiverted water from the workings.

Mud and most water-soaked soils hinder and endanger the movement of equipment, and, particularly, all hauling operations. There are two ways of overcoming this difficulty. One is to employ machines capable of traveling over soft ground. The other and the more important way is to provide solid tracks.

In machine equipment the most important development of years is the crawler traction. Non-clogging or self-cleaning buckets and conveyors for excavating machinery are a second line of development. A third improvement, in the respect that it reduces haulage to serve the machine, is the substitution of gas-engine and electric power for steam power. Most of these improvements have been prompted more, or quite as much, by other reasons than avoidance of bad-road troubles, but they cover this purpose also. In brief, earth moving equipment is designed primarily for dry weather operation and is provided as a secondary consideration with devices or attachments to meet certain outstanding wet weather requirements.

The second task of improving wet weather excavating methods is then:

2. Review earth moving machinery design with the fact in mind that it must operate probably a third of its time in rainfall or in material water-soaked or made muddy by rain.

Ordinarily in excavation the surface condition of the ground affects the hauling service to and from the excavator more seriously than it affects the excavator itself. Track or hard road construction is the obvious remedy. The vehicle itself has been improved to some extent, as by crawler traction or wide tired wheels, but this is not the logical line of development. This is to put the vehicle on a track or a hard road. Such service roads are temporary and require more or less frequent change of location. These requirements indicate the third task which has to be performed:

3. Investigate the design of service railways, plankways, etc. (1) to improve their strength and rigidity and (2) to perfect their portability; determine at the same time the best practice in constructing, keeping up and shifting service railways.

It deserves emphasis that some form of trackway is, so far as practice has determined, the principal solution of the wet weather haulage problem. Its design and construction have been so far in the hands of earth moving contractors, who have considered it a temporary tool deserving no more attention than that necessary to get it through its period of service, or else in the hands of manufacturers who have had primarily the commercial viewpoint. Given a thorough engineering study trackways appear capable of a development which promises largely to overcome wet weather haulage delays in excavation.

While housing of excavation has been dismissed as generally impracticable there appear to be oportunities for its adoption. In trench excavation and in subgrading highways the possibilities of tenting over sections so as to eliminate largely the effects of summer showers and light rains appear to be large.

Road Building—Rain and mud delays are emphasized in road building for the following reasons: (1) Practice requires so close a finish on subgrade that a very light rain is sufficient to stop work; (2) there is heavy hauling for long distances over unimproved roads; (3) the fine surface required on concrete roads is easily marred, on fresh work, by rainfall.

Under these conditions, on practically every day there is rain, paved road construction is interrupted. This year in Pennsylvania, up to July 22, it had rained on 34 of 82 working days. In Iowa last year, about 15 per cent of the calendar days of the season worked were lost due to rain and mud. On 13 per cent of the days worked rain and mud caused delays in excess of 45 minutes. Time lost in road building because of rain and mud is, therefore, probably not much less than 15 per cent of the total working season. How can this lost time be curtailed? Investigations of the question seem promising in the following directions:

1. Determine whether engineering limitations on wet weather work cannot be safely enlarged so as to extend the boundaries of rain and mud conditions within which construction is approved.

2. Determine the possibilities of housing. (Canvas tents on timber frames which roll on the side forms are widely used to protect green concrete pavement from sunshine and rain. Could not the same arrangements be adopted to shelter finished subgrade? They would seem practicable with industrial railway haulage on road-side tracks.)

3. Determine the possibilities of water-proofing the subgrade to shed rainfall. (Crowned subgrades have been found helpful in shedding water. A sprinkling of road oil has been advocated and given a tentative trial.)

4. Determine the possibilities of blotting up the mud layer by sprinkling the subgrade with sand, stone chips or other dry material.

5. Determine whether and under what circumstances drying is practicable. (Driers made like those for drying brick pavement for bituminous filler or like the heaters used in repairing asphalt pavement and traveling on the forms like a finishing machine seem to offer possibilities.)

As in earth moving, hauling is the outstanding wet weather problem in road building: first, it is the controlling construction operation; second, it is the one operation which has most possibility of disturbing greatly a previously accomplished operation—subgrade maintenance is virtually at the mercy of hauling methods. Investigation of methods of hauling least affected by rain and mud surpasses in importance any other task. In character it is virtually the same as in earth moving: (1) developing machines for soft ground and mud operation and (2) developing trackways for vehicles and machines.

Generalization—From the facts brought out in discussing earth moving and road building two broad generalizations for construction as a whole are possible:

1. Plan construction operations for wet weather conditions. (In present practice these conditions are recognized in the shape of a percentage added to the cost of work to cover rain and mud delays. What should be done is to plan carefully to reduce the delays themselves.)

2. Develop equipment and methods which rain and mud will least interrupt. (So far what has been done is incidental. The results are erratic. Brought together and analyzed, however, some degree of correlation and generalization is practicable and from this a statement is possible of the lines of development to be pursued.)

Economic Problems—As in every other factor of the problem of lost time in construction, one is confronted in considering the loss due to rain and mud delays by a great lack of means of valuation. There are almost no figures. Even formulated thought appears to be lacking. Quantitative statements are possible only by information. The condition would be discouraging except that it indicates a brilliant opportunity for research of the most useful character.

In order to make some attempt to present the situation specifically let us consider road building; it is disturbed more than most work by rain and also it is the operation for which we have a few records.

It may be assumed that a day on which it rains is a lost day in road building. It is true that many of the rains will be showers which will not delay operations a full day; but there are enough other protracted or night rains which will prevent operations for a part or the whole of a following fair day to maintain the average of a day lost for every day on which there is any considerable rainfall.

Inquiry made of road contractors in practically every state east of the Mississippi between the Canadian boundary and the Mason and Dixon line indicates that one day a week of rain is a conservative estimate This was about the average in Iowa in 1921, which was an exceilent year for roadwork. This year in the east the average has been 2½ days a week. Assuming one day a week and a 25-week season production is curtailed one-sixth or 16⅔ miles for every 100-mile unit of a roadbuilding program.

These figures will probably not be equalled in any other kind of construction, but in all kinds there will be some decrease in output due to rain. What is the loss? Obviously it is of two sorts:

1. Loss by the contractor of the service of his organization, equipment and involved capital and

2. Loss by the owner of the services of the postponed structure.

What do these errors amount to in dollars and cents? Without precise figures we know that a loss of even 10 per cent in output in an industry whose product fetches three billion dollars a year is enough to warrant serious consideration. But precise figures are exactly what we must have. No proclamation of generalities will induce action. The following questions have to be answered specifically and quantitatively:

1. What percentage of the working season is wasted because of time lost because of rainfall and its consequences?

2. What is the loss, represented by delays in construction, caused by these delays due to rain?

3. What means are practicable of reducing delays due to rain and what amount will they add to the cost of construction?

The fourth article of this series, developing the problem of delays due to management, will appear in our next issue.

Oil-Engine Drive for Dipper Dredges

IN THE excavation of drainage ditches the use of machines operated by internal-combustion engines often has particular advantages in eliminating the trouble and expense which would be incurred in supplying and distributing coal for steam boilers. At the National Drainage Congress, held in Kansas City in September, the use of oil engines for dipper dredges was the subject of a paper by Geo. B. Massey, consulting engineer, Chicago, a summary of which follows:

In dredges operated by oil engines the engine may drive the machinery directly by means of clutches or it may drive an electric generator supplying current to motors for the different mechanisms. In the former case a belt drive is usually employed owing to the distance from the engine to the machinery. In the latter case there may be one main generator or a separate generator for each motor. Although this second arrangement is more expensive it uses less power since no resistances are required for control. In fact it is considered better than a steam engine in the relations of torque and speed. On a dipper dredge the oil-engine occupies the position of the boiler in a steam machine.

Most of the oil-engines used in this class of work are of the semi-Diesel type, and in the vertical engines the air for scavenging the cylinders is compressed usually in the crankcase to about 2 lb. pressure. A modified horizontal design has a separate compressing chamber, which arrangement permits of higher pressures. To start the engine, an electric heating coil is used or a torch to heat a plug in each cylinder head. With the straight Diesel engine the charge is ignited by the temperature due to high pressure of air in the cylinder.

In a two-cycle engine, firing a charge at each outward stroke, the piston acts as the inlet and exhaust valve, so that there are few moving parts. A four-cycle engine, with a charge fired at each alternate outward stroke, requires valves and camshafts. Most of the semi-Diesel engines are governed by regulating the oil charge according to the load. They have to be started usually by air at 150 to 175 lb. pressure, so that an air compressor must be attached to the main engine or driven by a small independent engine.

A little water in the cylinder permits of higher compression and increases the fuel economy, but it should not be used if the oil is high in sulphur as the combination of sulphur and water is destructive to the cylinder walls and piston rings. Some engine builders stipulate that the oil used shall contain not more than 0.5 per cent sulphur. Oil companies have special brands of oil suitable for internal combustion engines and engine builders recommend the use of oils meeting certain specifications. The heavier the oil, the lower the price and the greater the B.t.u. Using a heavy oil in summer and a light oil in winter obviates the necessity of installing a heater to warm the heavy oil so that it will flow readily.

Capacity of Panama Canal Ample for at Least 30 Years

Dimensions of Locks, Operating Efficiency, and Water Supply Will Suffice for Estimated Traffic—Difficulties of Sea-Level Proposal

By J. K. Baxter
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Balboa Heights, C. Z.

The success of the Panama Canal has been so complete that the critics, who attacked almost every feature of the project between 1904 and 1915 and prophesied disaster unless radical changes were made in the accepted plans, have lapsed into silence. That the canal has been in successful and uninterrupted operation since the removal of the last great slides in 1916, and affords a safe and rapid means of communication between the two oceans is obvious and indisputable. Pessimists who still cling to the conviction that all is not well at Panama are forced to abandon the immediate present and postpone disaster to a problematical future. For the time being, they admit, the canal is serving its purpose, but its capacity, they say, is so limited that within a few decades at the most it will be outgrown and inadequate. For instance, one writer argues that not more than 50,000,000 net tons of shipping a year can be passed through the locks, and that the water supply will suffice for only 30,000,000 tons, while on the other hand there is every reason to expect a traffic of between 50,000,000 and 100,000,000 tons toward the middle of the century. The remedy usually suggested is that the present high-level lock canal be brought down to sea-level by gradual dredging.

It is perfectly true, of course, that the operation of the locks and the available water supply impose definite limits on the present canal. In the following paragraphs an attempt is made to estimate with reasonable accuracy what those limits are and how soon they may be reached.

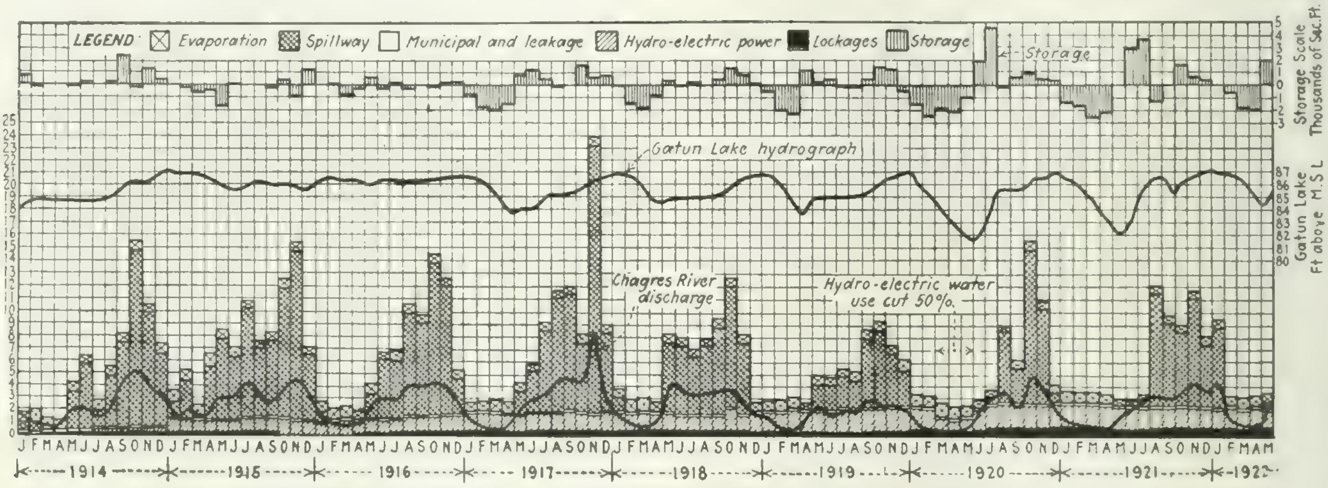
Factors Limiting Capacity—There are three factors which may limit the usefulness of the present lock canal: (1) The number and dimensions of the locks; (2) The operating efficiency of the locks; (3) The water supply available for lockages, development of electric power, and maintenance of the water level of Gatun Lake.

Lock Dimensions—The locks have a length of 1,000 ft., a width of 110 ft., and a minimum depth over the sills of 42½ ft. For commercial vessels these dimensions are more than ample, and there is no present reason to suppose that they will not meet all the requirements of commerce for many years to come. There can scarcely be the same certainty in the case of battleships. The beam of these vessels has been increasing very rapidly, and in the most recently designed ships exceeds 100 ft. To meet the possible needs of the navy the construction of a third set of locks with a width of 135 ft. has been contemplated. There are foundations available for these new locks, if it is decided to build them.

Operating Efficiency of Locks—The estimated maximum capacity of the existing locks, with both flights in use, under ordinary service conditions, is 48 lockages per 24-hr. day. This would mean more than 48 ships, as the smaller vessels can frequently be locked through in tandem, and the possible occasions for doubling up in this manner will increase with the growth of traffic. Allowing only 3,500 net tons of shipping for each lockage, this would be equivalent to a maximum of more than 60,000,000 tons per annum, which may be cut to 50,000,000 tons to allow for the periodical unwatering of one flight of locks for painting and repairs. If a third flight of locks is built, the capacity of the canal will be correspondingly increased, assuming, of course, a sufficient supply of water.

Water Supply—The water supply available to maintain the summit level of a lock canal has been the subject of careful and continuous study from the days of the French canal company to the present time, and fresh calculations have been made whenever new elements were introduced which affected the problem.

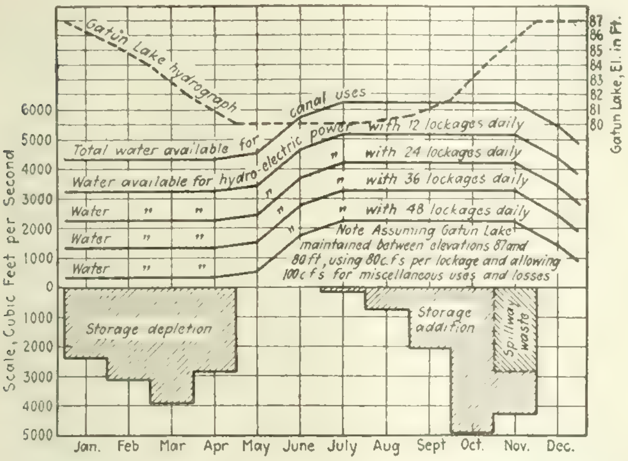
During the rainy season there is a surplus of water flowing into Gatun Lake, which under present conditions is wasted over the spillway. But during the dry season, which is normally less than four months long, but may extend to six months in exceptional years, the inflow is slight, and the canal is partially dependent on



DISPOSITION OF GATUN LAKE WATER SUPPLY FROM 1914 TO DATE

water stored during the wet months. The Gatun Lake is the only present storage basin. It is filled to a height of 87 ft. above sea-level at the close of the rainy season, and can be drained to 80 ft. during the dry season without interference with navigation. The storage capacity of the lake between the two levels is 31.8 billion cu.ft. This is sufficient for all present needs, including the operation of the hydro-electric plant at Gatun, but if in an extremely dry season it becomes necessary to economize water, a part of the power load can be transferred to the steam plant at Miraflores, which is maintained in reserve to meet this and other emergencies.

All plans for a lock canal, however, have contemplated



AVAILABLE WATER SUPPLY FOR CANAL USES WITH PRESENT STORAGE

Based on average net yield of 10-year period, 1911-1920

the need for additional water storage, to be provided by the construction of a dam across the valley of the Chagres River at Alhajuela, ten miles above Gamboa where the river now enters the lake. This is an important feature of the ultimate scheme. It is estimated that the Alhajuela Dam will impound 15 billion cu.ft. of water, which can be drawn upon to maintain the level of the Gatun Lake during the dry season. If further storage becomes necessary there are excellent reservoir sites in the valley of the Chagres and its tributaries above and below the proposed dam. The installation of a hydro-electric plant at Alhajuela is also contemplated. Water used there to generate power would flow into the Gatun Lake and still be available for the operation of the locks.

The following tables show the actual inflow of water into the Gatun Lake and the usage of water during the calendar year 1920, the driest on record since the lake was formed:

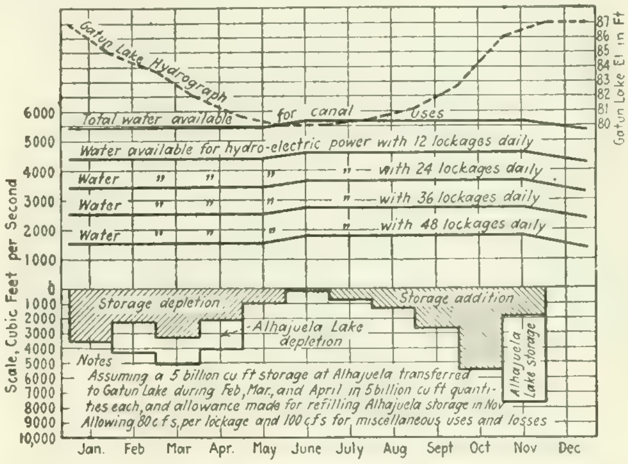
Inflow into Gatun Lake	Per Cent	Billions of Cu.Ft.
Run-off above Alhajuela	38	65.21
Yield from land area below Alhajuela	44	74.95
Direct rainfall on Gatun Lake	18	31.38
Total	100	171.54
Use or Disposition		
Evaporation from lake	13	22.40
Lockages	12	20.87
Hydro-electric power	26	44.42
Spillway discharge	47	81.00
Leakage and municipal water	1.5	2.45
Increased storage	0.5	0.40
Total	100	171.54

It will be noted that 47 per cent of the total inflow was wasted over the spillway, only 12 per cent was used for lockages, and 26 per cent for hydro-electric power. During the year in question 10,000,000 tons of shipping passed through the canal.

The most important present draft on the water supply is for the generation of electric power. The use of water from Gatun Lake for that purpose is convenient and economical, but it is not essential. It will be continued so long as and to the extent that water is available; but in case of shortage the load can be transferred in whole or in part to a hydro-electric plant at Alhajuela or to the steam plant at Miraflores.

The latest studies indicate that during the driest 12-month period of record (July 1, 1919, to June 30, 1920) the water available during the dry season would have sufficed under existing conditions for 30 lockages a day, provided none was used for power, or for either 24 or 12 lockages a day with operation of the Gatun hydro-electric plant at 14 or 45 per cent of its full capacity.

Under the same conditions of minimum dry-season inflow, but with the Alhajuela Lake to draw upon for



AVAILABLE WATER SUPPLY WITH ADDITIONAL STORAGE AT ALHAJUELA

Based on average net yield of 10-year period, 1911-1920, with 15 billion cu.ft. additional storage when Alhajuela Dam has been built.

additional water supply, it would be possible to make 56 lockages a day, provided the hydro-electric plant were closed down.

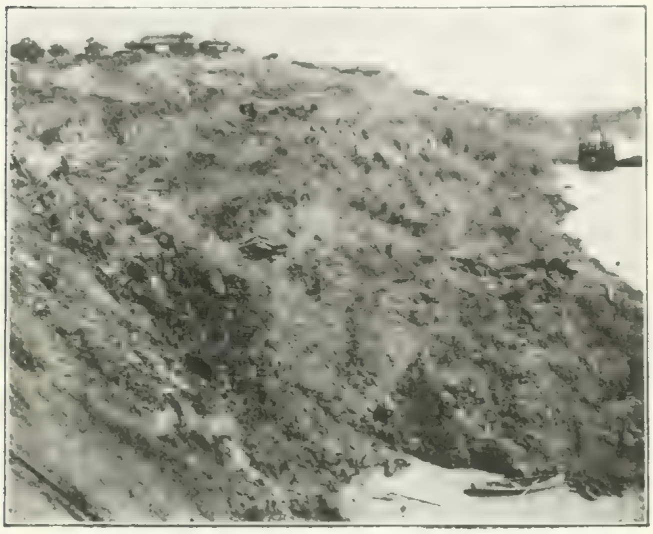
During an average year after the construction of the Alhajuela Dam it will be possible to make 24 lockages a day throughout the dry season while operating the hydro-electric plant at Gatun at full capacity, or 48 lockages a day with the hydro-electric plant running at 46 per cent capacity.

There is no reason to expect that the water supply will not be sufficient for 48 lockages a day, equivalent to not less than 50,000,000 tons of shipping per annum, even under the most unfavorable conditions of inflow, provided the plans for additional storage are carried out, and a reserve power plant is maintained capable of taking the load off the Gatun station for extended intervals. This is a conservative estimate, and it is probable that the water supply, if intelligently conserved, will suffice for a much heavier traffic. At any rate, the limiting factor, after the construction of the Alhajuela Dam, will be the operating capacity of the locks rather than the water supply.

Estimated Future Traffic—Assuming that not more than 50,000,000 tons of shipping can be passed through the present locks in one year, it remains to be considered how soon the traffic will attain to that volume.

This cannot be accurately determined. Any forecast of what the traffic will be thirty, twenty, or even ten years hence can be little more than a guess.

Prior to the opening of the canal Prof. Emory R. Johnson undertook an exhaustive study to determine what traffic would be available in 1915 and what rate of increase might reasonably be expected during the first decade of operation. His conclusions were published in a report on "Panama Canal Traffic and Tolls" submitted to the Secretary of War in 1912. He estimated that starting from 1900 the increase in the traffic which might use the canal had been at the rate of 60 per cent per decade, that the rate of increase after the canal was opened could only be conjectured, but that an assumption of an increase of 60 per cent between 1915 and 1925 would be conservative.



CLOSE-UP OF 1916 SLIDE IN GAILLARD CUT
A sea-level canal would require this cut to be dredged 90 ft. deeper, thereby causing further slides of far-reaching extent This 1916 slide is now at rest.

The following table shows the annual traffic through the Suez Canal in thousands of tons at 10-year intervals from 1870 to 1920:

Year	Thousands of Net Tons	Increase per Decade
1870	436	
1880	3,057	
1890	6,890	126%
1900	9,738	43%
1910	16,581	70%
1920	17,574	6%

The Suez Canal traffic increased very slowly during the first five years of operation, as the canal could not be used to advantage by sailing vessels, and did not come into its own until steam had definitely superseded sails. The decade from 1890 to 1900 was a period of general business depression, which is reflected in the statistics. In the decade from 1910 to 1920 normal development was interrupted by the war, and a considerable volume of traffic was diverted from Suez to Panama.

The following figures showing the increase of the world's tonnage over a period of 37 years are quoted from the Encyclopedia Britannica:

	1873	1890	1900	1910
World's tonnage (thousands of tons)	17,545	22,151	29,043	41,914
Increase on the basis of 1873 as 100	100	126	165	240
Average rate of increase per annum (per cent)		1.5	2.4	3.8

The records of the Panama Canal itself during the first seven fiscal years of operation probably do not afford a reliable index of future growth. The opening of the canal coincided with the outbreak of the war in Europe. The traffic of the first few years was adversely affected by the war, and the subsequent increases do not represent normal growth so much as the transition from war to peace conditions. Expressed in thousands of net tons the traffic of the Panama Canal has been:

1915	3,792	1919	6,124
1916	2,396	1920	8,546
1917	5,798	1921	11,415
1918	6,574	1922	

Note: Accurate figures for 1922 are not yet available, but the tonnage will be approximately the same as in 1921.

W. L. Hersch, electrical engineer of the Panama Canal, in a study completed in December, 1920, attempted to base a forecast of future traffic on these past records. Disregarding the first two years as abnormal, he concluded the number of vessels per month was increasing by arithmetical progression at the rate of 32 in a period of one year. Starting with 1,800 vessels in 1917, this would give 5,640 in 1927, 9,480 in 1937, 13,320 in 1947 and 17,160 in 1957. The increase during the first decade would be at the rate of 213 per cent, during the second decade 68 per cent, during the third decade 40 per cent, and during the fourth decade 28 per cent. This assumption of a very high rate of increase during the early years of operation declining gradually and constantly thereafter can not be reconciled with the Suez record nor with the record of the growth of the world's tonnage; but extended over a period of thirty or forty years it yields the same ultimate result as the assumption that traffic will increase at a uniform rate of 60 per cent per decade. With either method of calculation the date on which the traffic will aggregate 50,000,000 net tons per annum falls within the decade between 1950 and 1960.

SLIDE NORTH OF GOLD HILL IN 1915
This view shows the canal channel practically closed and indicates the difficulties that would attend the excavation of the canal to a grade 90 ft. lower.

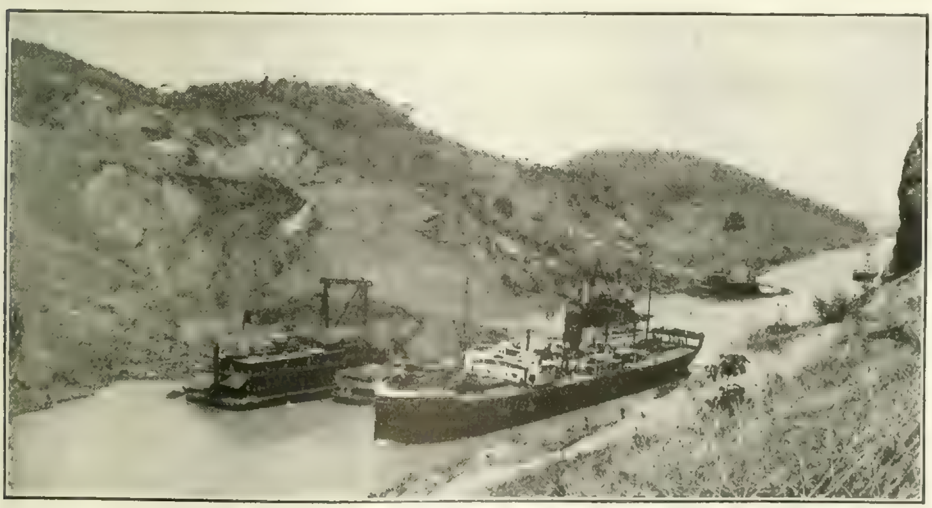
Period of Ultimate Capacity—A careful consideration of these facts and probabilities indicates that the demands for the immediate enlargement of the canal are premature. The present waterway ought to suffice for at least thirty years. It is conceivable, however, that at some time between 1950 and 1960 the traffic may pass the 50,000,000-ton mark, and that the canal will then approach the limit of its capacity. Given an era of unprecedented commercial expansion, this point may be reached at an even earlier date, or under adverse conditions it may be indefinitely deferred. That will be much clearer in 1930 or in 1940 than it is now, and

ample time will still remain to provide the improved facilities which may be needed.

The Sea-level Project—The favorite proposal of the critics of the present waterway is that it be converted by gradual dredging to a sea-level canal. The project is advocated by Lt.-Col. Bunau-Varilla, who submitted it to the International Board of Consulting Engineers in 1906, and has brought it forward on numerous occasions since. The only sea-level canal ever seriously considered, that recommended by the majority of the International Board, had a bottom width for 21 miles of only 150 ft., and for 19 miles of 200 ft., as compared with the minimum width of 300 ft. in the present Culebra Cut. It gave tortuous navigation through a comparatively narrow gorge in which large vessels could not proceed under full headway or pass without risk. The capacity of such a canal would scarcely be greater and might well prove less than that of a lock canal. No one would argue that the proposed dimensions would meet present requirements, and still less the requirements of the future. If a bottom width is assumed that would justify the appellation of "The Straits of Panama," a phrase that has been applied to an ideal and wholly imaginary sea-level canal, the cost of the work will be enormously increased. The amount of excavation that might be required through the continental divide can not be estimated with any degree of accuracy. In 1906 it was believed that the banks through this sector would stand at a relatively steep angle. Experience has shown that this is not true, and that no given slope can be predicted. But it may be regarded as certain that slides of the most serious nature will develop, if the present excavation is carried 90 ft. deeper. There remains the problem of controlling the Chagres River and the other streams which now flow innocuously into the Gatun Lake.

MIRAFLORES LAKE
If the canal should be deepened to sea-level to create a "Strait of Panama" this lake would become a ditch 70 ft. deep.

The undertaking bristles with difficulties, and it has never gained the support of any American engineer who has served on the Isthmus and is familiar with local conditions. Nothing in the present situation justifies this questionable improvement, and if some thirty years hence it becomes necessary to provide for the passage of a greater number of ships than the present lock canal can handle, it is probable that even then this sea-level project will be rejected for some more economical alternative.



CUCARACHA SLIDE IN 1920
This view, taken from north of Contractor's Hill, gives a further indication as to the task involved in lowering the grade to sea-level.

Improvements for South Manchuria Railway

For the fiscal year ending March 31, 1923, the South Manchuria Ry. has appropriated $4,061,910 to be devoted to railway improvements and construction, according to recent information from the company. The double-tracking of the line with 100-lb. rails between Tiehling of Chungku, between Chuantu and Shwangmiaotze, and between Wuchiatun and Suchiatun will be continued, and the type of rails used in the Dairen wharf inclosure will be changed. At Mukden station a roofed-in passenger platform will be constructed and additional sheeting will be purchased to protect against moisture in connection with the equipment for mixed storage of beans. On the line between Mukden and Suchiatun, an automatic signal system will be installed. The building of additional freight locomotives, reconstruction of rolling stock of all types, and the finishing of nine freight locomotives and twenty freight cars begun during the previous fiscal year are the other items included in program.—*Commerce Reports.*

Design of Sewage Dosing Tanks for Trickling Filters

Basic Efficiency Features—Shape and Dimensions —Intermittent Operation at All Flows— The Siphon Inflow

By Edmund B. Besselievre
Sanitary Engineer, New York City

Dosing tanks for trickling filters, while one of the most important units in a sewage treatment plant which employs that type of filter, are not usually given the amount of study that their important function deserves. Information on the factors entering into the proper design of dosing tanks, and on the proper value to be given these factors when actually designing a tank to fulfill certain known conditions, is meagre and in the past a great many engineers have depended upon the manufacturers of siphons for the design. This dependence upon the manufacturer of equipment has in general worked well in procuring proper co-relation between the tank and the filter, but the writer believes that it would be well for every engineer to be able to study this problem himself and design for himself a proper tank. The object of this article is to summarize experience covering a period of fourteen years, during which time the writer has designed or redesigned many dosing tanks, and witnessed a great many of the common errors in design which tend to nullify the results desired from the tank.

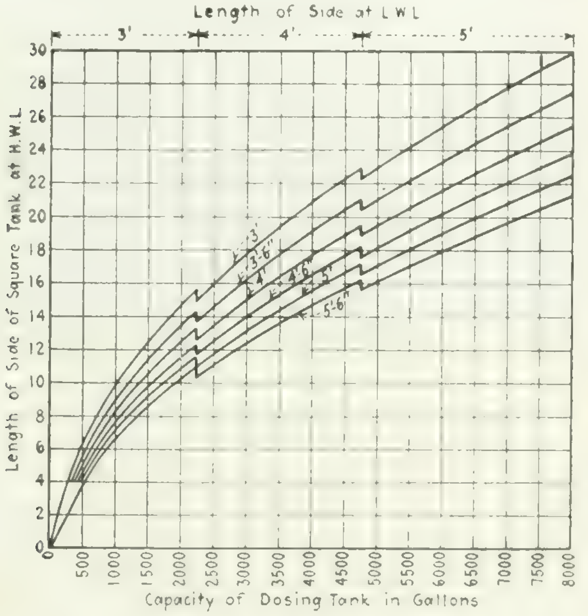


FIG. 1—DIAGRAM FOR DESIGNING SEWAGE-DOSING TANKS WITH VARIOUS DEPTHS OF SEWAGE

Computed from formula, $Q = 7.5\,[h/3\,(A + \sqrt{Aa} + a)]$, where A = top area of tank, a = low-water level, h = distance between high-water and low-water levels.

A recent article on this general subject by E. E. Sands, consulting engineer, Houston, Texas ("Hydraulics of Dosing Tanks and Trickling Filters," *Engineering News-Record*, July 13, 1922) added materially to the literature on the subject by outlining the hydraulics involved in the computation of size of dosing tanks and filters; but certain basic features were not covered in that article and must be given full weight and consideration to enable any tank to function efficiently. It is the writer's object to present these herein.

The Primary Object of a Dosing Tank is to discharge automatically a measured dose of settled sewage upon a trickling filter in such a manner as to insure that each square foot of the filter surface will receive the same quantity of sewage at all heads in the tank. Let us consider the factors entering into this ideal accomplishment and then show how each must be considered in designing the tank.

There must be determined (1) the amount of sewage to be treated per day; (2) the area of the filter to give efficient treatment to that amount of sewage; (3) the total head available between the invert of the discharge from the settling tank to the invert of the final outlet from the treatment plant; (4) the spacing of the nozzles on the filter and the determination of size of nozzle; (5) the dosing cycle or length of time it is desired that the nozzles shall be in play; (6) the depth of the filter; (7) the size of the dosing tank; (8) the size of the dosing siphon.

Mr. Sands, in his article, has covered the hydraulics of the various elements very well. His data will not be repeated.

Although experimentation and practice have shown that it is impracticable to procure perfect distribution over a trickling filter at all heads, the results obtained with a type of dosing tank that is easily designed and built are sufficiently satisfactory to make unwarranted attempts to secure better results by complicated structures.

The tank giving perfect distribution is one in which the area of the tank decreases as the bottom is neared. For perfect results, the tank would be in the shape of an inverted pyramid with sides of a parabolic form. In practice it has been proven that a tank in the shape of a four-sided inverted pyramid, or to be correct, frustum of a pyramid, with sides sloping straight downward from the high-water level to the low-water level, is sufficiently accurate to be generally adopted.

Size of Tank—Having determined the volume of sewage and the length of dosing cycle, the first consideration in dosing tank design will be the volume of the tank. Knowing the discharge capacity of each nozzle at the average head and the number of nozzles and the length of dosing, we can easily arrive at a figure which will represent the total volume to be discharged. This represents the largest part of the dosing tank contents. Unless twin dosing tanks are used, in which the inflow is shut off at the instant of commencement of discharge, the inflow of sewage into the dosing tank during the discharge period must be considered. As it is desirable that the tank be sufficient to operate at the maximum flow, the inflow rate must be considered on the maximum basis for the period of discharge.

Here is where the average designer stops and fails to allow for the most important element. All plants or plans that the writer has seen provide for nozzles spraying to a predetermined radius from the nozzle but in very few cases is that condition reached in practice. Why? For the simple reason that between the dosing tank and trickling filter distribution system, there is a system of piping, beginning with the siphon in the dosing tank and continuing in the main distributors and laterals in the beds and the risers to the nozzles and a certain portion of this piping must be above the tops of the nozzles. After the siphon has stopped discharging, all the water remaining in that portion of this connect-

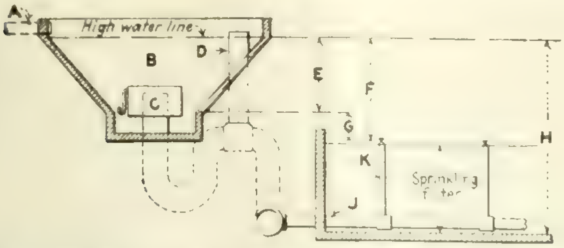


FIG. 2—PRINCIPAL ELEMENTS OF DOSING TANK DESIGN
A = Inlet. B = Dosing tank. C = Automatic siphon. D = Vent and overflow. E = Depth of tank or effective dosing head. F = Minimum head on nozzles. H = Total available head. J = Distributing pipes. K = Risers to nozzles.

ing link which is above the nozzles will drain out through the nozzles. What has that to do with distribution, it is asked?

The most effective head, that which will produce the widest radius of spray, is naturally the high-water line in the dosing tank or the point at which the siphon comes into operation. Therefore, if the plant is of considerable size, the pipes between the siphon and the filter will be large and, if a short cycle of dose is used, the dosing tank will be small. Consequently whatever length of pipe is above the nozzles must be filled with sewage before any sewage will be forced from the nozzles and this sewage comes from the first flush of the siphon and consequently is taken from the highest and most effective head, so that instead of this valuable pressure being distributed in the form of widely flung spray, it is wasted by filling up a pipe.

The writer has seen several plants wherein failure to consider this has caused most ineffective distribution and a very small wetted area on the filter. In one instance, on a large plant, the nozzles did not cover a radius of more than 3 ft. and in another, not only was distribution poor but the air in the pipes being forced out through the nozzles rivalled the best steam calliope any circus ever had.

The remedy for this trouble and waste of effective head is easy to employ and consists in (1) so designing the distribution pipes that the smallest possible amount is higher than the lowest nozzle on the beds and (2) providing dosing tank capacity for filling the pipe at the high heads.

It is a simple matter, after having determined the size of the dosing tank, to compute the capacity of the piping that will be emptied at each discharge and if this piping is laid out properly, it will then be a simple matter to add to the height of water in the dosing tank the few inches which will give the volume of water desired. In properly designed plants the writer has found in a large number of cases that this extra head seldom amounts to more than 2 or 3 inches.

Tank Depth—Now we have the three elements entering into the volume of water or sewage to be held in the tank. Next we must consider the depth of the tank. Usually the depth of the filter is determined by the engineer from his experience or by reference to data on successful plants. Subtracting this depth from the total available head we have the balance available for dosing tank. However, before deciding the depth of the tank we must allow for that head which is necessary to overcome friction in the distributing system and which will give a small spray. This head varies in each case, but reference to the catalogs of siphon manufacturers will show that the minimum between the nozzle head and the low-water line in the dosing tank is about 1 to $1\frac{1}{2}$ ft., depending upon the size of the siphon, pipes, etc. Assuming it to be 18 in., this must be added to the depth of filter and deducted from the total available head. The remainder is the total allowable depth of dosing tank from the high-water line or the point at which the siphon starts to low-water line or point at which the siphon stops.

To facilitate the computation of dosing tanks the writer has devised a chart (Fig. 1) which will enable any engineer, after having determined the total volume of the tank as given above, to lay out a tapered tank of the proper size. This chart shows at the bottom the capacity of the tank in gallons. The curves indicate different depths of tanks. At the left side is given the length in feet of each side of a square-topped tank and at the top is shown the length in feet of the side at the bottom of the tank or the small area of the frustum of the pyramid. To select the proper tank is a simple matter. Having the volume, go straight up the chart to the line representing the depth of the water in the filled tank, then straight to the left from that point will give the length of the top of each side of the tank. Straight up from the volume to the top of the chart will give the length of each side of the bottom of the tank. This length is the minimum that will give the desired results. In large tanks the length of the sides of the bottom may be made as long as seems most advisable consistent with the length of the sides at the top of the tank and the slope of the sides of the tank, which should approximate an angle of 45 degrees wherever practicable.

The reason for including the length of the side at the low-water line is an important one. In order to empty a dosing tank there is usually provided an automatic dosing siphon. This siphon is located in the center of the tank in most cases and the part of the siphon visible in the tank is a large cast-iron dome or "bell." The low-water line in the tank is the invert of a small vent pipe on the outside of this bell, and in order to avoid a large amount of sewage being allowed to remain in the tank, the tank is usually constructed as an inverted frustum of a pyramid, superimposed upon a rectangular section with an area equal to that of the small area of the pyramid and a depth equal to the distance between the low-water line and the bottom of the siphon bell, plus the clearance called for between the bottom edge of bell and floor by the siphon manufacturer. Fig. 2 shown here illustrates this construction.

Having determined the size of tank and the size of siphon to discharge it in the allotted time, the size of siphon bell will be known and it is wise always to make the bottom of the pyramid larger by at least 12 in. than the diameter of the siphon bell. Thus with a siphon bell 30 in. in diameter, the length of side of tank at low-water level would be at least 42 inches.

Another important function of the dosing tank is that it operate intermittently at all flows. Therefore to

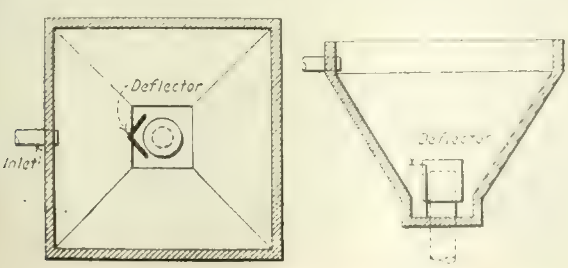


FIG. 3—INFLOW DEFLECTOR FOR DOSING TANKS

secure this, it is necessary to install a siphon capable of discharging at the low head close to the low-water line more water than is flowing into the tank at maximum flow rates. If too small a siphon is installed, at times of high flows the filter will go into continuous operation, which may result in flooding and negative bacterial action and this will continue until the high flow recedes. Careful use of the tables furnished by the siphon manufacturers will help to avoid this error.

Siphon Inflow—One other point that is of prime importance in procuring the maximum efficiency from the dosing siphon is the placement of the siphon as regards the inflow. In most tanks it is usual to bring the influent pipe in at the top of one side and allow the sewage to flow down that side. When the tank is empty the velocity of the flow toward the bottom will be very high. In several large plants this water rushing down and under the bell of the siphon has seriously interfered with the operation of the siphon by withdrawing some of the air from the bell. In order to have the siphon start operation at the same elevation each time it is necessary that the air conditions in the bell be the same after each discharge and this rush of water under the bell is very apt to draw out some of the air, varying in quantity with the volume and velocity of the water, thus introducing an element of uncertainty as to the high-water line. In one large plant it was necessary to place a wing-shaped deflector around the bell on the side from which the water came so as to divert the water to the sides of the bell. This is a simple matter (Fig. 3) and in a large plant with great volumes and high velocities, will eliminate one more cause of possible trouble. The writer has always deemed it wise to include some modification of this device in all large tanks.

In several large plants designed within the last few years, it has been desired to attain definitely measured doses of sewage upon the bed regardless of the rate of inflow to the plant. This has been accomplished by the use of two dosing tanks of identical size, shape and volume, each equipped with a siphon for emptying and also with an air-lock feed through which the inflow comes. When the water level in either of the tanks is reached, the air-lock feed, which is operated by an air bell in a subsidiary chamber, stops the flow of water through the feed of the filled tank and at the same time opens the feed of the second tank and starts the discharge siphon of the filled tank. This cycle goes on continuously, each tank discharging exactly the same amount of sewage at each discharge, the only difference being that the tanks take longer to fill at low rates of flow. Sets of these tanks are in operation at the sewage-works of Lexington, Ky., and Mansfield, Ohio.

The writer believes that the information given will prove of value to those engineers who are called upon to design sewage dosing tanks and he knows that if the special considerations of design are carefully studied whenever such a case arises, there will be no more of the regrettable failures in proper distribution.

More and Better Maps Demanded

The need for accurate topographical maps in connection with highway construction and for those engaged in the petroleum industry has added greatly to the public demand for more and better maps, it was brought out at a recent meeting of the Federal Board of Surveys and Maps. It was announced that so far as the topographic maps published by the Geological Survey are concerned no change in scale will be recommended.

Pavement "Explosions" Continue For Five Years

Portions of Surface Violently Break Away From Concrete Base—Thirty-Three Upheavals in Five Years

CONTINUED failures of a paved road by the violent parting, with mutual shattering, of the brick surface and the concrete base, has become of increasing concern to the highway officials of King County, Washington, in which the city of Seattle is located. The breaks, besides being a constant expense to repair, have been on occasions so violent that passing vehicles have been injured and in one instance, which will later be more fully noticed, the "explosion" was the basis of a successful suit for damages in a large amount. In all 33 breaks have occurred since the first, on June 13, 1917, a few months after the completion of the pavement.

VIEW OF EXPLOSION AREA IN PAVED ROAD IN KING COUNTY, WASHINGTON

The bricks which were scattered by the explosion have been replaced approximately in their original position. This explosion wrecked a passing motor truck.

A description of the pavement construction was published in *Engineering News-Record*, April 19, 1917, p. 131. From this description it appears that the pavement consists of a 1:3:6 concrete base, 3 in. thick at the edges and $5\frac{1}{2}$ in. at the center. On this base $3\frac{1}{2}$ x 4 x $8\frac{1}{2}$ in. paving brick were laid flat and bonded to the base by a 1:3 dry mortar cushion in which their bases were embedded immediately after the concrete was poured. The filler between the bricks was a 1:1 cement grout spread with brushes and squeegees. The roadway is 20 ft. wide and for much of its length is on grades ranging up to a maximum of 4.6 per cent. There were no expansion joints. In the base, at the end of each day's run, there was a beveled construction joint.

Of the 33 failures which have occurred since 1917 more than half have been violent and are referred to as "explosions." In case warning is given in the form of

a crushing of the bricks or a slight upward bulging, endeavor is made to prevent the more complete rupture by putting maintenance crews at work immediately, cutting the pavement at the point where the excess stress is manifest and substituting an 8-in. strip of asphaltic compound for two transverse rows of bricks. More often, however, the upheaval comes without warning and as much as 200 sq.ft. of the surface has been suddenly thrown from the base and shattered as though from an explosion. In some instances the base has been broken by the shock. In a damage suit growing out of an explosion, witnesses testified on the stand that pieces were thrown 30 to 40 ft. high in the air. Fragments are said to have been found 80 to 100 ft. from breaks.

A study of the location of the breaks does not show anything in common on this score. They occur on fills and in cuts, on the north, as well as the south slopes of hills, on the tops of gravel benches and in wet flats. On some parts of the road a number of breaks have occurred close together and in other stretches of considerable length there have been no breaks whatever. In the comparatively short section where expansion joints ½ in. wide were used in the brick, but without any joint in the concrete base, breaks occurred the same as in the other sections. In sections where new bricks have been relaid after a break, using the same form of construction as the original pavement, breaks have occurred a second time in the same spot. It is notable, however, that no breaks have recurred where the relaid pavement has been provided with the 8-in. asphaltic expansion joint referred to previously. This type of joint has now become standard practice when breaks are repaired. It extends through the concrete base as well as through the brick surfacing.

Some of the earlier failures and their possible causes were described and discussed in *Engineering News-Record*, Aug. 16, 1917, p. 319. There it was mentioned, the passing of trucks or cars over the weak spot appeared to "set off" the explosion. This fact is to be noted in connection with the accident that, as previously noted, caused legal complications.

On June 20, 1920, a truck driving over the pavement was wrecked by a violent upheaval of the surface beneath it. Such was the force that flying fragments smashed the running gear, brought the truck to a sudden stop and caused those riding on the driver's seat to be thrown to the pavement. A suit brought against King County on account of injury sustained in this accident secured a judgment from the Superior Court of King County in June, 1921, for $10,000 damages. The case was appealed to the Supreme Court of the state, which court on March 4. 1922, affirmed the judgment of the lower court. A petition for rehearing, filed by the county, is still pending.

The case did not bring out the causes of the upheaval from the engineering point of view, but rather showed that (1) the county knew the road was subject to these upheavals but (2) despite that had not succeeded in "maintaining the road in a safe and satisfactory condition" as required by statute.

Rail Earnings for August at Low Ebb

According to reports filed by the carriers with the Interstate Commerce Commission the net operating income of the Class I railroads of the United States totaled $52,579,799 in August. This represented a return of only 2.65 per cent annually on their tentative valuation.

Boldly Designed Center for Heavy Concrete Arch

Steel Viaduct Practice Applied to Timber Falsework —Settlement Under Load Less Than an Inch—No Wedges Used

A CENTERING so slender that its failure was freely predicted has recently been taken from under the successfully completed arch ribs of the Beechwood Avenue Bridge in Pittsburgh, Pa. This bridge has a clear span of 279 ft., and the two ribs with their connecting struts, which the centers had to carry, contained about 1,500 cu.yd. or, say, 3,000 tons of concrete. Four timber towers, with four legs each, carried the load during construction and the sixteen 20-in. square posts of these towers were virtually the only supports during the 2½ months while the arch ribs were being concreted. They extended upward 65 ft. unbroken by joints and there were, in fact, only four bearing surfaces from the footing to the lagging, which explains the total deflection under load of only ¾ in.

FIG. 1. CONSTRUCTION TRESTLE, CENTERING AND CHUTING PLANT

A description of the main structural characteristics of the Beechwood Avenue Bridge was published in *Engineering News-Record*, Jan. 5, 1922, p. 29, where also the principal dimensions were stated. Briefly the arch ribs are 8 ft. wide and 10 ft. deep at the springing lines tapering to 6½ ft. at the crown. The intradosal rise is 55.89 ft. Each rib is reinforced with a structural steel rib of eight 6 x 4 x ¾-in. angles and 2¾ x ¾-in. bars. Each rib was concreted in nine sections, a crown section of 70 ft. and eight 30-ft. sections, with 3½-ft. key sections between them. Concreting the two arch ribs and eight cross struts was begun April 24 and with the exception of the key sections was completed on May 3. It took five days to ream and bolt the structural reinforcement in the key spaces and two more days to concrete the key sections, thus completing the ribs and struts on May 10.

Only two unusual features call for especial attention: (1) the trestle for the traveler which erected the centering, forms and reinforcement and (2) the falsework and centering. The view Fig. 1 shows the complete outfit, the trestle and traveler in the foreground and, behind the trestle, the falsework, centering and arch-rib forms. It will be noted that the trestle was carried

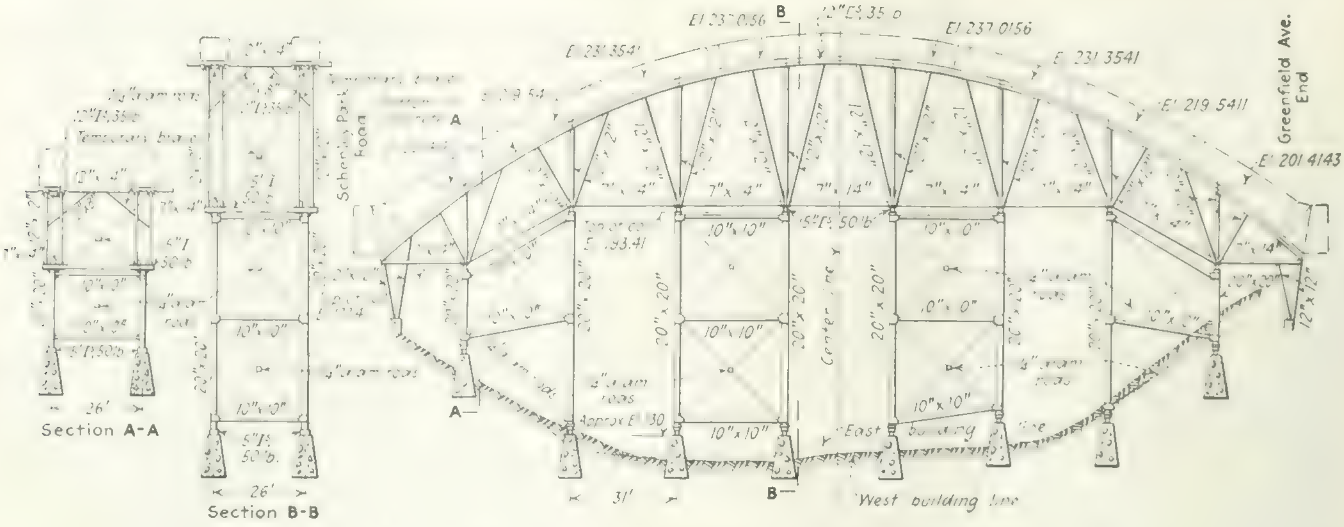


FIG. 2. FALSEWORK AND CENTERING FOR TWO-RIB ARCH

out from one bank only far enough for tne derrick to reach the opposite abutment This gave a stub-end structure about 145 ft. high at the unattached end.

In designing the trestle and the falsework for the center, steel viaduct practice was followed. Towers with four legs were braced in horizontal planes at determined intervals and in the planes of the legs with X-bracing for each vertical panel. The drawing of the falsework Fig. 2 shows the arrangement except that in the case of the trestle the legs of the bottom panel were given a transverse outward batter to widen the bases of the towers, as shown by Fig. 1.

As stated the purpose of the trestle was to erect the centers and forms and to handle the reinforcement. Practically all the concrete was placed by chuting from mixing plants located on the high banks of the gorge spanned by the arch. A 40-ton derrick traveler was planned, and to bring it well above the loads it had to handle, the top of the trestle was established at a height well above the crown of the arch ribs, as shown by Fig. 1. A uniform span of 30 ft. was adopted both between tower legs and between towers. The tower legs were made of 12 x 12-in. x 32-ft. timbers spliced together with steel plates to which the timber transverse bracing and the 1¼-in. steel-rod sway bracing were attached. The tops of the legs were capped transversely with 12 x 12-in. timbers. These caps carried a 24-in. I-beam on each side of the trestle and the traveler rails were bolted to these beams. The trestle was 33 ft. 6 in. wide on top, 375 ft. long and 145 ft. high at the highest point. There were four vertical panels in all the towers in the valley bottom while the towers on the slope had three, two and one panels as their height decreased.

Standing 145 ft. high, with its slender posts and bracing, the free end of this trestle presented an appearance of lateral instability which its action in service

FIG. 3. VIEW OF CENTERING WITH RIBS COMPLETED

belied. With the traveler derrick swinging loads of several tons, 30 ft. or more to one side, the structure showed no appreciable side sway. In March, during several of the heaviest wind storms, with the traveler working 75 ft. from the end, transit observations showed a sway of only ⅛ in. This remarkable rigidity must be attributed to the precision of the framing and erection which was virtually as great as that which would be employed in a steel structure for permanent service.

As illustrated by Fig. 2 and the views Figs. 1 and 3, the falsework for the centers consisted of four viaduct-type timber towers. Oregon fir timbers 20 in. square were used for the legs. Two short 15-in., 50-lb. I-beams were anchored to the footing pedestal and carried ¾-in. bearing plates on which the posts were seated. These posts were 63 ft. long and on their tops carried pairs of 15-in., 50-lb. I-beams. Footed on the I-beams were 12-in. square timbers, three from each post, radiating out fanwise to support segment beams which were bolted through steel stirrups capping the ends of the radial timbers. The segment beams were pairs of 12-in. 35-lb. channels bent to the curve of the arch. The remaining bracing and the essential dimensions are given by the drawing Fig. 2.

It will be noted that there are only four bearings in any line of vertical supports from the footing pedestals to the segment beams, a height of over 100 ft. As these joints were very carefully framed and assembled their compression was slight. As stated the centers settled ¾ in. when loaded and when the centers were lowered the arch ribs dropped ¾ in. more. Contemplating the old type falsework, the specifications had called for an arch camber of 3½ in. The falsework was built to this requirement but less than half of the expected possible settlement occurred. A noticeable feature of the centering is that no wedges were used. To lower the centers, therefore, jacks were set on the pedestals, taking a lift under the angles used to anchor-bolt the posts, and with the jacks carrying the load the I-beam webs were cut with torches.

The erection of the centering was begun March 11, and was completed ready for the arch rib forms on April 4. As the concreting of the arch ribs and struts was finished, as already stated, on May 3, it required a little less than 2½ months to build the centers and the rib and strut forms and to place the concrete for ribs and struts. This is submitted by the engineers and the contractor as being remarkably fast progress. The bridge is being built by the city of Pittsburgh, Pa., John D. Stevenson, assistant chief engineer, in charge of bridges. Fred C. Coder was engineer in charge of construction. The contractor was The E. M. Wichert Co., Pittsburgh, Pa.

Railway Car-Icing Plant to Serve Refrigerator Trains

Standard Layout for Icing Trains While Changing Engines at Division Points—Ice Making, Storing and Handling

TYPICAL of standard plans for railway car-icing plants which have been adopted by the Pacific Fruit Express Co. is the plant at Ogden, Utah, a plan of which is shown in Fig. 1. These standard designs for track layout, buildings and equipment were prepared in connection with a program for establishing a number of new plants along the Southern Pacific Ry. and Union Pacific Ry., since the time and cost of construction will thus be reduced materially. In the Ogden plant a one-story building 100 x 150 ft. contains the compressor room and ice-making or freezing room. Adjacent to this is a two-story building 85 x 165 ft., with the first floor holding ice for the day's work and an upper room for storage. Beyond this is an ice house 150 x 165 ft., divided into two sections of 10,000 tons capacity each for general storage and winter storage.

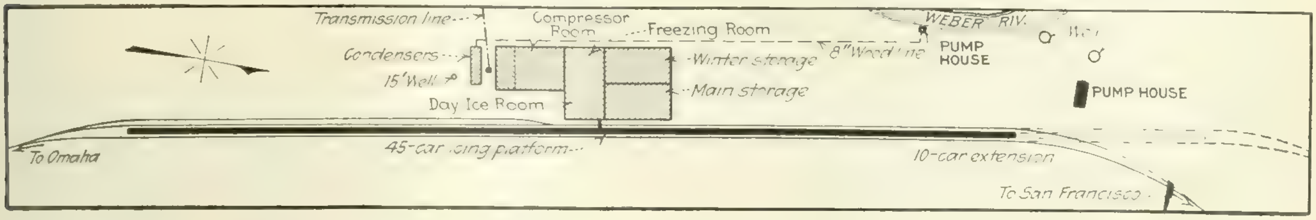


FIG. 1. CAR ICING PLANT AT OGDEN, UTAH

Ice blocks on the first floor of the day storage building are trucked to an inclined conveyor which carries them to the upper end of an inclined chute extending to the roof of the icing platform, as shown in Fig. 2. This chute connects with a similar but steeper chute at right angles to it, which in turn delivers the blocks to a conveyor running along the center of the icing platform. Men with ice tongs pull the blocks off the conveyor and slide them over hinged aprons to the hatches of the car bunkers. Two tracks long enough for solid trains of 45 cars are served by this elevated platform and provision is made for increasing this length to take 55-car trains.

Reinforced concrete is used for the buildings, which have sides of pilaster and curtain-wall construction and floors of the flat-slab type on girders between columns

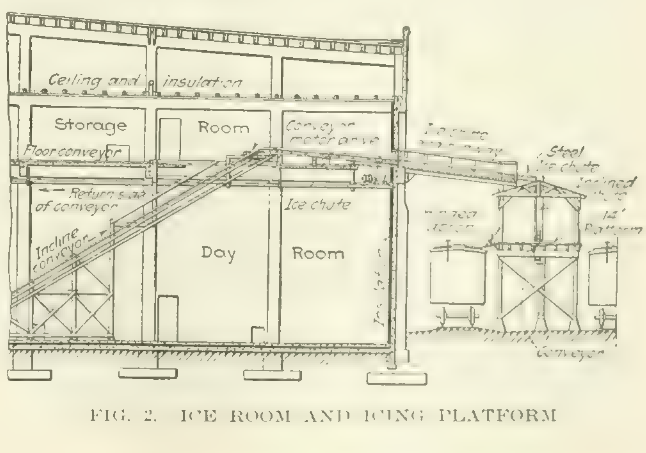


FIG. 2. ICE ROOM AND ICING PLATFORM

spaced about 21 ft. c. to c. A wooden false ceiling with insulating material above is placed over the storage room, leaving a ventilated air chamber between this ceiling and the plank roof. Corkboard insulation is used in the storage rooms.

Railway icing stations served by this company have platforms usually 2,460 ft. long to accommodate two solid trains of 55 refrigerator cars. This arrangement is found more economical than a side or single-track platform, both in the handling of ice and in the time required for icing trains. Shorter platforms cause delays and extra switching of cars. The platform is a frame structure approximately 14 ft. wide with shelter roof and with an endless chain conveyor extending along the center line.

The track layout is so arranged as to enable the railroad to bring inbound trains of refrigerator cars direct to the icing platform with the road engines. The incoming engine and caboose are then cut off and the outgoing engine and caboose are coupled on. Train inspection is accomplished while icing is under way and the entire operation is made without the necessity of moving the train until it is ready to depart. This arrangement decreases the loss of time and the cost of switching at division points, the former being of special importance in the transportation of perishable freight.

The Direct Oxidation Method of Sewage Treatment

Papers and Discussion Before the Cleveland Convention of the American Society for Municipal Improvements

Electrolytic or Direct Oxidation and the Lima Deadlock

By George W. Fuller

Of Fuller & McClintock, Consulting Engineers, New York City

The use of electricity as a purifying agent has appealed and continues to appeal fascinatingly to the lay mind. For more than thirty years arrangements in which use is made of electricity have come up for consideration. The writer first became acquainted with the so-called "Webster process" of this type in London in 1890. In test plants this process was shown to be to a considerable extent a coagulating arrangement whereby electricity was used to decompose iron or aluminum electrodes, thus forming hydrates of these metals. The effective work was chiefly done in a manner more or less resembling the coagulating effect in water treatment plants in which use is made of sulphates of iron or alumina.

Undoubtedly there is some electrolytic decomposition of water even where iron and aluminum plates are used and bubbles of oxygen and hydrogen are released. Some of the oxygen is released in an atomic or anodic state whereby it has a high power for oxidizing even inert organic matter. Excessive cost has kept this process from general adoption.

Harris Process—The writer investigated the "Harris magneto-electric process" at Louisville at considerable length in 1897, but they did not offer reasonable prospects for practical success. Plants of this type were installed for sewage treatment at Santa Monica, Cal., Oklahoma City, and a few [six] other places [in Oklahoma—Editor.] Practical accomplishments were small and all of the plants have been abandoned except the one at Santa Monica which was found a year ago to be still in service under conditions greatly overtaxing its limits of effective performance.

Recent Developments—During the past ten years much attention has been given to improved arrangements, made largely through the efforts of the Landreth Company of Philadelphia, by the introduction of revolving paddles between the electrodes to remove the gases which cause polarization. Use was made of lime, presumably at the outset to increase conductivity and to lessen the quantity of electricity used per unit area of electrode. The "Landreth electrolytic process" was installed some eight years ago at Elmhurst in the Borough of Queens, New York City. It was investigated at length by the city officials of New York, preparatory to deciding whether to adopt the process for other plants within the city limits, but no such plants have been installed. At Decatur, Ill., extensive investigations were undertaken shortly thereafter, but the process was not adopted and after a delay of some five or six years trickling filters are now being installed there.

Clark Process—The "Clark process" of the electrolytic type was devised and patented by J. M. Clark six or eight years ago, when it received some attention in New Jersey. The successor to this process is known as the "Selo method," which is somewhat similar to the "Landreth electrolytic process" except that in the "Selo method" there is separate treatment of the sludge, to which salt is added, and there are certain differences in plant details. By this method the sewage is dosed with milk of lime in an agitating tank, then settled in a circular tank having a Dorr thickener and passed through an electrolyzer. The sludge is mixed with a solution of salt and electrolyzed, disinfected and deodorized by the sodium hypochlorite which is formed by the use of electricity. It is claimed that the sludge is rendered drainable to 60 per cent moisture in 48 hours so that it may be used as a fertilizer.

A plant of the "Selo method" was installed several years ago by the Thermoid Rubber Co. at Trenton, N. J. It is understood that the electrolytic features of this plant added little or nothing to the quality of sewage effluent and it was found on a recent visit there that the electrolyzers had been removed.

Direct Oxidation Process—The Landreth patents covering the so-called "direct oxidation process" are controlled by the Municipal Sewage Disposal Co. of Philadelphia, which has installed two plants, one at Phillipsburg, N. J., and another at Allentown, Pa. At Phillipsburg the plant has been in service for about two years and last spring an extensive set of tests was made by the State Department of Health but the results have not yet been made public. At Allentown a 3-m.g.d. plant at a cost of about \$180,000 was installed and has been in intermittent service for nearly a year. Sanitary sewers in Allentown have been built only to a limited extent and it is understood that at present there are only about 700 sewer connections, which produce a volume of flow which permits the treatment plant to be operated only a few hours each day.

At Easton, Pa., a test plant was installed in 1919 for demonstrating the practicability of the improved devices of Mr. Landreth, in which use is made of both electricity and lime, followed by sedimentation. This test plant was studied by several engineers and chemists of Philadelphia with results as stated in a paper presented to the Franklin Institute in 1919. The Easton plant was also investigated by the Pennsylvania State Department of Health with results as summarized in *Engineering News-Record* of Sept. 18, 1919, p. 569. [This summary was followed by a summary of the Franklin Institute report.—Editor.]

As the "direct oxidation process" now stands, it may be fairly stated that it has received widespread attention and that the merits of the process have come into sharp controversy. This means that adequate data for giving the

process a true rating are seemingly lacking, at least to the extent of being persuasive to the minds of many. Briefly, the opponents claim this process to be no more efficient than if lime alone is used; that the process is unreasonably expensive to operate, especially where the sewage contains a very high amount of hardness requiring a large dose of lime; that the effluent, while very well clarified due to the coagulating effect of magnesium hydrate, is not purified of its organic matter to a degree sufficient to serve the local requirements at many places; and that the destruction of bacteria by the process is not due to the action of electricity but on the contrary to the excess of caustic lime in the effluent, which ranges from 30 to 80 parts per million.

On the other hand, the proponents of the "direct oxidation process" claim that it is cheaper to install than plants of the biological type; that it permits an attractive looking and inoffensive plant to be located within built-up portions of the city; and that it allows the sludge to be handled in an inoffensive condition and dried so as to produce a product that is marketable.

Sewage Treatment Situation at Lima, Ohio—It is not the purpose of this paper to go into great technical detail but rather to outline some of the main comparative features of the so-called "direct oxidation process" and of so-called "biological processes" as they have come into competition at Lima, Ohio. Controversial aspects of the local sewage problem as it now stands at Lima have produced a deadlock for the present year, leading to a series of claims and counter claims which are of some interest and perhaps of value as a warning guide.

Lima is a city of about 45,000 population with several large manufacturing plants and a growing population outside the present city limits. It is located on the Ottawa River, having a drainage area of about 100 square miles. The flow of this stream, which passes through the heart of the city, becomes almost nominal during summer and is lessened by storage reservoirs above the city into which water is pumped from the river during periods when there is a substantial flow. The result is that the stream bed is practically an open sewer from which offensive odors emanate for a distance of several hundred yards on either side.

Due to the complaints of riprarian owners below, the State Department of Health under the terms of the Bense Act ordered the city to purify its sewage. Fuller & McClintock made a report in 1916 on relief sewers, intercepting sewers and treatment works, recommending the adoption of the activated-sludge method. But little was done during the war period and beginning in 1919 construction work related largely to relief sewers to improve conditions in the built-up part of the city where the original combined sewers proved inadequate.

In 1921, Fuller & McClintock were engaged to design intercepting sewers and treatment works. After considering the problem in detail they recommended the adoption of fine screens followed by trickling filters and final settling tanks equipped with Dorr thickeners. This decision, differing from the preliminary report of 1916, was made partly because of inability, with the activated-sludge process, to treat the sludge in a way to yield any proceeds from its sale, but chiefly because under the Ohio law it is highly desirable, if not essential, to keep the operating expenses of sewage treatment plants at a minimum.

Under the terms of the amended Bense Act the interest charges on bond issues required for the construction of sewage treatment works when ordered by the State Department of Health to correct a nuisance, are not required to be paid from the general fund raised by taxation, to which there is a maximum limit of 15 mills per dollar of assessed valuation. Operating expenses for treatment works, on the other hand, must be paid out of funds raised by taxation and must be kept within the 10-mill rate unless there is a special election to authorize, by vote of the people, a special tax above this limit; but in any event a limit of 15 mills cannot be exceeded.

Plans and specifications for the fine screens and trickling filters were completed and approved by the State Department of Health, subject to the provision that preliminary sedimentation would be required if found necessary. A letting was authorized, with bids to be received on April 1, 1922. About a week prior to this date, the Municipal Disposal Co. of Philadelphia persuaded the City Commission at Lima to postpone the date of the letting and to take steps towards receiving alternate bids for a plant of the Landreth "direct oxidation" type. Plans and specifications for the latter were prepared and submitted to the State Health Department for approval. Specific data on the cost, method and adequacy of performance of the "direct oxidation process" have been requested of the city officials by the State Department, and Col. George A. Johnson has been retained by the city to obtain information in respect thereto.

Several months have elapsed during which the merits and demerits of the trickling filter method (Contract A) and of the "direct oxidation process" (Contract A-II) have been debated pro and con by the various parties in interest. Briefly, the situation may be summed up by the following paragraphs:

1. The installation cost of pumping station and treatment works by the trickling filter method, with its established record of adequacy and successful performance for a quarter of a century, was estimated in December, 1921, at $691,000 as compared with a sum said to be about $400,000 for the proprietary arrangement with a number of novel features not yet worked out on a practical scale on a sizable plant.

2. The annual operating cost of the trickling filter method, including all pumping, fine-screen operation and sludge disposal from final settling tank, is estimated to range from $13,000 to $15,000 in comparison with which is an estimated sum of $40,000 for the "direct oxidation" process. In this latter process it will be necessary to use, according to tests at Lima, about 2,800 lb. of lime per million gallons and about 150 kw.-hr. per million gallons for electrolyzers, in addition to the costs of pumping and screen operation, attendants for pumps, fine screens, electrolyzers, Dorr tanks, and sludge drying plant (three tons dry basis per million gallons) of the vacuum filter type. These estimates in each case are for fine screens operating at the rate of 4 m.g.d. for twelve months per year and secondary treatment for the seven warmer months. As the quantity of sewage increases later the financial disadvantage of the "direct oxidation" process will increase.

3. As to quality of effluent, the trickling filter plant will produce an adequately clarified and non-putrescible effluent, suitable for discharge into the Ottawa River. As regards clarification, the "direct oxidation" process, when an adequate dose of lime is applied, will produce the same result. But as to the removal of dissolved organic matter the evidence indicates that the "direct oxidation" process is no more efficient than "excess lime treatment" alone and that dissolved organic matter is not removed with substantial completeness but is simply left undisturbed in a sterile effluent so long as sufficient caustic alkalinity remains.

4. The "excess lime treatment" for sewage is not a novelty but was employed at London more than 30 years ago and was abandoned on account of the secondary putrefying reactions which took place with the organic matter on the bottom and sides of the River Thames.

* * *

One Year's Operation of Direct Oxidation Sewage-Works at Allentown

By Harry F. Bascom
City Engineer, Allentown, Pa.

ALLENTOWN has a population of about 90,000. Plans for direct-oxidation sewage-works for a part of the city, prepared by me, were approved by the Pennsylvania Department of Health, Oct. 1, 1919. The ultimate sewage flow tributary to the works is estimated at 1.91 m.g.d. of sewage uncontaminated with trade wastes with 2.8 m.g.d. maximum. The plant includes fine screens with ¼-in. circular perforations; grit chambers; a Venturi meter; lime storage and dosing apparatus; three sets of 1-m.g.d. elec-

trolyzers, each consisting of 48 plates spaced ¾ in. apart, the plates being cleaned by revolving paddles; sedimentation basins, with a detention period of 1½ to 2 hours at full 3-m.g.d. capacity; and sludge drying beds.

During the past year the plant treated 73,000,000 gal. of sewage without the slightest evidence of nuisance or complaint and produced an effluent which was consistently and uniformly stable and of low bacterial count.

TABLE I—RESULTS OF SEWAGE TREATMENT AT ALLENTOWN, PA.

	Raw Sewage P.P.M.	Effluent (1 Hr. Settling) P.P.M.	Per Cent Change
Suspended solids			
Total	150	69	—54
Volatile	110	46	—58
Oxygen consumed	17	8.1	—53
Free ammonia	21	13	—33
Nitrogen			
Dissolved	10.4	7.7	—26
Total	24.0	14.6	—39.1
Chlorine	117.0	123.0	5
Alkalinity as CaCO	287.0	50	
Bacteria			
Total 37 C.	2,036,000	12,000	—99.6
B. Coli	87,000	18	—99.98
Causticity as CaO			

The sewage is a normal sanitary sewage and its composition as well as the average composition of the effluent is shown in Table I.

Allentown is unfortunate in that its water supply is well above the average in hardness and therefore [the sewage] requires much more lime than many other communities. Accurate records of cost show that when the plant operates at full capacity, or 3-m.g.d., the cost would be as given in Table II.

TABLE II—OPERATING COSTS, ALLENTOWN SEWAGE-WORKS

Unit cost per 1,000,000 gal., based on operation at full 3-m.g.d. capacity [deduced by Mr. Bascom from figures for amount treated "during the past year," averaging 0.2 m.g.d. *Editor*]

Power 213 kw.-hr. @ 2.8c.	$5.96
Lime 0.6 ton @ $9.10 per ton (86% CaO)	5.46
Operators: 1 @ $135; 2 @ $125; 1 @ $100 per mo. 2 laborers @ 40 c. per hour	7.61
Heat	.08
Light	.17
Miscellaneous supplies and repairs	1.02
	$20.30

Sludge—The sludge as removed from the sedimentation basin contains 94 per cent moisture and amounts to 21 cu.yd. per million gallons. After 4 to 6 days drying on the sludge beds in normal weather the volume shrinks to 11 cu.yd. and the moisture content drops to 71 per cent. Therefore when dry the sludge will amount to about 3 cu.yd. per million gallons.

The wet sludge from the sedimentation basin was absolutely free of colon bacilli, contained 44,000 per c.c. of total bacteria and when diluted with river water and distilled water had a stability of over 99 per cent with methylene blue in dilutions ranging from 1 to 25 up to 1 to 1,000.

During the year the sludge has in the main been satisfactorily used for filling around the plant, although in some instances truckers have carted it away and used it on their farms, and they report that it is a very good growth stimulant, soil corrector, and improves the mechanical property of the soil.

Several improvements have been made in the lime dosage during the year, a new slaking chamber installed and the lime added further upstream from the electrolyzers, giving better slaking and mixing, also effecting a saving of approximately 25 per cent in the quantity of lime used.

Lately a new type electrolyzer was installed and tested out, showing a reduction of 50 per cent in the hydraulic head required as well as an electrical efficiency considerably greater than the older type. This unit has the same effective electrode area as the older ones but contains only a single row of ten banks of electrodes and the agitators reciprocate instead of rotate, being driven from the top instead of the side.

Comment has been frequently made that the direct oxidation process is no more efficient than lime alone. In this connection a great number of tests have been made at Allentown both by the city chemist and by other investigators and the results are conclusively in favor of the direct oxidation process, which gives an effluent that shows a greater reduction in oxygen demand, oxygen consumed, organic nitrogen and bacteria.

These tests also showed that the effluent produced by lime treatment, even though practically sterile when discharged, will putrify if mixed with river water, while that from the direct oxidation process will stand up indefinitely.

Conclusion—A very significant feature about the operation of the direct oxidation process is that it is mechanical in nature and depends for its success, not upon the delicate adjustment of conditions in an endeavor so far as possible to favor the caprices of bacterial life, but solely upon simple mechanical contrivances whereby lime is fed into the sewage in sufficient quantities to render that sewage always slightly but definitely caustic, and thereafter to maintain an uninterrupted charge of electric current in the electrolyzers. Outside of these features the process is automatic.

Except in the screen room, where the raw sewage passes over the screens, there is no odor of sewage, stability being obtained in the electrolyzing units without production of odor. No odors are present outside the building even from the sludge beds. Fly and mosquito nuisances such as is always prevalent at all other kinds of sewage-works are unknown at the Allentown plant.

The plant operates irrespective of weather or temperature conditions. The variation in flow of sewage through the electrolyzers up to the capacity of the unit has no effect upon the current required; in other words, any quantity of sewage up to the capacity of the unit requires the same amount of current as the rated flow.

* * *

Discussion of Fuller and Bascom Papers

Col. George A. Johnson, consulting engineer, New York City—In no other branch of public sanitation has there been less real progress made than in sewage treatment.

Bacterial purification of sewage is only incidental to any "purification" which it undergoes in the great bulk of the accepted sewage treatment processes of today. Keep the stream "sweet," attractive to the eye and inoffensive to the olfactory sense, and leave to the water purification plan the job of making the water supply safe for human consumption. That is the concept of the sanitary mind today.

I question the soundness of such promises when I realize that the cost of ideal sewage treatment is one of the real reasons why we do not strive for higher degrees of sewage purification. Some years ago Hazen said that the public derived more benefit from one dollar spent for water purification than from ten dollars spent for sewage treatment. In a broad sense he was right. Money spent for water purification returns a *direct* measure of protection of the public health against water-borne disease. Money spent for sewage purification results in an incomplete and indefinite benefit. It *minimizes* the danger from pathogenic germs by reducing their number. It cannot give absolute protection as can water purification, because even if every city, town and village in the country should treat its sewage to a point of innocuousness before discharging it into public waterways, it must still be remembered that those waterways drain areas populated or traveled by human beings whose excreta are not always collected in sewer systems, but sometimes are deposited at points on the watershed from which they find their direct or indirect way into the nearest stream or lake, thus to pollute it, maybe dangerously, and in any event incontrovertibly to render all surface water potentially unsafe for human consumption unless properly purified before being delivered through the mains to the consuming public.

Everything Incidental—Today, after thirty-five years' practice beginning at the Lawrence Experiment Station of the State Board of Health of Massachusetts, we have "advanced" to a point where we judge the ***efficiency*** and worthiness of a process of sewage treatment by its ability to turn out a fairly clear effluent which by itself will remain

stable for a few days. Everything is incidental. High bacterial purification is considered desirable but no particular point is made of it.

Why are we willing to allow sewage treatment plants to pour uncountable billions of bacteria into our public waters every hour of the day, when such waters must be used later for public supply? Why are we willing to accept sewage treatment works which we know with positiveness will fail several times during an average year, particularly during cold weather? Why do we complacently impose upon the water purification plant the full responsibility of protecting the public health against water-borne disease?

If it were the rule for every community to purify its sewage thoroughly, and not incompletely and uncertainly, as is almost always the case, all would be well; but where only the elimination of gross nuisance in streams is the prime consideration, as we know it mostly is, it is not easy to convince the people of one municipality that they owe a debt of common decency to their neighbors which they should pay—even if their neighbors are not similarly minded—and so become pioneers in a movement which would do so much toward actually cleaning up our public waterways and lessening the growing burden on water purification systems.

Direct Oxidation—Everyone knows, or should know, that of all the processes of sewage treatment in practical operation today there is only one which for its success does not depend upon the capricious activities of bacterial life. The "direct oxidation" process is not a biological system but a combination of mechanical devices depending not at all upon bacterial actions—which fail signally at times and at best are unreliable—but merely upon the faithful operation of certain relatively simple mechanisms. An effluent results which is practically free from suspended matter, which is stable and which contains but very few bacteria. Furthermore, the effluent is uniformly stable, as is the sludge—which is true of the sludge from no other process. Moreover, there is no local nuisance created around such plants, something which has never before been true of any other type of sewage-works. All of these facts were well demonstrated during my recent test of the direct oxidation plant at Allentown, Pa.

The cost of sewage treatment by the direct oxidation process is fairly comparable with that of other well-known methods which are far less easily managed, less reliable and all of which are certain nuisance breeders in some particular and in varying degree. At Trenton, N. J., for example, where I am preparing plans for a plant of this type, the total cost of treatment, including all charges, is estimated at about $20 per million gallons.

It is true that this process is patented, as is some of the apparatus used in it; that it is exploited commercially. I cannot see, however, wherein these facts need be given adverse consideration. We can use other processes, even the patented Imhoff tank, and obtain inferior and always uncertain results at less cost; or we can use this process, which, in the minds of some oblique-minded people, bears the stigma of a commercial exploitation, and obtain what we want and need, continuously and reliably, winter and summer, and at reasonable cost.

Must we shut our eyes to the advantages of definitely cleaning up our public waterways, continuously and permanently, and not as an intermittent and incomplete proposition, merely because a process which gives great promise of being able to serve this purpose best is a patented one susceptible of commercial exploitation? Some municipalities and some engineers adopt a discriminatory attitude toward patented devices, in some cases with good and sufficient reason, no doubt, but in the case in point if we favor the direct oxidation process over all others solely because of its merits and potentialities, and where cost factors are not clearly prohibitive, are our efforts to be discredited on the questionable grounds of unreasonable bias and unwarranted idealism?

T. Chalkley Hatton, chief engineer, Milwaukee Sewage Commission — Mr. Fuller has well stated that "the use of electricity as a purifying agent has appealed and continues to appeal fascinatingly to the lay mind.' He might have gone a step further and stated that to many lay minds electricity can accomplish almost any service if properly applied; that because of its *mysterious workings* its field is practically unlimited and therefore it has again and again in the past thirty years been used to remove the impurities from sewage-laden water, and I fancy there is not an engineer familiar with sewage treatment work who has not had more or less to do towards either trying out some process of sewage or water treatment in which electricity plays a part or given such a process very considerable study. In spite of this history there has not yet been built a sewage or a water treatment plant of any considerable magnitude in which electricity plays an important part.

Several small plants have been built where electricity was used as the sole purifying agent. All of these but one have been abandoned. Two small plants have been built where both electricity and lime have been used—the Phillipsburg and Allentown plants. I believe each of these plants has three 1-m.g.d. electrolyzers but that up to date neither of them has been operated at a rate of 1 m.g.d. for the whole works. The sewage so far treated is extremely weak, ranging from 60 to 80 p.p.m. of suspended matter, with low oxygen requirements. There is no published record of either plant which would warrant the engineer in concluding that they could continuously and satisfactorily treat a typical city sewage at rated capacities or what the cost of treatment would be.

Col. Johnson's Allentown Report — I have read within the past few days a detailed report of tests of the Allentown plant made under the direction of Col. George A. Johnson. These tests covered a period of 31 days (July 18 to Aug. 18, 1922) during which the average flow was 409,400 gal. and the maximum flow 700,000 gal. for 24 hours, or from 40 to 70 per cent of the rated capacity of one unit [out of three]. The sewage was treated at these rates for three different periods of the day, the flow in the sewers being too low to provide for a continuous daily operation of the plant, and the sewage was considerably below the average city sewage in carbonaceous and suspended matters, and was therefore not typical of average American sewage.

There were 57 tests made, divided into five groups, which appears to me to be far too few to warrant Colonel Johnson or any other careful engineer of his type to make the statements contained in his discussion.

Col. Johnson estimates that the plant he is designing for Trenton will treat that city's sewage for about $20 p.m.g. including all charges; my recollection is that in his report to Lima, Ohio, as referred to in Mr. Fuller's paper, the cost was about $45 p.m.g., which included the cost of sludge drying. If he proposes to dry his sludge by means of filters and dryers, as suggested in his report to Lima, and using the vacuum filters, as mentioned in Mr. Fuller's paper, the drying alone, based upon our experience in Milwaukee, will cost him from $20 to $30 p.m.g. of sewage, with very little, if any, return from the sale of a sludge devoid of nitrogen, phosphorus or potash.

The sludge problem is very lightly passed over by those who recommend the direct oxidation process and yet all those engineers who have built sewage disposal plants of any considerable magnitude, both in this country and abroad, realize more and more, as these plants are operated, that the proper disposal of sludge resulting from any type of sewage treatment is the largest part of the problem, and one which must be faced sooner or later; and when such enormous quantities of sludge are to be disposed of as the direct oxidation process produces, the problem of its disposal becomes naturally a costly and troublesome one to solve, even though the sludge may be inodorous.

It has not been proved (to the writer's satisfaction, at least) what the cost of electric current would be to operate a million-gallon unit to full capacity month in and month out. Our experience in Milwaukee with the Lautzenheiser electrolytic process was that with new plates when treating typical sewage at full rated capacity we secured admirable results for a few weeks; that we started off with five volts on the plates and increased to 100 volts within a period of

four weeks; that the amperes started at 70 and were reduced to less than 40, and that the weight of the electrodes diminished consistently in proportion to the sewage treated.

There can be no doubt that the electrodes rapidly diminish in weight and must be replaced; that a macnine with so many moving parts as the Landreth electrolyzer contains requires expensive upkeep, and that the known complexity of the varying conditions of the average sewage naturally imposes a correspondingly varied service upon the machines, influencing very largely the cost of operating this direct oxidation process.

It is not the writer's desire to cast any reflection upon the value of either the Phillipsburg or Allentown sewage disposal plants, but until they have fully demonstrated their worth by a long-time test to their full capacity, when treating typical American city sewage, and until reliable records have been secured and published, it would seem logical to go slow towards the general adoption of this process by engineers who are responsible for the expenditure of public funds in such large amounts as sewage treatment requires.

F. N. Moerk, chemist of the Municipal Disposal Co., promoter of the Landreth direct-oxidation process and contractor for the Allentown and Phillipsburg plants.

In his discussion Mr. Hatton states that the sewage of Allentown is relatively weak. Analyses show that it is almost identical with the sewage of Worcester, Mass. Mr. Hatton says he can't understand why at Lima the estimated cost for the direct-oxidation process is around $58 p.m.g., while at Trenton the estimated cost is about $20. The explanation is that at Lima the lime demand will be about 2,600 lb. of 90 per cent lime, so far as we can tell by analysis, while at Trenton it will be only 550 lb. As to the sludge problem: Future direct-oxidation plants will be equipped with Dorr thickeners. At Trenton the sludge will be used for fill. The U. S. Department of Agriculture estimates the value of the direct-oxidation sludge not on the nitrogen but primarily on the calcium carbonate content. On this basis the sludge is worth at least $5 a ton.

H. P. Eddy, consulting engineer, Boston, Mass.—After about as many years of experience in sewage treatment as were mentioned by Col. Johnson, I have concluded that while high ideals as to the degree of sewage treatment are desirable there is a cost limit which cannot be passed. Where sewage-works have fallen down is not in design and construction but in operation. This operating cost limit will apply to the direct-oxidation process, as it certainly will to the activated-sludge process. It is practically impossible now to get money for sewage-works operation, although it may be obtained for first cost. At Lima, the estimates show a big difference between the operating costs of direct oxidation and of screens and sprinkling filters. If a direct-oxidation plant were built there, and funds for full operation subsequently denied, the result might be a lime-treatment plant only.

I want to say just a word about Col. Johnson's remark on patented processes. I have never felt that we should refrain from taking advantage of patented processes. We are doing it all the time in engineering matters. Why not in sewage treatment?

Mr. Fuller—As to the remark by Mr. Moerk, chemist of the Municipal Sewage Disposal Co., there will be a variety of things to look out for in the application of the electrolytic process to the sewage of Lima where the sewers are on the combined plan and deal at times with storm water, besides having to cope with varying degrees of hardness in the water supply that makes up sewage. Mr. Moerk will have to look after the lime application in respect to free carbonic acid and to half-bound carbonic acid, both of which vary in different seasons of the year. Due to the slowness of reaction even in the presence of much mixing and agitation, a matter with which all water-works men are familiar, he will have to apply two equivalents of lime to one of magnesia. The magnesia content will vary not only due to its varying content in the public water supply but also due to infiltration water and storm water in the sewage. The direct-oxidation process, Mr. Moerk says, calls for a certain amount of causticity. In plain English, this means lime water in excess of what combines with the sewage as it goes through the electrolytic cells. The excess quantity is stated to be 30 to 50 p.p.m., and may be 80 parts. In order to get a dose of lime to give this desired amount of causticity, it will be necessary to top the aggregate combining power of three variables—free carbonic acid, half-bound carbonic acid, and magnesium. This would have to be done with the fluctuating flow of a combined system of sewers. This comment also applies to Colonel Johnson's assertion that the direct-oxidation process is a mechanical one.

In his Lima report, Colonel Johnson is strong on every-day-in-the-year operation. I believe that for a part of the time screening only will be enough. The adequacy of the data on which Col. Johnson's cost estimates for Lima are based, is in doubt in view of both the small size of the direct-oxidation plants thus far in use and the fact that they are not yet running at full capacity. As to claims that the operation of the direct-oxidation process is simple, being entirely mechanical, there are a number of chemical points that must be carefully watched. Finally, as far back as 1876, the British government called for a high degree of sewage treatment, but the demands were not met and long afterwards the Royal Commission on Sewage Disposal, although insisting on the formulation of sewage-works programs, provided also for what they called relaxation, with subsequent building up to the standard. A wedge should not be used blunt edge first.

Canada Taking Inventory of Prairie Lands

For the guidance of future settlers, what are known as "classification surveys" are being made over large and partially settled areas, in the Canadian prairie provinces under the auspices of the Topographical Surveys Branch of the Department of the Interior. From the results already obtained the new departure has been fully justified. Specimens of soils are being collected over the area investigated and analyses made at a soil laboratory established for this purpose at the University of Saskatchewan, Sask. Thus, the prospective homesteader may not only be informed as to the quality of the best soil, but also the crops which will yield the best returns. The lands inspected under the new system are classified under one of the following heads: Not open for homestead entry, suitable for immediate settlement, considered fair for settlement, lands which can be economically improved, those requiring extensive improvements, hay meadows, grazing lands, and lands of no agricultural value. Classes 2, 4 and 5 contain an acreage of good soil, which, after clearing and improvement, will be equal in value to the average improved farm of the district. Class 2 contains from 20 to 30 acres of land open or ready for breaking with little preparation. Class 4 is covered with a light or medium growth of poplar and other timber of no commercial value, while class 5 is heavily wooded with poplar and scattered spruce, birch, etc. Class 3 when improved will not be equal to the average improved farm of the successful homesteaders of the district owing to deficient acreage of cultivatible land or to some deficiency in the soil. Maps published recently by the Topographical Surveys Branch showing the classification of lands by quarter-sections for settlement purposes cover the districts around Lac la Biche and north of Prince Albert. Other maps covering other districts are in the course of preparation.

Water Power Timely Topic at Am. Soc. C. E. Fall Meeting

San Francisco Meeting Shows Lively Interest in Power Problems Because of Extensive Developments in Prospect—More Than 600 Registered—125 Inspect Hetch Hetchy Project

Engineering News-Record Staff Correspondence

THE meeting of the American Society of Civil Engineers held in San Francisco on the first week in October and devoted to "The Water Power Problem" afforded a timely opportunity for the discussion of a subject in which there is intense interest throughout the West. The degree of interest was apparent not alone from the heavy registration, but in the consistently large attendance and very close attention throughout all the sessions. The attendance at each of the forenoon sessions was about 350. Several references were made to the success of the plan of holding spring and fall meetings in various districts and the interest and enthusiasm in the local section which such meetings produced. The total registration was about 600 of which 150 were upper classmen in civil engineering courses at the University of California and Stanford. Suggestion was made that the student attendance offered a new and useful feature of such meetings that might well be encouraged in future.

Program of the Meeting—The arrangement of each of the two days' program into morning and evening sessions, with an afternoon excursion each day, afforded an opportunity for everyone to get outdoors and to either make the scheduled trip or go somewhere on his own account each afternoon without interfering with attendance at meetings. This plan was notably successful in keeping the percentage of attendance high.

Prior to the arrival of delegates very thorough preparations had been made by the local section. A variety of maps, reprints of technical articles and pamphlets on points of interest were collected for distribution and thus there was available at registration headquarters a wealth of ready information. This was very much in demand. The publicity of the convention was handled by an expert who had reporters of four daily papers present at the technical meetings and thus secured an unusual amount of publicity for the society and for the civil engineer generally.

President John R. Freeman opened the meeting on Wednesday morning with a comparison of modern hydro-electric practice, as he saw it exemplified a few days before at the Pit River plant in northern California, with early developments. One of the 40,000-hp. Pit River units develops more power than the combined output of the 150 installations operating in the vicinity of Lowell and Lawrence, Mass., only fifty years ago when he began his water power work. He was particularly impressed with the fact that only three men per shift were required on the Pit River plant, indicating the comparative economy of human effort that modern development has made possible. Mr. Freeman outlined in a broad way the possibilities of the work of the convention and particularly stressed the importance of Western power development.

Colorado River Development—A. P. Davis, in an illustrated talk on the Colorado River, stated that because it is technically and actually navigable for over 400 miles, involves international rights and can be made to irrigate 6,000,000 acres and develop 6,000,000 hp., the question of developing the Colorado has become a peculiarly national problem. An objection to developing storage on the lower basin, he pointed out, is the 90,000 acre-ft. of silt annually delivered to the lower Colorado. On the other hand, storage above the canyon could not regulate more than half of the drainage area. The Gila River alone, with only 21 per cent of the basin and contributing only 6 per cent of the water, occasionally discharges floods which for short periods peak above those of the Colorado at Laguna Dam.

A dam can be built in the Granite Gorge of Boulder Canyon, he said, that will form a reservoir sufficient to regulate the entire flow of the river above the Gila and regulate this to any desired regimen of discharge. Such a reservoir would not only completely eliminate the flood menace of the river, but would furnish the regulation and the head necessary to develop 600,000 primary horsepower and fulfill the requirements of irrigation in Arizona and California. This site is within transmission distance of large available power markets in Arizona, California, Nevada and Utah.

Feasible reservoir sites have also been surveyed at Flaming Gorge on Green River, Juniper on the Yampa, and at Dewey and Gorge Canyon on Grand River. Numerous smaller reservoirs on the smaller tributaries of the Colorado are available for local use in irrigation with perhaps some power development.

In discussion of Mr. Davis' paper, J. B. Lippincott (Los Angeles) stated that the entire summer flow of the Colorado is now being diverted and that the time has already come when the storage of flood waters must be begun. He expressed a hope that the U. S. Reclamation Service would be able, with federal aid, to undertake the development of storage and power on the Colorado, but that if that could not be done soon that federal authorities would at least allow private companies who stood ready to proceed to undertake such development. This he felt is urgent on account of the flood danger to the 50,000 people and the 500,000 acres of irrigated land along the lower reaches of the river.

Federal Water Power Rights—O. C. Merrill, executive secretary of the Federal Water Power Commission, stated that in the two years since the water power act was passed 348 applications for permits aggregating more than 20,000,000 hp. have been filed with the commission. This is more than twice the existing water power installation of the United States and more than six times all applications for power sites under federal control in the preceding twenty years.

Because of limited funds and personnel, the commission has been greatly delayed and hampered in its duties, Mr. Merrill said, but nevertheless final action has been taken on 197 applications, or more than half of the total number received. Up to Oct. 1, 1922, the commission has authorized 64 preliminary permits and 64 licenses of which 25 were for transmission lines. The 60 permits now outstanding involve about 2,540,000 hp. and the 39 licenses for power projects, 2,040,000 hp. Of the 39 licenses, 15 involving an estimated installa-

tion when completed of 1,880,000 hp. and investments of $220,000,000 are either completed or under construction. This is one and a half times as much as was constructed under federal authorization in the twenty years preceding the passage of the recent water power act. There is now more water power under construction than at any previous time in the history of the country.

F. H. Fowler (San Francisco) showed that practically all the Western coast is within a 500-mile radius of the two great sources of power on the Colorado and the Columbia Rivers. The enormous power possibilities here, however, cannot be developed economically, except in large blocks and consequently markets for the power must be found before development will be feasible. West of the Rockies coal and gas can compete with hydro-electric power only in very small areas or under special conditions, he said, and in the long run oil cannot be a competitor of hydro-electric power.

John D. Galloway (San Francisco) discussed the necessity for avoiding conflict of irrigation and power interests in water storage. Irrigation needs are best served by water stored until the dry season in low-level reservoirs that can draw from the entire watershed. Power uses are best served by continuous flow from reservoirs in the upper part of the basin where a maximum of head may be developed. Power demand in California has been increasing three to four times as fast as the population. The use of water power has increased there 138 per cent in nine years, or at the rate of approximately 9.9 per cent compounded annually. Adding steam power, the rate becomes 11.1 per cent compounded annually. By 1930 he estimated that the annual energy output will exceed 10,000,000,000 kw.-hr.

M. M. O'Shaughnessy (San Francisco) expressed a view favorable to state ownership of power development only when the entire power resources of an extensive area can be tied together and controlled as one system. Such development must be on a sound basis, he said, very unlike the impracticable scheme of the California Water and Power Act now proposed. He rated the domestic supply as the first or highest order of water use, irrigation second, and power development third. He estimated that 8,000,000 to 9,000,000 hp. would be developed in California within the next ten years.

F. W. Peek, consulting engineer, General Electric Co., Pittsfield, Mass., showed that the ultimate voltage of transmission lines would not be limited by any engineering difficulties, but rather by sources and markets for power. The cost of very high voltage lines is such that they can be built only when great amounts of power are to be transmitted. A 1,000,000-volt transmission line, for example, should have tubular conductors 6 in. in diameter hung 30 ft. apart on 20-ft. insulators, probably on towers about 200 ft. high.

H. W. Dennis (Los Angeles) said that in the territory served by the Southern California Edison Co. the population has increased over 300 per cent between 1910 and 1920. The company has increased its service from 379,900,000 kw.-hr. in 1910 to 1,079,000,000 kw.-hr. in 1921. Some 550,000 acres of land is irrigated by water pumped with power supplied by this company. An acre of arid land uses 300 kw.-hr. yearly, has its sale value increased thereby from $30 to $225 and yields an annual return of from $50 to $100 in crops. The increase of electric power production in territory served by this company has been compounded annually at the rate of 10 per cent. Anticipating steady increases in power demand for many years to come, a very extensive program of development has been laid out. During the next six years 322,000 hp. will be developed and distribution system provided at a total cost of about $125,000,000. . During 1922 the company is expending $27,000,000 for new plants and facilities.

Only the conclusions were read from the paper by C. F. Loweth (Chicago) on "Hydro-Electric Power as Related to the Electrification of Railroads." His conclusions were that it is reasonably safe to assume that hydro-electric power will be a large factor in steam railway electrification under the following conditions: "(A) When it is available over such an extended area as will include a large main track mileage for the individual railroad under consideration, (B) when the several sources are tied in together so as to insure reliability, (C) when it can be contracted for extending over long periods, (D) when its cost reduced to terms of locomotive tractive effort is cheaper than that of steam generated power.

Excursions—During the forenoon technical sessions the ladies were entertained by a ladies reception committee on personally conducted trips to Chinatown, the University campus at Berkeley, and other nearby points. Ladies were also included in all three of the main excursions. On Tuesday afternoon thirty automobiles, supplied by members of the San Francisco Section and placarded with the blue shield of the society, took the visitors for a 94-mile drive. At the start of this trip some of San Francisco's tunnels, boulevards and buildings were inspected and then the caravan, aided and escorted by two traffic officers, went down the peninsula, along the Spring Valley Lakes, to Crystal Springs Dam, thence to Pulgas Tunnel, now under construction, and finally to Stanford University where refreshments and a special program had been prepared. On Thursday afternoon the trip was across Golden Gate and through the redwoods to the top of Mount Tamalpais, El. 2,600 ft.

The inspection trip over the Hetch Hetchy project, was made via Pullman train leaving San Francisco after the meeting Thursday night and returning Sunday morning. This afforded an opportunity to study in detail a typical Western development of large proportions. In the present state of the Hetch Hetchy project work is under way on a concrete and an earthen dam, an 18-mile tunnel, forebay, penstock, power house and a variety of other construction work incidental to a combined water and power development served by its own 68-mile railroad.

Award of Prizes for Papers—At the meeting of the Board of Direction just prior to the fall meeting, which was reported in the issue of Oct. 12, the committee on prizes recommended awards as follows: The Norman medal to Charles H. Paul for paper "Core Studies in the Hydraulic Fill Dams of the Miami Conservancy District," J. J. R. Croes' medal to William Cain for paper "The Circular Arch Under Normal Loads," Thomas F. Dowland prize to Gustav Lindenthal for paper entiled "The Continuous Truss Bridge Over the Ohio River at Sciotoville, Ohio, of the Chesapeake & Ohio Northern Ry.," James Laurie prize to Arthur T. Safford and Edwin Pierce Hamilton for the paper entitled "The American Mixed Flow Turbine and Its Setting." No award was made of the Arthur M. Wellington prize, or the Collingwood prize for juniors.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Text and Reference Book on Hydraulics

REVIEWED BY JOHN H. GREGORY

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HYDRAULICS—By Horace W. King, Professor of Hydraulic Engineering, University of Michigan, and Chester O. Wisler, Associate Professor of Hydraulic Engineering, University of Michigan. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9; pp. 237; illustrated. $2.75 (13¾s. net).

In their preface the authors state that this "book is designed as a text for beginning courses in hydraulics and as a reference book for engineers who may be interested in the fundamental principles of the subject"; and they also go on to say that "tables of coefficients are given which are sufficiently complete for class-room work, but the engineer in practice will need to supplement them with the results of his own experience and with data obtained from other published sources. The book must therefore be considered primarily from the standpoint of the instructor, and only to a limited extent from that of the practising engineer.

The text is divided into eleven chapters. Following a brief introductory chapter are two on the principles of hydrostatic pressure and on pressure on surfaces; and after these come two chapters on immersed and floating bodies and on the relative equilibrium of liquids. The next chapter is devoted to the principles of hydrokinetics. The four following chapters, perhaps the most important in the book, treat of the flow of water through orifices and tubes, over weirs, through pipes, and in open channels. The last chapter takes up briefly the subject of hydrodynamics.

Taken as a whole the text is well written, and it is evident that the authors have a good understanding of the subject. In places, however, the text could to advantage be simplified, so that the student would more readily grasp the subject, which, to many is "dry."

As a beginner's textbook, and in the hands of a competent instructor, preferably one who has had enough practical experience to know the limitations of the subject, the volume should prove satisfactory for classroom work. At the end of each chapter, except the first, numerous problems are given—in all a total of 168—a feature much to be commended.

As a reference book, the practising engineer will find only a limited treatment of the subject, as was to be expected from the statements made in the preface by the authors. On the other hand, the engineer will find certain phases of the subject given a somewhat different treatment from that ordinarily found in other textbooks on hydraulics, and well worth reading.

The tables are not numbered, which is to be regretted; and the formulas are not numbered consecutively through the book from beginning to end, new numbering beginning with each chapter, which is also to be regretted. In the practical solution of everyday hydraulic problems, diagrams are very commonly used. No such diagrams are given in the book; an omission, which, in the writer's opinion, should be corrected in subsequent editions. The student should have brought to his attention in a course in hydraulics the use of diagrams as a supplement to numerical computations.

In places, the authors use a nomenclature somewhat different from that used in other books on hydraulics. This comment is not to be construed as a criticism, but rather to call attention to the fact that a standard nomenclature in hydraulics is greatly to be desired.

The illustrations are well executed and in general the book is well made. An index is included, but there is no separate index of tables.

Turbines and Water-Power Installations

REVIEWED BY LEWIS F. MOODY

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BERECHNUNG UND ENTWERFEN VON TURBINEN—UND WASSERKRAFT—ANLAGEN, Mit einer Anleitung Zur Anmendung des Turbinenrechenschiebers—Von Ing. Holl. In dritter auflage neu bearbeitet und erweitert von Dipl.-Ing. E. Glunk. München und Berlin: R. Oldenberg. Paper; 7 x 10 in.; pp. 181; 41 illustrations. 225 marks in paper; 270 bound.

There have recently been signs that the publication of technical works in Germany which had been interrupted for a long period by the war is now being actively renewed. Several new editions of publications issued before the war have appeared. In any field in which rapid progress is being made, it is questionable whether it is worth while to attempt to bring up to date technical works which have been published a considerable number of years before, and the result of such efforts is frequently disappointing. The work here considered is a case in point.

The original book by Holl was published in 1908 and, as stated in the preface, it was prepared as an explanation of a special slide rule which Holl had devised as an aid in hydraulic turbine computations. From examination of the plans of the slide rule as illustrated in the book, the slide rule itself seems to have gone out of date in a number of particulars.

The period from 1908 to the present has witnessed a revolution in the development of hydraulic turbines and the development of the modern turbine has taken place almost entirely within this period. This development is still continuing at what seems to be an accelerated rate. It is therefore not surprising that the bulk of the material of the book has gone out of date since its original publication.

This period also witnessed the death of the author and the second edition (1913) bore a note by Professor Reichel, explaining that owing to the author's death no attempt had been made to revise the book. Professor Reichel expressed his opinion in the note that the book represented such an intimate knowledge on the part of the author in the field of water-power engineering and that the material was so wisely selected for the small space it occupied that even aside from the use of the slide rule the book was of value.

In the present edition a strong effort has been made to bring it up to date, but although a considerable amount of new material has been added by E. Glunk, and although considerable revision is evident, neverthe-

less it is not believed that the book in its present form will prove to be of much value, particularly to American engineers.

The modern turbine is largely an American turbine and the pre-eminence which used to be claimed for German engineering in this field certainly does not exist today. A book which practically ignores the great modern developments which have been carried out in the United States and Canada, as this one does, must naturally be virtually handicapped. A note has been added on the Station No. 3 Extension of the Niagara Falls Power Co., but it is very inadequate. Much of the material presented in the plates and text will be recognized at a glance as being out of date. For example, the highest efficiency shown for impulse turbines is 83 per cent and the highest efficiency for Francis turbines is 84 per cent.

A considerable amount of space on the Holl slide rule is taken up with turbines having from two to eight runners on a shaft, representing types of installations of but little interest today. No design is shown of a strictly modern turbine and no reference is made to such important features of moderr power development, for example, as the differential surge tank, the Johnson valve, or the new forms of draft tubes.

It is almost too much to expect that a book should present the latest results from high specific speed runners and in many other features of the turbine of today, since new results are continually being obtained and new features introduced with surprising frequency. The engineer who has undertaken the revision of the book is, therefore, not entirely to blame for the inadequacy of the work for present use.

The latter part of the volume contains some material of value in its descriptions of a number of European power developments. There are also a useful collection of formulas and construction data in an appendix.

Marvels of Science and Nature

THE OUTLINE OF SCIENCE: A Plain Story Simply Told. Edited by J. Arthur Thompson, Regius Professor of Natural History in the University of Aberdeen. With 40 Colored Plates and 800 Illustrations in Black and White (in the entire four volumes). Vol. II and III. New York and London: G. P. Putnam's Sons. Cloth; 7x11 in.; pp. 299-564 and 565-864. $4.50 a volume.

The middle two volumes of this work follow the same general lines as were indicated in the brief commendatory notice of the first volume that appeared in these columns on July 20, p. 115. It is now possible to get a better general idea than before of the work as a whole, although there is still another volume to come.

Microscopy, The Body-Machine, Darwinism Today, Natural Science—including Birds, Mammals, and the Insect World—and the Science of the Mind are dealt with in the second volume. The third volume opens with a short section on Psychic Science, by Sir Oliver Lodge. After the break in Natural Science caused by the injection of the two sections just mentioned, Botany is presented. Then come Inter-Relations of Living Creatures, Biology (by Julius S. Huxley) and Characteristics of Living Creatures. Chemistry has two sections—on its romance and its uses—; Meteorology, one, Applied Science, three—Marvels of Electricity, Wireless Telegraphy and Telephony, and Flying.

Certainly "the intelligent student-citizen, otherwise called the 'man in the street,'" for whom the publishers' jacket says the work is intended, would profit by a more logical arrangement than has been followed—as might also be expected in an "Outline of Science." If the illogical sequence is due to the exigencies of gathering material from various sources and publishing it while fresher than would be possible under a logical grouping, let it be hoped that subsequent editions will be improved in arrangement.

Except for the names of Sir Oliver Lodge and Julian S. Huxley, the reader is left in the dark as to the authorship of the various sections thus far published. He may assume either that all the other sections were written by the editor or else that they were so largely reworked by him as to make them virtually his own.

Thus far engineering has been let alone, except as it comes in, although not by name, in the three sections on Applied Science that close the third volume. Under Marvels of Electricity there are some statements about hydro-electric power, electric heating and the electrification of railways that may mislead the uninformed. It is not even hinted that the choice between coal and falling water as a source of power is largely a matter of comparative capital and operating costs. A statement that electric current may be much more efficiently converted into electric heating than electric lighting, followed by remarks about the various uses to which electrically derived heat is put, may lead some to wonder why so few buildings are heated by electricity.

The over emphatic and the spectacular which every writer and editor of essays and books on popular science should guard against are illustrated on p. 794, where we read that electric energy "will drive the transcontinental express up the dizzy heights of the Rocky Mountains." Again, one of the illustrations bears this subtitle: "A scene on the Chicago, Milwaukee and St. Paul Railway, the largest electrical railway system in the world, *running practically across America.*" The British author of the four words we have italicized would be convinced that "practically" is hardly the word to use before he had walked the 1,000 miles from Chicago to New York City. A few pages on, the reader is told that the "longest stretches of main line yet electrified" are one 440 and another 211 miles in length, but he is not told that the C. M. & St. P. "system," mentioned under the illustration, comprises 10,000 miles of track.

Such details as the foregoing are unimportant compared with the general soundness and excellence of the three volumes already published. Those who have had the pleasure and profit of seeing these volumes will await the final volume with interest.

Handy Six-Place Tables

SIX-PLACE TABLES: A Selection of Tables of Squares, Cubes, Square Roots, Cube Roots, Fifth Roots and Powers, Circumferences and Areas of Circles, Logarithms of Numbers, Logarithms of the Trigonometric Functions, and the Natural Trigonometric Functions. New York and London: McGraw-Hill Book Co. Flexible; 4 x 7 in.; pp. 124. $1.25.

The justification for this book lies in the prefatory statement that it is "a pocket-sized book of tables such as are in regular and continuous use by engineering students and instructors, and, to a certain extent, graduate engineers in their professional work." Six-place tables have a definite place not filled by those of four or five places and the saving in bulk over the occasionally more useful seven-place has a definite advantage.

Colloids in Theory and Practice

REVIEWED BY MALCOLM PIRNIE

Of Hazen & Whipple, Civil Engineers, New York City

THE CHEMISTRY OF COLLOIDS AND SOME TECHNICAL APPLICATIONS. Second Edition. By W. W. Taylor, M.D., D.Sc., Lecturer in Chemical Physiology at the University of Edinburgh. London: Edward Arnold & Co. New York: Longmans, Green & Co. Cloth; 5 x 7 in.; pp. 322; illustrated. $3.50.

APPLIED COLLOID CHEMISTRY: General Theory—By Wilder D. Bancroft, Professor of Physical Chemistry at Cornell University. New York and London: McGraw-Hill Book Co. Cloth; 6 x 8 in.; pp. 345; illustrated. $3.

Contrary to a general impression that colloids is a subject too highly theoretical to be readily grasped by the average engineering student, Professor Taylor's small volume presents the facts, theories and examples so clearly and concisely that it will hold the interest of readers not advanced in the knowledge of chemistry.

The book is a convenient text and an excellent reference book for workers in all branches of science. It defines colloids and crystalloids, not as different kinds of matter, but as different states of matter, and then describes the phenomena observed to take place when matter in the colloid state is treated in various ways. The deduction which has been made that colloids are an intermediate step between solids and true solutions is sufficient reason why they deserve the careful study of all scientists. They are particles either solid, liquid or gaseous, dispersed in liquids, gases or solids. At least one dimension of a colloid is very small so that the surface area for a given mass is correspondingly great. In these circumstances, forces of which we know little play major parts, overcoming the force of gravity and interfering with or aiding chemical reactions.

The volume outlines the general properties of colloids; gives selected experimental evidence for the theories set forth; describes the methods of preparation of various elements and matter in the colloid state; deals briefly with the phenomena incident to large surfaces and adsorption—which might be called the prime mover of colloids, as it is the force of attraction or repulsion between colloids and molecules that is consistently greater than gravity. Finally, the application of this branch of chemistry to the dyeing and tanning industries and to biology is pointed out as selected examples of the practical importance of the subject.

Students of concrete, water purification, sewage treatment, bacteriology and many other subjects will find in this book experimental facts analogous to phenomena encountered in their experiences and theories furnishing plausible explanations which will be helpful in guiding future investigations.

In the present edition, considerable new material has been added. This comprises either more convincing illustrations of already established theories or new experimental results which have led to changes in previously accepted theories. Professor Taylor's volume is valuable not only as a textbook, but also as a stimulus to investigation by those who must deal with matter in the colloid state.

Professor Bancroft's book is an interesting introduction to the chemistry of colloids and will be found valuable for reference. Every chapter contains information of interest to engineers that can be readily understood without advanced chemical training. A progressive thinker in almost any line of endeavor will discover facts and theories which will suggest new lines of investigation or furnish reasonable explanations of experiences that cannot be accounted for in the usual way.

More than one-third of the volume is devoted to the discussion of adsorption, which is the force of attraction or repulsion between liquids, gases and solids in their normal or colloid states. Adsorption of gas or vapor by solids—with resulting chemical reactions, in certain cases, of vapor by liquid and of liquid and solid by solid and liquid and adsorption from solution by solid and liquid—are clearly explained with reference to their practical applications in established industries or by accounts of reliable experiments. The remainder of the book describes surface tension and Brownian movements; coalescence and its reverse peptization; preparation and properties of colloidal solutions; gelatinous precipitates and jellies; emulsions, foams, fog and smoke, gases and solids in solids and thickness of surface films.

It is pointed out in the preface that this book on general theory should be followed by at least ten volumes adequately to set forth the colloid chemistry of the following subjects: Silicate industries; paints and varnishes; plastics; fibers and dyeing; photochemistry and photography; petroleum industries; ore flotation and allied subjects; foods and beverages; soils and crops; biology and medicine. But the present volume supplies the rudimentary principles essential to an understanding of cement, bricks, pottery, porcelain, glass, enamels; oils, greases, soaps, candles; glue, starch, and adhesives; paints, varnishes, lacquers, rubber, celluloid and other plastics; leather, paper, textiles; filaments, casts, pencils and crayons; ink; roads, foundry cores, coke, asphalt; graphite, patines; zinc, phosphorous, sodium, and aluminum; contact sulphuric acid; hardened oils, etc.; beer, ale and wines; cream, butter, cheese and caseine products; cooking, washing, dyeing, printing; ore flotation, water purification, sewage disposal; smoke prevention; photography; wireless telegraphy; illuminants; comets; pharmacy; physiology. This list is found in the introduction and is an incomplete statement of subjects commonly met in every-day life in which colloids play an important part.

Bridging a Gap

STRUCTURAL PROBLEMS, PART I—By C. R. Young, B.A.Sc., C.E., M.E.I.C., Associate Professor of Structural Engineering, University of Toronto. Second Edition. Toronto: Engineering Society of the University of Toronto. Paper; cloth back; 6 x 9 in.; pp. 96; line cuts.

For the young engineer there is apt to be a distinct gap between a piece of theory or an algebraic formula and its practical application in designing. Prof. Young shows a very serviceable bridge across this gap, so far as structural design is concerned. His manner of treatment makes the crossing of the bridge really a lesson in engineering, where formulas and theories are mere auxiliary aids in taking quantitative account of the physical facts of the case. By emphasizing in each of his design examples the assumption made antecedent to the calculation, Prof. Young compels his student-reader to think about the correspondence between the real columns, girders or frame and the ideal structures about which books on applied mechanics are written. Both steel and wood are dealt with in the little book. There is room for much more instruction in both fields, about details as well as about the larger structural elements. Possibly the further instruction is yet to come, as the present pamphlet is headed "Part I."

Basic Facts on Materials of Construction

MATERIALS OF CONSTRUCTION—Prepared for the Extension Division of the University of Wisconsin by H. E. Pulver, B.S., C.E., Associate Professor of Civil and Structural Engineering, the University of Wisconsin. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 218; illustrated.

This is an accurate and adequate text prepared for correspondence school study. It is frankly elementary, but there is enough given to provide the student with the base facts regarding the manufacture and properties of the materials used in construction.

References on Fire Hazards and Resistance

The Municipal Reference Library of Chicago (Frederick Rex, librarian) has issued a "List of References on Fire Hazards and Fire Resistance of Office Buildings, Sky Scrapers and Fireproof Structures." It is also getting out occasional lists entitled "What Other City Councils Are Doing," consisting of brief notes on resolutions, ordinances, reports, etc., by city councils and executives.

Air—Refrigeration—Gas

A collection of illustrated papers and notes entitled "Air—Refrigeration—Gas" has been published separately in English, French and Spanish by the Verein Deutscher Ingenieure, Berlin, Germany. The main subjects treated, each by a different author, are piston compressors, turbo compressors and blowers, fans, locomotives, air drills and hammers for mining, pneumatic tools, refrigeration and air liquefaction and separation.

State College of Washington Bulletins

Three recent Engineering Bulletins of the State College of Washington (Pullman) are: "Well and Spring Protection," by M. K. Snyder; "Water Supply for the Country Home," by Mr. Snyder and H. J. Dana; "The Use of Ropes and Tackle," by Mr. Dana and W. A. Pearl. All are illustrated.

Publications Received

[When possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated. Many of the pamphlets can be obtained without cost, or by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain any publication listed should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

New Books and Revised Editions

ENGINES AND BOILERS—By Thomas T. Eyre, Dean, College of Engineering, State University of New Mexico; Formerly Assistant Professor of Mechanical Engineering, Purdue University. [Engineering Science Series.] New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 234; line cuts. $3.50.

Designed for "an elementary course in heat engines"; based largely on lecture and mimeographed notes used by the author at Purdue University. Representative problems are given.

GUILD SOCIALISM: An Historical and Critical Analysis—By Niles Carpenter, Ph.D., Instructor and Tutor in Social Ethics in Harvard University. New York and London: D. Appleton & Co. Cloth; 6 x 9 in.; pp. 350. $2.50.

THE HYDRAULIC PRINCIPLES GOVERNING RIVER AND HARBOR CONSTRUCTION—By Curtis McD. Townsend, Colonel, United States Army (Retired), M. Am. Soc. C. E., Late President Mississippi River Commission. [Engineering Science Series.] New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 189; 7 line cuts. $2.60.

OFFICIAL SOUTH AFRICAN MUNICIPAL YEAR BOOK, 1922—Joint Editors: W. P. M. Henderson, Formerly Town Clerk of Durban; Francis G. Pay, Cape Town. London: Edw. G. Allen & Son, Ltd. Cloth; 6 x 10 in.; pp. 413. 25s.

Besides giving a general description of each of the municipalities and their activities, together with their principal officials, this volume contains tables of comparative statistics, including light and power, municipal debts and other finances, water supply, fire protection and public libraries.

PHYSICAL AND CHEMICAL EXAMINATION OF PAINTS, VARNISHES AND COLORS—By Henry A. Gardner, Director Scientific Section, Educational Bureau, Paint Manufacturers Association of the United States; National Varnish Manufacturers Association, Co-operating. Washington, D. C.; P. H. Butler, Sales Agent, 1845 B St., N.W. Cloth; 6 x 9 in.; pp. 219+ various circulars of the U. S. Bureau of Standards; halftones and line cuts. $9.

RAILWAY ELECTRIC TRACTION—By F. W. Carter, M.A., M. Inst. C. E., M.I.E.E., Assoc. A.I.E.E. New York: Longmans, Green & Co. London: Edward Arnold & Co. Cloth; 6 x 9 in.; pp. 412. $8.50 net.

SHIELD AND COMPRESSED AIR TUNNELING—By B. H. M. Hewitt, M. Am. Soc. C.E., M. Inst. C.E., Director, Jacobs & Davies, Inc., New York, Consulting Engineers, sometime engineer on the construction of the Central London Railway, of extensions to the City and South London Railway, of the Hudson River Tunnels for the Pennsylvania R.R., New York, and of the Laxaxalpam Aqueduct Tunnels for the Mexican Light & Power Co. in the State of Puebla, Mexico; and S. Johannesson, M. Am. Soc. C.E., sometime engineer on the construction of the Islington extension to the City & South London Railway, of the Pennsylvania Railroad Tunnels, New York, and of the Manhattan Elevated Railroad improvements and extensions for the Interborough Rapid Transit Co., New York. New York and London: McGraw-Hill Book Co., Inc. Cloth: 6 x 9 in.; pp. 465; $5.

SIX YEARS IN BOLIVIA: The Adventures of a Mining Engineer—By A. V. L. Guise. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 213; half tone plate. $7.

THE WELDING ENCYCLOPEDIA: A Practical Reference Book on Autogenous Welding—Compiled and Edited by L. B. Mackenzie and H. S. Card of the Editorial Staff of the *Welding Engineer*. Chicago: The Welding Engineer Publishing Co. Flexible; 6 x 9 in.; pp. 388; 550 illustrations. $5.

Materially enlarged from first edition.

Reports and Pamphlets in Various Fields

FOREST PRODUCTS: Census of the United States, Manufacturers, 1919—Paper; 10 x 11 in.; pp. 84. Washington, D. C.: Bureau of the Census.

QUEBEC STREAMS COMMISSION: Report for 1920-21—Quebec, P.Q. Paper; 6 x 9 in.; pp. 112; diagrams.

RAMSHACKLE COUNTY GOVERNMENT: The Plague Spot in American Politics. By Richard S. Childs. New York: National Municipal League, 261 Broadway. Paper: 4 x 6 in.; pp. 27; 1 diagram. 10c.; $5 per 100.

A revision of Mr. Child's snappy exhibit of what has been called the weakest spot in American government today.

SAMPLING AND ANALYSIS OF PIG IRON: Methods of the Chemists of the United States Steel Corporation—[J. M. Camp, Chairman, Chemists' Committee.] Paper; 6 x 9 in.; pp. 40; line cuts.

STATISTICAL ABSTRACT OF THE UNITED STATES, 1921—Compiled by Edward Whitney. Cloth; 6 x 9 in.; pp. 942. 75c. from Superintendent of Documents, Washington, D. C.

STATISTICS OF COMMON CARRIERS: Preliminary Abstract of 1921 Report. Washington, D. C.: Interstate Commerce Commission. Paper; 9 x 12 in.; pp. 39. 5c. from Superintendent of Documents, Washington, D. C.

TESTS OF JOINTING MATERIALS FOR VITRIFIED CLAY PIPE—By S. E. Dibble, College of Industries, Carnegie Institute of Technology, Pittsburgh, Pa. Also Report of Bureau of Surveys, Philadelphia, Pa. Issued by Eastern Clay Products Association, Philadelphia, Pa. Paper; 8½ x 11 in.; pp. 15. The first part consists of brief summaries of tests of "compound" jointing material (largely bituminous) and of cement mortar and neat cement, under a variety of conditions. The Philadelphia report deals entirely with bituminous jointing material.

WATER POWER AND STORAGE POSSIBILITIES OF THE HUDSON RIVER: Report of New York Water Power Commission, Prepared Under Direction of Frank M. Williams, State Engineer and Surveyor, Member and Secretary of Commission, by E. H. Sargent, Senior Assistant Engineer. Paper; 6 x 9 in.; pp. 75; illustrated, including map diagrams, and half tones.

Continuation of investigations previously made by Conservation Commission. Describes various possible reservoirs, also power developments both actual and possible. Contains tables and diagram of gagings.

WATER SUPPLY INSTALLATIONS FOR FARMSTEADS AND COUNTRY ESTATES—By William Paul Gerhard, C.E., Dr. Eng., Consulting Engineer. Published by the Author, 17 W 42nd St., New York City. Paper; 6 x 9 in.; pp. 24. 40c.

WISCONSIN STATE PLUMBING CODE (Fourth Edition)—Madison, Wis., State Board of Health. Paper; 5 x 7 in.; pp. 204.

Besides the State Plumbing Law of 1913, and the State Board of Health Plumbing Regulations, the pamphlet contains a variety of useful information on water supply and sewage disposal for houses, etc., including sketches with explanatory matter.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

To Prevent Theater Accidents

Sir—With the Strand theater accident Pittsburgh has been again shocked and grieved and made to realize the futility of impersonal and thinly distributed responsibility. A very bad type of design, and one that invited deterioration in several distinct ways, is the cause of this disaster. Wooden joists projecting 2 in. into a brick wall; 5 in. of plain concrete over these joists, with its great dead weight and its impervious character; an enclosed, unventilated, unpaved and unused cellar, which furthermore was very damp and is said to have been frequently flooded; these are the things that brought on an almost total destruction by wet rot in the short period of eight years.

Of course we will have the usual "rigid investigation" and the usual formal placing of responsibility which will not remain placed. The usual farce will be enacted while the public is forgetting about it. Some clerk will doubtless be sent to each theater to ask the proprietor if his building is safe and maybe to see if it has doors enough to let enough people in to fill it quickly.

A real examination of this building and of the Majestic theater, which collapsed a few months ago, could not fail to have disclosed to a structural engineer the absolute danger of using either.

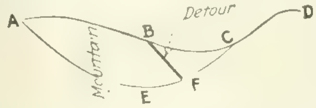
What is needed is an ordinance or a public demand that all public buildings be examined by a responsible structural engineer and that a notice be posted signed by this engineer—his personal signature—stating that the building is safe. We have had quite enough of bureau inspection rubber-stamped by one of the drawers (of salary) of the bureau. EDWARD GODFREY.

Pittsburgh, Sept. 26.

Meditations on Detour Practice by an Autoist

Sir—As one motors day after day through various states over roads good, bad, and indifferent, with unheralded and unchartered detours, he is apt to ponder whether, after all, he is not mistaken in assuming that the function of a highway is to furnish ease of transportation.

If the routes of detours were plainly marked it would facilitate the journey. Too often one is turned loose on a detour and must needs negotiate it as best he can. Next, there should be sufficient maintenance of the detour to keep it in passable condition. The detours are often over unimproved roads and, even though they carry the normal traffic with fair efficiency, when the heavier traffic is turned over them they soon become very bad. There is no excuse for allowing these roads to have entirely across them such deep ruts that cars drag on the ridges.



There should be also readily accessible data on detours so that before starting on a route a person may know what is ahead of him and not proceed on a main road only to be deflected, without previous warning, over an atrocious side road. One method of accomplishing this result would be to have the information in regard to detours posted at the beginning of a route *A*, giving the points between which the detour is, with information in regard to the character of the detour. In many cases it would then be possible, in going from *A* to *D*, to take another route where the road would be good and the distance not much greater. In many cases it would be preferable to take the other route at a considerable increase in distance when taking into account time, wear and tear on the automobile, and the amount of gas used.

As illustrated by the sketch one could go from *A* through *E* to *F*, instead of through *B* to *F* where *B-F* is very poor, at an increase of only ten miles in distance. Further the road from *A* to *B* passes over a mountainous road with high grades, whereas from *A* to *E* the route is through a notch with very gentle descending grades. On the reverse route, from *D* to *A*, full information should be given at *F* in regard to the routes *F-B-A* and *F-E-A*. In general, information in regard to detours should be more easily accessible before the point of detour is reached.

More care should be used not to place signs in regard to construction or repairs until they are needed and to remove them when the work is finished. In one state a road was encountered with a sign on the left "No passing, Bridge up." On the right was the warning "Construction, Unsafe but Passable." Having experienced several instances in that state where the road construction was completed but the "Unsafe but Passable" sign was left in place, doubt was had as to the advisable procedure. However as the "Bridge Up" sign looked fairly new it was decided to take the detour. Often also the roads might be left open while under construction. In another state a concrete road had a "No Passing" sign. Inquiry at a nearby house elicited the information—"Cars all go through and none come back." This road was in good condition. The only evidences of construction were a pile of gravel and a small piece of machinery on the shoulder at the end of the road.

In another state where work was in progress inquiry was made as to the character of the detour. The official questioned replied—"It is a very bad detour but I guess you can get through." While looking over the car to make sure that everything was in good condition another car was seen to stop. Shortly the informer in regard to the detour came up and said,—"See that car. That is a highway official. He is going over the main road. If he can, you can. Follow him." This advice was heeded and the trip was made in comfort. CHARLES A. HOLDER,

Director, Thayer School of Civil Engineering.

Hanover, N. H., Aug. 19.

Coal-Bin Pressures

Sir—In connection with the article "Some Data on the Design of Steel Coal Bins," by R. Fleming, in *Engineering News-Record* of Aug. 31, p. 346, I should like to comment upon the theories used to obtain the lateral pressures.

Table I, p. 348, is based upon a wedge theory which assumes that the plane of rupture bisects the area between the wall, the plane of repose and the surface of the fill. This result was given by Rebhann (1870) and later elaborated by Weyrauch (1878), who is also responsible for the "pressure triangle," (DFE in Fig. 3). Since the theory is based upon an undisturbed granular mass beyond the plane of repose, and a balanced mass at rest between the planes of repose and rupture, it does not apply to the case of bins. Had the author drawn the plane of rupture from both sides of the bin, he would have noticed that a certain portion of the material tends to exert pressure on both sides of the bin at the same time, so that neither side is acted upon by the effect of a complete wedge. A better, but still not perfect, theory for the case of a bin was developed by Woltmann (1799), who takes into account the simultaneous pressure on both sides of the bin and also the frictional resistances on both walls.

The diagram in Fig. 3 shows the resultant inclined at an angle of 30 deg. to the horizontal. It is doubtful whether the angle of friction of coal on steel ever reaches 30 deg.; the author mentions that Dull had taken 16 deg. for anthracite and 18 deg. for bituminous.

The use of an equivalent-fluid method is theoretically unsound and has been experimentally proven incorrect. Granular materials, especially of the size of coal, do not obey the laws of liquids. For example, how can we consider the condition of coal piled up at the top surface if we

assume the coal to act as a liquid and even give it an equivalent liquid density?

The theories of Rebhann and Weyrauch are most easily accessible in Prelini's "Graphical Determination of Earth Slopes, etc." (1908). Woltmann's theory may be found in his "Hydraulischen Architektur" or in Hagen's article on "Untersuchungen ueber den Druck des Sandes" in *Annalen der Physik und Chemie* (1833), Vol. 116, pp. 17 and 217.

From Table I the writer notes that, evidently, the width of the bin has no effect upon the lateral pressure if the surface of the fill is horizontal. However, even for a height of 2 ft., in the case of sloped fills, an increase in width for all widths results in an increase in pressure. The value for a 15 ft. width, 57, which is greater than for the 20 ft. width, 54, is probably an error. There is no theoretical or experimental foundation for any variation after the width is sufficient to give a full plane of rupture from each side. However, if we assume that the material acts like a liquid, the width should have absolutely no effect upon the pressure; the pressure should be the same whether the walls are an inch or a mile apart. JACOB FELD.

Brooklyn, N. Y.
Sept. 16.

Rapid Sand Filter Plant in the Far East

Sir—In the article on "Waterworks and Filtration Plant for Dairen, Manchuria," appearing on p. 244 of your issue of Aug. 10, this recently installed plant is described as the "first rapid sand filter plant in the Far East."

Six years ago a rapid filtration plant of 8,000,000 g.p.d. was installed for Kobe City, the contract being placed through Mitsui & Co., with the Paterson Engineering Co., Ltd., of London, who supplied the whole equipment for metering and coagulant supply gear, sedimentation tanks, twelve 24 x 12 ft. Paterson gravity filter units, constructed in reinforced concrete, with pure water storage tank below, and electrically driven auxiliary machinery, etc.

The plant has been in operation for the past six years with consistently satisfactory results, and what is practically a duplicate plant is now being installed at Fushun, Manchuria. O. C. KERRISON.

London, Eng., Sept. 22.

Return Water From Wyoming Streams

Sir—In *Engineering News-Record*, July 20, 1922, p. 105, R. I. Meeker calls attention to the very important part that return water plays in irrigation, especially in the older settled regions of the West. This phenomenon is emphasized by results obtained on streams in Wyoming.

During the summer of 1920 the U. S. Geological Survey in co-operation with the state engineer, conducted a series of measurements on streams in the Big Horn Basin and the northeastern section of Wyoming to determine the amount of return water. The work was described in detail in the fifteenth biennial report of the state engineer, but no comparisons were made between diversions and return water.

The streams selected were those on which irrigation had been practiced since the early eighties and where the majority of ditches were completed prior to 1900. So extensively are these streams utilized that in dry years an acute shortage of water occurs. The streams have a fall ranging from 30 to 65 ft. per mile with an average of about 45 ft. In Big Horn Basin the land irrigated is chiefly bottom land, which forms a comparatively narrow strip along the streams. Land irrigated from Greybull River, however, comprises many thousand acres of so-called bench land lying above the river bottoms. In the northeastern section irrigation has reached a higher stage of development than in the Big Horn Basin and a large part of the area irrigated is bench land.

The accompanying table shows the percentage of return water to total diversion in the different streams investigated together with the total discharge of the streams. So important is the return water that in about half the series given in the table, the total diversions are greater than the discharge of the stream at the head of the irrigated section plus the flow of tributary streams below.

SUMMARY OF RETURN WATER IN WYOMING STREAMS

Stream	Length of Stream Investigated, Miles	Dates of Measurement	Discharge of Stream at Head of Section+Tributary Flow, Sec.-Ft.	Diversions, Sec.-Ft.	Return Water, Sec.-Ft.	Per Cent of Return Water to Diversions
Big Horn Basin						
Owl Creek	38 0	Sept 6 7, 1920	14 5	12.0	— 7.8	
No Wood Creek	33 5	July 27 28, 1920	281	47 3	41.5	88
Tensleep Creek	6 0	July 26, 1920	223	57.6	12.7	..
Paintrock Creek	13 5	July 23 24, 1920	278	110	—14.0	..
Paintrock Creek	13.5	Aug. 24–25, 1920	68.8	52 1	17.3	33
Medicine Lodge Creek	6 1	July 21 22, 1920	42 5	66 0	24.7	37
Medicine Lodge Creek	5 6	Aug 25, 1920	26 2	50.3	21 0	42
Shell Creek	16 8	Aug 15 16, 1918	112	103.4	46.6	45
Shell Creek	16.8	Sept. 1, 1918	100	121.7	50.1	41
Shell Creek	16.8	June 30, July 1, 1919	83	111.7	42.4	36
Shell Creek	16.8	July 29, 1919	58	80 8	19.8	24
Shell Creek	20.4	July 22–24, 1920	145	155 4	48 5	31
Greybull River	66.0	Aug. 30, Sept. 2, 1920	174	203	23.6	12
Wood River	10 0	July 30, 1920	171	27 4	22.4	82
Wood River	13.2	Aug. 30, 1920	70	32 3	30 2	94
Northeastern Section						
Little Goose Creek	16.8	Aug. 18, 1920	41.2	85.4	56.9	67
Little Goose Creek	16.8	Sept. 11, 1920	34.9	47 2	28 7	61
Clear Creek	42.4	Aug. 12, 15, 1920	122	126	44.2	35
Clear Creek	42.4	Sept. 20, 21, 1920	70	38.1	17.5	46
Rock Creek	13.1	Aug. 13, 1920	72	58.6	0 0	0
Rock Creek	13.1	Sept. 18, 1920	11.2	7.9	3.6	46
French Creek	8.9	Aug. 11, 12, 1920	49.6	68.7	23.7	35
French Creek	7.3	Sept. 17, 18, 1920	13.3	12.0	5.4	45
Piney Creek	22.0	Aug. 17, 1920	59	56 3	18.5	33
Piney Creek	22.0	Sept. 14, 15, 1920	41.6	20 9	5.3	25
North Piney Creek	3.5	Aug. 16, 1920	106	97 6	11.6	12
North Piney Creek	4.0	Sept. 13, 1920	60	28 4	1.1	34
South Piney Creek	2.5	Aug. 16, 1920	136	115	20 6	18
South Piney Creek	2.5	Sept. 14, 1920	43	38 8	11.5	30

ROBERT FOLLANSBEE,
District Engineer, U. S. Geological Survey.

Denver, Colo.,
Sept. 20.

Possibilities of "Sacramento" Aerator Nozzles

Sir—The "Sacramento" floating-type of aerator nozzle described in *Engineering News-Record*, Sept. 7, p. 384, offers the interesting possibility of arranging influent piping to slow sand filters so that the raw water can be aerated in the space between the water line of the filters and the under side of the covers, thus making it possible to aerate even in the coldest weather and to combine the control of aeration and filtration under one roof at probably a minimum of expense for construction and operation.

F. B. MARSH,
Designing Engineer,
Providence Water Supply Board.

Providence, R. I.

Labor Costs and Conditions in Mesopotamia

Sir—The readers of *Engineering News-Record* may be interested to learn of the great difference of labor costs that exist between the United States and the Middle East.

In Mesopotamia (or 'Iraq as it is now to be called) "common labor" costs 14 annas a day of 8 hours. At the present rates of exchange the rupee (16 annas) is equivalent to 29c., so that the laborer or coolie commands a salary of 25½c. per day. The New York laborer appears to receive 11 to 14 times as much, though he does about five times as much work.

An Arab bricklayer receives 75 to 87c. a day, and can lay about 300 bricks in a simple wall, in 8 hours.

Women and children do useful small jobs, and well earn 18 and 10 cents a day respectively.

In Baghdad, 350 miles north of Basrah, the rates are nearly 50 per cent higher. The following types of coolies are obtainable: Persians (of a very low caste, having extremely small intelligences) who are useful for carrying loads, Arabs who are physically much finer and more active, but who take some driving, Kurds and also Armenians, the latter being Christians and almost European in appearance.

H. C. LOTT,
Deputy Director of R. E. Services.

Basrah, 'Iraq, Aug. 22.

NEWS OF THE WEEK

New York, October 19, 1922

President Names Federal Coal Commission

Authorities on Technical, Social and Economic Problems of Industry Compose Fact-Finding Body

Washington Correspondence

The President on Oct. 10 announced his selections for the federal commission which will make an exhaustive study of the problems of the coal industry. The commission will consist of John Hays Hammond, mining engineer; Thomas R. Marshall, vice-president during the Wilson administration; Samuel Alschuler, judge of the circuit court; Clark Howell, editor of the *Atlanta Constitution;* George Otis Smith, director of the U. S. Geological Survey; Edward T. Devine, writer on social and economic questions; and Charles P. Neill, formerly member of the board of adjustment for labor disputes under the Erdman Act.

The commission will meet for organization purposes on Oct. 18. While Mr. Marshall and Dr. Smith each has been mentioned for the chairmanship, it is believed that this will go to Mr. Hammond.

Practically all comment on the personnel of the commission is favorable. It very generally is regarded as a good blend of conservative and liberal opinion. Perhaps never before has any investigation of coal by a federal agency started with so little prejudice. It has the great advantage of having a personnel which is not in any way interested in making political capital out of its fact-finding activities and in this way differs greatly from the efforts of several congressional investigating committees.

Individual Qualifications

As to special qualifications of the commission members the following may be said: Mr. Hammond has been linked prominently and intimately with the mining industry for so long that it is regarded as very fitting he should participate in what is expected to be one of the most important steps taken in connection with coal in recent years. Dr. Smith for many years has made coal the study to which he has devoted most of his personal attention. It is believed that Mr. Neill has the confidence of both operators and mineworkers. It is conceded that he knows more than anyone else, outside of the coal business, as to the conduct of collective bargaining in that industry. Mr. Marshall is nationally known as a friendly type of philosopher with a real sense of humor and possessed of a general desire to ascertain honestly the other man's point of view. Judge Alschuler has given many indications of judicial balance and a sense of fair play. He is best known to the coal industry for his part in refusing to sustain Judge Anderson's check-off injunction. Mr. Howell is a southern editor: conservative and accustomed to pass dispassionately on questions of great moment. Mr. Devine has that characteristic of good will and friendliness which seems to run through each of the members of the commission.

It is expected fully that the commission will appoint a fairly large staff of specialists who know how to collect coal information and put it together and that it will hold as few formal hearings as possible, gleaning its information rather through intimate contact with those who are acquainted with the industry.

Renew Alabama Power Lease at Muscle Shoals

Announcement has been made by Secretary Weeks of the War Department that the lease under which the Alabama Power Co. operates the government steam-electric plant at Muscle Shoals, Ala., has been renewed for another year. This has been done because of the exigencies of the demand for manufacturing in the South and the improbability of early settlement of the future of the Muscle Shoals plant.

New York Merchant's Association to Study Transit Plans

Pursuant to a report of its committee on city traffic, the Merchant's Association of New York has made an appropriation for the study of the two transit extension plans recently proposed by the Transit Commission and by Mayor Hylan. The investigation will be directed by Col. Frederic A. Molitor, chairman of the committee on city traffic. An expenditure of $2,500 has been authorized for engineering and other assistance that may be required.

New Development by Alabama Power Company

The Alabama Power Co. has applied to the Federal Power Commission for a preliminary permit covering a project for the development of 60,000 hp. of primary power on the Tallapoosa River in Elmore, Randolph, Chambers and Tallapoosa Counties of Alabama. The construction of four dams is proposed. Ten miles above Tallahassee, Ala., it is planned to erect a dam 110 ft. high at Cherokee Bluffs. Another dam would be located five miles from Alexander City, just below the mouth of Rigby Creek. This dam will be 85 ft. high. The third dam would be erected at a point on the river ten miles north of Dadeville. Its height will be 60 ft., according to the estimate submitted to the commission. The upper dam is to be just above the mouth of Crooked Creek, a few miles below the junction of the Tallapoosa and the Little Tallapoosa Rivers. That structure will have a height of 150 ft. It is understood that the company plans the full development of this project within a period of ten years.

To Hold Highway Education and Transport Meeting

Conference To Take Place at Washington Under Direction of Highway Education Board

An attendance of approximately 400 is expected at the second annual Conference on Education for Highway Engineering and Highway Transport, which will be held in Washington Oct. 26, 27 and 28 under the auspices of the Highway Education Board.

The object of the conference, as set forth in the official announcement, is, "to review the field of highway engineering and highway transport education in the light of the expanding State and federal highway program and the rapidly increasing social and commercial use of the highways; to discuss general and special courses in undergraduate and graduate curricula; and to exchange views on educational trends arising from these developments in the national transportation system."

List of Speakers

Among the speakers will be T. H. MacDonald, chief of the Bureau of Public Roads; A. J. Brosseau, president, Mack Brothers Motor Car Co.; T. H. Agg, professor of highway engineering, Iowa State College; Arthur H. Blanchard, professor of highway engineering and highway transport, University of Michigan; C. J. Tilden, professor of engineering mechanics, Yale University; Lewis W. McIntyre, assistant professor of civil engineering, University of Pittsburgh; George H. Graham, vice-president, Chandler Motor Co.; Roy D. Chapin, president, Hudson Motor Car Co.; Dr. W. K. Hatt, director, advisory board on highway research, National Research Council; Alvan Macauley, president, Packard Motor Car Co.; Dr. Charles S. Howe, president, Case School of Applied Science; Charles J. Bennett, State Highway Commissioner of Connecticut; Dr. F. L. Bishop, dean, school of engineering, University of Pittsburgh, and others whose definite acceptance of invitations is being awaited.

Ten special committees will submit reports, which will be discussed at the conference, on these subjects: required and elective undergraduate subjects in highway engineering; required and elective undergraduate subjects for highway transport business and engineering positions; subject matter of basic required undergraduate course in highway engineering; subject matter of basic undergraduate course in highway transport; subject matter of undergraduate course in highway engineering theory and design; subject matter of undergraduate course in highway engineering laboratory; nature and content of supporting non-technical courses in economics and English; graduate work in highway engineering and highway transport; conferences or short courses on highway engineering and highway transport; teaching highway traffic regulation and safety.

Street Sanitation Men Exchange Experiences

nternational Association Officials Discuss Problems at Chicago Meeting

A definite trend toward garbage incineration, toward motorization of street cleaning equipment, toward restriction of automobile parking after midnight to permit streets to be swept or flushed, and toward the use of eductors for cleaning catch basins, was noted at the third annual conference of the International Association of Street Sanitation Officials which met Oct. 9 and 10 in Chicago. The meeting was strictly a conference, with round table discussions which drew out the experience and opinions of the city officials. No addresses or papers were presented. The second day was given over to an inspection of the equipment and methods of street cleaning and garbage disposal in Chicago.

Garbage Problems

On garbage problems the following salient points were brought out: St. Louis is building and about to test the first of a series of four 100-ton high-temperature, forced-draft incinerators guaranteed to burn the garbage for $1 per ton with a maximum of 140 lb. of coal; motors and trailers have cut costs of collection from $5 to $2; Minneapolis is still using two 20-year old and one 10-year old incinerators requiring 70 to 140 lb. of coal per ton of garbage but the engineers do not consider the production of steam a commercial practicality, as at one time heralded; and tractors and trailers have reduced the odor nuisance due to collection.

Chicago finds that the disposal of dead animals costs $57,500 annually now instead of yielding a revenue of $5,000 as formerly. The number of dead animals handled has decreased from 6,570 in 1917 to 3,735 in 1921. Boston's reduction plant is being studied by George A. Johnson, consulting engineer. Newark's hog-feeding contract was in financial straits until the city advanced $25,000 which was secured by retaining title to 2,000 hogs. Joplin, Mo., compels the hotels to care for the town's garbage for the privilege of hauling their own rich wastes to their own piggery. On Erie's hog farm 1,200 hogs eat 60 to 70 tons daily.

As to the effect of traffic on street sanitation work the following was reported: Chicago finds that night parking seriously interferes with flushing. Minneapolis and St. Louis have ordinances prohibiting parking in congested districts after midnight unless the automobile is accompanied by a chauffeur to move it for the cleaners.

Automotive Equipment Use

Automotive equipment is growing rapidly. Detroit, with its 250 trucks and 350 passenger cars in a motor transport department, has begun standardization of equipment, keeps elaborate accounts such as mileage per gallon and costs per mile on each vehicle and rents out equipment to other departments. It operates on a $100,000 revolving fund and makes money, though its charge for cars is 50c. per hour less and for trucks $2 per hour less than the prevailing rate. It is building one of the largest garages in the country, 7 acres, for which $750,000 is available, plus $230,000 for the site.

Chicago, like most cities, is floundering over the question of control of heavy truck traffic, said F. H. Cenfield. St. Louis has recently designated major streets for all traffic and minor streets from which trucks are excluded. It has twenty-five plain clothes inspectors to enforce the traffic ordinances.

Catch basin cleaning by eductors in Newark costs $3.14 against $5.02 by hand. The machine cost includes interest, a 20 per cent annual depreciation, repairs and maintenance. In St. Louis eductor cleaning costs $1.50 to $2 and hand cleaning, $3 to $5. Mr. McGrath, Chicago, superintendent of sewer cleaning, said that cleaning sewers by a machine of the eductor type offered a field for the inventor and manufacturer. He exhibited a reversible rim catch-basin top in three pieces which eliminates tearing up the pavement when the ring needs replacement. The assembly weighs 80 lb. less than the one formerly in use.

Motor driven flushers in Chicago will be augmented by ten each year for the next five years, said W. J. Galligan, Bureau of Streets, Chicago, who favors the double-unit type. Minneapolis pins its faith on sweepers and does half as much flushing as formerly. Joplin has discontinued flushers.

The officers elected for 1922 are as follows: W. J. Galligan, president; Abram Swan, O. B. Mahoney, W. J. Walsh and Theodore Eichorn, vice-presidents; A. M. Anderson, Chicago, secretary.

General Connor Goes to China

Brig.-Gen. William D. Connor, U. S. A., a former Corps of Engineers officer, and who has been serving as Assistant Chief of Staff of the War Department, has been ordered to the command of the American troops in Tientsin, China. The relief of Col. William F. Martin, in command there, is believed due to the increasing political importance of the post and the necessity of having a man in command with a rank higher than that of colonel.

General Connor is a graduate of the Military Academy with the class of 1897, having finished at the head of his class. After graduation he served under Major W. L. Fiske in the Department of the Columbia, later actively engaging in the siege and capture of Manila during the Spanish-American War. After that war he was in charge of water-works and water supply of the City of Manila, and later served as city engineer. Other military engineering assignments include design and construction of seacoast batteries in Connecticut, instructor in civil engineering at the Military Academy, student officer at the Army Staff College, in charge of the 1st and 2nd districts of the Mississippi River Improvement, in charge of the U. S. Engineers' Office at Little Rock, and in command of engineer troops. At one time he was managing editor of *Professional Memoirs*, now *The Military Engineer*.

General Connor left the Corps a number of years ago for general staff duty. During the World War his chief assignment was Chief of Staff to Major-General Harbord.

Dr. S. W. Stratton Heads M.I.T.

Washington Correspondence

Dr. S. W. Stratton, for twenty-one years director of the Bureau of Standards of the Department of Commerce, has resigned to become president of the Massachusetts Institute of Technology.

As the director of the Bureau of Standards, Dr. Stratton built up an institution. He took over the directorship of the Bureau when it was created in 1901. The Bureau sprang from a division in the Coast and Geodetic Survey concerned with the standardization of weights and measures.

The Bureau of Standards was intrusted during the first year of its existence with the expenditure of an appropriation of $200,000. From that small beginning Dr. Stratton was able to build up a great scientific laboratory which has been intrusted with the expenditure of more than $2,000,000 on a year's work. Under Dr. Stratton's direction, the Bureau has grown until it is the largest physical laboratory in the world, and employes more specialists in research than any other single agency in this or any other country.

Those who have worked for many years with Dr. Stratton declare his strongest point is his ability to direct the work on a large number of diversified technical problems in a way so as to insure maximum results. Despite the widely varying character of the experimentation conducted by the Bureau of Standards, Dr. Stratton's associates declare that he always has kept abreast with the work and invariably could be relied upon for a practical suggestion as to its conduct. He is credited with being particularly apt in recognizing when sight was being lost of the objective and the work being allowed to proceed along a tangent.

Dr. Stratton was born in Litchfield, Ill., July 18, 1861. He received his B. S. degree at the University of Illinois in 1884 and his D. Sc. from the Western University of Pennsylvania in 1903. He was an instructor in mathematics, physics and electrical engineering at the University of Illinois from 1885 to 1892, and an instructor in physics at the University of Chicago from 1892 to 1901. In that year he assumed his duties as Director of the Bureau of Standards.

In connection with Dr. Stratton's resignation, Secretary of Commerce Hoover issued a statement condemning the "desperately poor pay" allowed scientific and technical men by the government. He pointed out that the Massachusetts Institute of Technology, an educational institution, has no difficulty in paying men of Dr. Stratton's caliber three times the salary which the government allows them. "The inability of scientific men in the government to support themselves and their families properly under the living conditions in Washington," said Secretary Hoover in his statement, "and to make provision for old age, makes it impossible for any responsible department head to secure such men for public service at government salaries."

Dr. Richards Installed as Head of Lehigh University

Dr. Charles Russ Richards, former dean of the college of engineering at the University of Illinois, was inaugurated president of the Lehigh University, Bethlehem, Pa., Oct. 14. The inauguration was part of the Founder's Day program and a tea and dinner to Dr. and Mrs. Richards were parts of the ceremonial. Dr. Richards is a graduate of Purdue University where he received his bachelor's and master's degrees in mechanical engineering. He took his doctor's degree at the University of Nebraska in 1920. For twenty years Dr. Richards was on the faculty of the Colorado Agricultural College as professor of mechanics, mechanical engineering, associate dean of the Industrial College in charge of all engineering; and then as dean of the Engineering College. In 1911 Dr. Richards was appointed professor of mechanical engineering at the University of Illinois. Two years later he became acting dean of the College of Engineering of that institution and acting director of the Engineering Experimental Station, and in 1917 was made dean and director. He is a member of the American Society of Mechanical Engineers, the Western Society of Engineers and the Society for the Promotion of Engineering Education.

Irrigation Division of Am. Soc. C. E. Now Being Formed

At a meeting of about thirty members of the Am. Soc. C. E. held during the recent fall meeting of the Society in San Francisco it was agreed to form an irrigation division of the Society. This will be done in accordance with the plan for divisions adopted at the Portsmouth meeting last spring.

The signatures of twenty members which are necessary for the formation of a new division were assured from those present at the San Francisco committee meeting and completion of the plan is only a matter of carrying out the prescribed form. A committee appointed to formulate the organization consists of T. H. Means, C. E. Grunsky and B. A. Etcheverry, all of San Francisco.

Landis Award Committee Is Operating Trade School

For some time the Citizens Committee to Enforce the Landis Award in Chicago has maintained a trade school for plumbers. It has recently employed C. L. Bailey, a trade school organizer from Cincinnati, to enlarge the school. Five classes are to be started at once; sheet metal work, carpentry, painting and decorating and blueprint readings. The courses are not confined to men already at work on Landis Award jobs but are intended for boys recommended by contractors. At first, however, the men at work will probably make up the bulk of the membership.

The Engineer in Public Life

A. M. LOCKETT

The Civitian Club of New Orleans, a national organization with local chapters similar to the Rotary and Kiwanis clubs, has an engineer for its president in the person of A. M. Lockett, president of A. M. Lockett & Co., Ltd. In this post he is in close contact with the civic and business affairs of the city. This contact is further strengthened by membership in the New Orleans Association of Commerce, of which organization he has served as a director and also as chairman of several important committees.

When the governor of Louisiana was called upon recently to appoint a Board of Commissioners of the Port of New Orleans, Mr. Lockett was named as one of the six members and elected as vice-president of the board, which has entire charge of the business management of the port. The members of the board serve without compensation. Mr. Lockett is known locally as an able and public-spirited man who is engaged in a number of activities in addition to his engineering work. He has always displayed interest in any question of civic betterment and among other duties has served as director of a municipally controlled trade school at New Orleans. He is a member of the Louisiana Engineering Society, the American Society of Mechanical Engineers, and other technical organizations.

Montana Makes Route Survey as Road-Building Preliminary

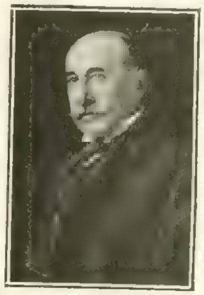
The Montana Highway Department during October is undertaking a route and condition survey of its entire 7 per cent or trunk-highway system comprising approximately 4,700 miles of road. This survey is being conducted under the immediate supervision of the ditrict engineers of which there are four. The survey will determine with-reasonable limits the location of all future construction with federal aid and will indicate the urgency of construction in various parts of the state. From the information obtained a three-year construction and maintenance program will be worked out by the department during the winter months. It is expected that the survey will be complete by Nov. 1 The work is under the general supervision of John N. Edy, chief engineer.

Wenatchee Yard of G. N. Ready

Construction of the Great Northern Ry. yard south of Wenatchee, Wash., has been completed and the yard was turned over to the railway by A. Guthrie & Co., contractors, on Oct. 1.

Engineer on Coal Commission

John Hays Hammond, the engineer member of the fact-finding commission appointed Oct. 10 by President Harding to investigate the coal industry, is a mining engineer of international reputation, and one who has not confined himself strictly to professional duties but has actively engaged in many enterprises outside the profession. Mr. Hammond was born in San Francisco in 1855. He is a graduate of the Sheffield Scientific School of Yale, and was a student at the Royal School of Mines at Freiburg, Germany. His honorary degrees include an A.M. from Yale, D.E. from Stevens Institute of Technology, LL.D. from St. John's College and E.M. from the Colorado School of Mines.



He began his professional career with Senator Hearst, of California, and later as mining expert with the Geological Survey made exhaustive studies of the California gold fields. He has done consulting work for many large corporations including the Union Iron Works, San Francisco, and the Central Pacific and the Southern Pacific Railroads. He became associated with Barnato Bros., London, in South Africa and later manager of the large properties of Cecil Rhodes, and consulting engineer of the Consolidated Gold Fields of South Africa.

As consulting engineer for the Tonopah Mining Co. he developed one of the richest mining properties in this country. He has also served the Guggenheim interests in the acquisition and development of large properties. Since 1907 he has been in private consulting practice.

He has served the government on previous occasions, having twice visited Russia on governmental business. He declined an appointment as minister to China offered by President Taft, but accepted his appointment as special representative of this country at the coronation of King George.

He is a member of a score or more of private, professional, scientific and technical clubs and organizations in various parts of the country.

Ninth A.A.E. Convention To Be Held in Norfolk Next May

Following the recent quarterly meeting of the board of directors of the American Association of Engineers, a decision was reached to hold the ninth annual convention of the association in Norfolk, Va., May 7-9, 1923.

F.A.E.S. Meets in Washington Next January

As provided in the constitution of the Federated American Engineering Socities, the annual meeting has to be held in Washington in January. Accordingly, the date set is Jan. 11-12, 1923.

Engineers Elected Officers of Drainage Congress

That "drainage reclamation needs no subsidy" was the keynote of the presidential address by Clark E. Jacoby, president of the National Drainage Congress, at the annual meeting held in Kansas City, Mo., in September. He stated emphatically that the association discourages and disapproves of general appropriation of government funds for the reclamation of swamp lands owned by private individuals. But the government should pay the share of the public welfare derived from reclamation, such as the benefits to health and sanitation, highway transportation, flood control and regulation of navigable channels.

The importance of engineering advice on drainage projects was voiced by R. H. McWilliams, Memphis, Tenn., who pointed out that ill-advised projects react against the development of worthy projects. Unless drainage commissioners and promoters engage the services of competent engineers and experienced contractors, financial institutions should refuse to underwrite the bonds. As a representative of bond houses, T. W. Kemper, Kansas City, spoke of the importance of one management supervising the several phases of financing, maintenance, colonization and operation.

An exhibit of excavating machinery, pumps and supplies employed in drainage work was made by about thirty firms. In connection with machinery development there was a paper by George B. Massey, Chicago, on the use of oil engines for operating dredges. Resolutions were passed endorsing a federal hydraulic laboratory under the U. S. Bureau of Standards; federal and state fish and game preserves; extension of the Flood Control Act and the jurisdiction of the Mississippi River Commission above Rock Island, and the co-operative federal and state topographic surveys. Again an engineer was elected as president, with other engineers among the officers, the list for 1922-23 being as follows: President, Jacob A. Harman, consulting engineer, Peoria, Ill.; vice presidents, Charles H. Young, Muscatine, Iowa; Roy N. Towl, Omaha, Neb.; H. J. Sternberg, St. Louis, Mo.; Willis J. Ayers, Memphis, Tenn., and directors, Clark E. Jacoby, Kansas City, and Frank B. Knight, Chicago.

Civil Service Examinations

UNITED STATES

For the United States civil service examinations listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Mechanical Engineer—Vacancy in the Coast and Geodetic Survey at $3,000 per year. Application on form 1312 must be filed with the Civil Service Commission, Washington D. C., before the close of business on Nov. 7, 1922.

Laboratory Assistant, senior grade—Vacancies in the Bureau of Standards, Department of Commerce. Salaries, $1,200 to $1,380 per year, subject to increase by bonus granted by Congress of $20 per month. Examinations will be held on Nov. 8 and 9, 1922.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17 and 18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

The California Section of the American Water Works Association will hold its annual meeting in the East Bay Water Company's building, Oakland, Calif., Oct. 26, 27 and 28.

The Iowa Section of the American Water Works Association will hold its annual meeting in Iowa City and Cedar Rapids, Iowa, Nov. 1, 2, and 3. The first day's meeting will be held in Iowa City. The two following days will be spent at Cedar Rapids.

The Southwestern Geological Society elected the following officers at the close of the convention in Dallas, Sept. 16: Leon Pepperberg, Dallas, president; C. M. Bennett, Shreveport, La., first vice-president; J. W. Beede, Bartletsville, Okla., second vice-president; Dr. H. P. Bybee, Austin, Texas, secretary; R. B. Whitehead, Dallas, Tex., treasurer.

Personal Notes

CAPT. THOMAS HAROLD MESSER, Corps of Engineers, U. S. A., retired, has resumed private practice as consulting engineer with offices in the Mills Bldg., San Francisco. He will specialize in architectural and landscape development, country planning and civic betterment.

H. C. BERRY is at present serving as acting director of the department of civil engineering, University of Pennsylvania, succeeding Prof. Milo S. Ketchum, who, as already noted in these columns, has resigned to accept an appointment as dean of the college of engineering, University of Illinois.

ANTON SCHNEIDER has been appointed city manager of Lakeland, Fla. He will report for duty Nov. 15. He is at present manager for the city of Bartow, Fla. Mr. Schneider has had extensive engineering work, having served as resident engineer for the Manhattan Railway Co. in New York in charge of the construction of the Third Ave. and Bronx Park extensions, and for two years as division engineer in charge of construction on the East River tunnels, New York City. Previous to that time he was acting chief engineer with the Cerro De Pasco Railway, Peru. He also served two years with the Rapid Transit Subway Construction Co., New York City, as draftsman and assistant engineer. He is a graduate of Lehigh University.

JOHN M. RIBBLE of Petersburg, Va., has been assigned to the Ft. Worth office of the U. S. Bureau of Public Roads as junior highway engineer.

JOHN H. SAWKINS, until recently a designer in the grounds and buildings department of the General Electric Co., Schenectady, N. Y., has associated himself with the Consolidated Engineering Co., Baltimore, Md.

NORRIS H. PHILLIPS has severed his connection with the B. R. & P. Ry. Co., and has been made an assistant engineer in the New York Highway department.

W. A. JUDD has been made engineer in charge for the Layton Construction Co., general contractors of Gillespie, Ill. He was formerly assistant engineer with the Central States Engineering Co.

WILLIAM M. SHANNON has been made engineer of highways of the Morgan County Highway Department, Ala. He was formerly with the Majestic Coal & Coke Co. as engineer on new construction.

F. J. HAAGEN, until recently assistant division engineer of the Erie R.R. at Huntington, Ind.; has been elevated to the position of division engineer in charge of maintenance-of-way work in his district. He is stationed at Marion, Ohio.

WILLIAM H. SMITH, assistant engineer of the West Virginia State Highway Department, has been appointed material engineer in Dist. 10 for the U. S. Bureau of Public Roads. He is stationed in Baltimore, Md.

MELVIN E. HARTZLER has resigned from the Illinois Division of Highways and has accepted a position as superintendent for the Merom Gravel Co., Merom, Ind.

MAX L. CUNNINGHAM, state highway engineer of Oklahoma under Governor Robert Williams, has been appointed state highway engineer again by the present governor. He succeeds E. S. ALDERMAN, who resigned recently. It is understood that Mr. Alderman's resignation was due to friction between him and the governor over certain federal-aid road work. Mr. Cunningham assumed his new duties late in September.

C. R. WINKS, former city engineer of Trenton, Mo., has been appointed assistant county highway engineer of Warren County, Ind.

R. E. WILLIAMS, formerly a chemist in the Pittsburgh Testing Laboratory, has become an assistant to the city engineer of Gainesville, Fla.

C. M. OSBORN, city manager, East Cleveland, Ohio, has been appointed city manager of Kenosha, Wis. Mr. Osborn is president of the City Managers' Association.

J. B. RUTTER has been appointed chief engineer of the Merrimac Chemical Co., Boston, Mass. Other recent appointments include the following: sales manager, WILLIAM M. RAND; and designing engineer, M. S. MAXIM.

J. MINSHALL HOLDEN, former field engineer for the Turner Construction Co., has become associated with the Holden Construction Co., general contractors of Chester, Pa. Mr. Holden's new position is that of general superintendent.

WILLIAM C. EMIGH has resigned from the department of the New York state engineer to become sanitary engineer with the Midvale Steel & Ordnance Co. at Coatesville, Pa.

STANLEY F. MORSE, consulting agricultural engineer of New York and New Orleans, has been retained by the United Fruit Co. to make a complete agriculturial inspection of its Cuban sugar cane estates comprising nearly 90,000 acres.

JAMES G. COONEY, formerly assistant highway engineer of the Illinois Division of Highways, and who had charge of fifteen miles of construction work on the Meridian Trail, is now promotion engineer for the Portland Cement Association, with headquarters at Centralia, Ill.

OBITUARY

EDGAR B. TYLER, vice-president of the Mississippi Valley Structural Steel Co., St. Louis, Mo., died in St. Louis, Sept. 27, aged 57 years.

J. R. C. BROWN, at one time city engineer of Ironton, Ohio, died in that city recently, aged 87 years. He was the father of the late Prof. C. Newton Brown, professor of civil engineering at the University of Illinois.

W. E. SMYTHE, former chairman of the Irrigation Congress, an organization which succeeded, under President Roosevelt, in reclaiming large portions of arid lands in the West, died Oct. 6 in New York City, aged 61 years. Though not an engineer, Mr. Smythe had devoted a great part of his life to the irrigation movement and to colonization.

CECIL A. PRESTON, valuation engineer with the Pennsylvania R.R., died Oct. 9 at his home in Philadelphia, aged 70 years. He had retired from 40 years active service in the company's employ but two days previously. Mr. Preston was graduated from the Polytechnic College of Philadelphia in 1872. During the following five years he followed railway surveying and construction in the states of New Jersey, New York and Pennsylvania. From 1877 to 1879 he was with the Maderia and Mamore expedition that proposed to build a railroad through the Negros River valley in Brazil, a project which was abandoned in the year 1889. Following this Mr. Preston joined the engineering forces of the Pennsylvania R.R. With the exception of two years that took him to Mexico where he was employed by the National Railroads, he had been with the Pennsylvania ever since. In 1913 he was made valuation engineer, which position he had held until his death.

From the Manufacturer's Point of View

Lumber Standards Central Committee Holds First Meeting

The first meeting of the newly appointed Central Committee on Lumber Standards was held Oct. 3, in Washington, D. C., John W. Blodgett, president of the National Lumber Manufacturers Association and chairman of the committee, presiding. The committee reviewed the standardization progress to date, including the proceedings of former general conferences.

A specific program for future work was outlined to cover (1) grade simplification, (2) size standardization and (3) certification of quality and quantity for the protection of the public.

A representative committee of lumber producers is being formed from appointees of the various manufacturers' associations to co-operate with the Secretary of Commerce and with the Central Committee on Lumber Standards. Similar committees or representatives are also being appointed from the lumber retailers, wholesalers and consuming interests.

Discussion Concluded on Fewer Grades of Asphalt

With the following comment by Major Besson, Mr. Adler and Col. Compton discussion is concluded on the subject of reducing varieties of asphalt called for in specifications for road and paving work, as proposed in the Sept. 28 issue of *Engineering News-Record*. Judged from the opinions expressed the proposal has been favorably received by highway engineers whose views, together with those of the producers of asphalt, are now available for such use as society committees and other specification-making organizations may make of them.

F. S. BESSON

Major Corps of Engineers, U. S. A.,
Assistant to the Engineer Commissioner,
Washington, D. C.

In designing asphalt pavements there must be realized the purpose for which certain restrictions are placed on bituminous materials and the purpose served by each of the ingredients entering into the complete pavement mixture. Primarily, though there may be secondary classifications, asphalt specifications cover two classes of requirements:

FIRST CLASS

Penetration	Bitumen Percentage
Ductility	Specific Gravity.

Required for purposes of identification, factory control, and gauging the uniformity of supply.

SECOND CLASS

Flash Point	Penetration of Residue
Loss on Heating	

Required for estimating the heat that may be used in mixing and the effect of aging after the mixture is placed in the pavement.

Bituminous mixtures are composed of three elements: Bituminous cement; aggregate (sand, for instance); and filler (usually limestone dust). These three elements may be combined in such proportions that, at the will of the engineer, a roadway surface may

(*Continued on p. 676*)

The following article presents the manufacturer's side of the problem. In next week's issue will begin a discussion of winter buying from the point of view of the purchaser of pipe. The following water-works engineers and officials will express their opinions:

F. A. Barbour, Boston.
G. H. Fenkell, Detroit.
F. C. Cutts, St. Louis.
W. S. Cramer, Louisville.
J. A. Jensen, Minneapolis.
C. E. Davis, Philadelphia.
F. C. Jordan, Indianapolis.
W. C. Hawley, Wilkinsburg.
C. R. Henderson, Davenport.
D. R. Gwinn, Terre Haute.
C. M. Saville, Hartford.
G. W. Batchelder, Worcester.

Cast-Iron Pipe Makers Decry Seasonal Buying

Benefits Would Follow Distribution of Purchases Throughout the Entire Year

SO COMMON is the practice of buying cast-iron pipe a few weeks previous to the time it is to be laid that both buyers and manufacturers have had to pay an unnecessary penalty for the delay in purchase. Consideration of the effect of this summer buying of pipe on the final cost of the pipe in the ground would result in spreading the purchase of this material over the entire year, to the advantage of all concerned. This is the opinion expressed to *Engineering News-Record* by a spokesman for the cast-iron pipe industry, whose views on the general subject are summarized below.

It is easily comprehended how the product of a costly plant working at its maximum capacity for about six months in the year must necessarily cost more than if a constant rate of manufacture could be maintained. Whether the plant is running on full or part time it is impossible to avoid charges for interest on the investment, depreciation on buildings and equipment, insurance, and taxes. In general, all property expense continues whether pipe is being manufactured or not and the expense must necessarily be reflected in the price of the finished product.

EFFECT ON LABOR

Concerning labor, the same condition is true to a considerable extent. Office and supervisory help cannot be expanded and contracted during the year to correspond with output. The many skilled laborers in shops where specialized knowledge is necessary—in the pipe shops, for example—must be provided for. Even the common labor turn-over that results in the wide variation in demand for pipe is a source of considerable expense. If a constant rate of output could be maintained, the office supervisory and labor forces could all work at a uniform rate and at a maximum of efficiency and result in the elimination of considerable unnecessary expense.

Another consideration of no small importance is the effect of climate on the efficiency of the individual workman.

Most of the pipe foundries are in the South, where the heat is so extreme that workmen, especially in the foundries, are affected. Hence the desirability of winter work, with its lower quota of "lost" pipe.

When all pipe buyers come into the market for pipe at the same time and demand immediate delivery, what is the result? Instead of keen competition between makers of pipe, the competition is reversed and the buyers compete with one another for deliveries. This condition could easily affect the price of pipe in a way that would not be to the benefit of the buyer.

Pipe Laying in Winter

In many parts of the country pipe is not laid during cold weather. With modern trenching methods, however, a small amount of frost in the ground has little effect on the cost of excavation, and work can be carried on just as well in cold as in hot weather. Even where conditions are such that pipe cannot be laid, delivery of pipe on a job is often easier with the ground frozen than it would be later in the year.

The reduction in cost of hauling made possible by winter buying is of no small importance in many cases and in low swampy land amounts to a great part of the laying cost. As there is no danger of deterioration of cast-iron pipe due to exposure while strung along the proposed pipe line, there is no reason why the pipe cannot be delivered many weeks or even months in advance of laying.

The purchase of pipe in the winter and its delivery on the job makes it possible to make a definite plan for water extensions and to carry out this plan on a definite schedule. Concentrated buying must naturally result in delayed delivery and, as a consequence, the disruption of extension plans, the laying off of pipe-laying gangs, delay in laying pavements, dissatisfaction of property owners and a higher cost to all concerned.

The cessation of pipe-laying during the war has made the concentrated buying even more severe at the present time than in normal years. The delayed improvements must go in, and in many cases, can be put off no longer This condition will probably exist for several years and it is to the interest of the pipe buyer as well as the pipe seller, to spread the purchase of pipe over the entire year rather than confine pipe manufacture and pipe laying to a few months in the year as is the present general practice.

Tars and Centrifugal Pipe To Be Discussed

At the luncheon meeting of the New England Water Works Association at the Boston City Club on Nov. 14, there will be shown motion pictures of the pipe being cast by the centrifugal process at the Birmingham plant of the U. S. Cast Iron Pipe & Foundry Co. A paper on "Iron Castings" will be presented by Dr. Richard Moldenke, consulting chemist. "Tars" will be the subject of an address by S. R. Church, of the Barrett Co.

Asphalt Discussion Concluded

(*Continued from p.* 675)

be obtained that will be friable—and it will crack; that will be too soft—and it will creep into waves; or, that will be neither friable nor too soft and will, therefore, give good service. This can be done using any one of a number of well known bituminous cements. The fact that there is a choice of penetrations, ranging from soft cements to hard, is but an incidental aid to the engineer in designing mixtures. Ductility, bitumen percentage and specific gravity may vary greatly and, whether the cement is a straight residual, a blown petroleum or a lake asphalt, these factors might well be whatever the manufacturer of the particular product has found to be most satisfactory.

Having designed an asphalt paving mixture, based upon a certain brand of cement of a given degree of hardness, tests relative to the characteristics of the first class, noted above, are useful mostly for gaging the uniformity of supply. As for the penetration test, certainly a 10-point latitude should be allowed for cements below 90 penetration. The personal equations of many investigators cover almost as wide a range as that.

The characteristics of the second class—flash point, loss on heating, and penetration of residue—are of importance to the engineer in the field rather than to the laboratory man. May sufficient heat be applied at the plant to turn out a mix satisfactory to the gang on the street, and will the cement after 10 or 20 years of service in the roadway be as "live" as when first mixed? These are questions of primary importance and the second one, it is feared, can never be fully answered by means of any accelerated laboratory test. The A.S.T.M. tentative specifications require:

Flash Point: Not less than 175 deg. C. (347 deg. F.)
Loss on heating at 160 deg. C. (325 deg. F.) 50 g., 5 hours: Not more than 2 per cent.
Penetration at 25 deg. C. (77 deg. F.) 100 g., 5 sec., of residue: Not less than 60 per cent of the 25 deg. C (77 deg. F.) Penetration.

It is believed these requirements need not be more rigid, except possibly for the flash point. There are many aggregates that cannot be satisfactorily handled unless they reach the job at approximately 400 deg. F. Apparently, however, raising the flash point would place no undue hardship on the manufacturers for most cements on the market flash well above 400 deg. F.

Col. R. Keith Compton
Chairman and Consulting Engineer, Paving Commission, Baltimore

This office is in full accord with the efforts displayed by your magazine in the article on asphalt "From the Manufacturers Point of View," in the issue of Sept. 28, 1922. The matter of standardizing specifications for materials for public work will certainly have a tendency towards economy, not only on the producers' side but also on the construction side.

The number of brands of asphalt cement should be reduced between certain limits, but these limits should be decided upon after a full, open and candid discussion before a committee composed of manufacturers, contractors and engineers. federal, state and municipal. The engineers can be largely represented through our several technical organizations, such as the American Association of State Highway Officials, the American Society for Municipal Improvements and the American Society for Testing Materials.

In order that the work of such a committee could fit in with the specifications adopted by the two latter societies it is suggested that the chairmen of committees handling such work for these societies be members of the proposed standardizing committee. Reference need only be made to the excellent work done last year and this year by the committee appointed for standardizing vitrified paving brick. This committee held its first meeting in Washington last fall and found that there were some 66 varieties and styles of paving brick being made. At the first meeting, lasting all day, these were reduced to 11, and at a subsequent meeting held last spring they were further reduced to 7.

Such action is necessary in all industries if we are to look for economy and uniformity in practice. Your magazine could not perform a better service to the construction industry at this time than to advocate such procedure in all lines where it is possible to do so.

Julius Adler
Deputy Chief, Bureau of Highways, Philadelphia

The statement of the manufacturers' viewpoint on the production of asphalt products for highway purposes clearly shows an unwarranted lack of standardization of penetration requirements. The responsibility for this situation is placed so squarely upon the shoulders of the engineers and consumers that it is only fair to consider the other side of the matter. There is but little indication that the producers themselves, until perhaps very recently, have evidenced any very concerted desire to standardize the various products; the effort rather seemed for each producer to try to standardize his own products with the hope that the consumers would fall in line with their practice.

In the next place, the over-enthusiasm which is noted as existing among some of the consumers in the introduction of special requirements and test limits in their specification (apparently believing that great things could be accomplished from some of these highly technical variations) is a condition which the producers fostered themselves in the early stages of the use of bituminous materials in highway work. Now that this erroneous idea is widespread, it is no simple matter to check it completely.

In the matter of permissible range of penetration, there are few, if any, cases where a variation within 10 points is not sufficiently close for the purposes of the consumer. There is no doubt that the method of expressing penetrations, and the fact that a skillful operator can readily detect, say, 5 points difference in penetration between two samples, has resulted in a false idea of the significance of a few points variation as applied to the pav-

ing mixtures. On the other hand, with permissible 10-point ranges for successive grades, the producer must recognize his responsibility in establishing a clearly determinable difference between his products.

For example, if one grade is designated as 40 to 50 and another grade as 50 to 60, they must be prepared in general with the intention of being midway between these limits, and not on the dividing line between the two grades, since the latter practice defeats the attempt of the consumers at proper selection. It was undoubtedly this idea which led to the form of specification referred to as providing a 9 point range, for example, 40 to 49 and 50 to 59 (actually a 10 point range, not 9) which in a measure prevents the producer from supplying two grades from a single product.

In all fairness, however, it should be conceded that the situation of the producers is one that deserves immediate consideration from the consumers and specification-making organizations. Though the adoption of uniform standards in highway matters is always comparatively slow and there is always a small proportion of specification writers who may insist upon including individual peculiarities in their specifications, the writer believes there is no serious obstacle in the way of a general standardization of the heavier grades of asphalt for highway work.

Business Notes

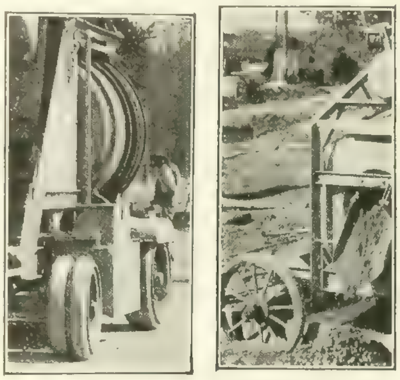
THE NORTHWEST ENGINEERING CO., Green Bay, Wis., manufacturers of crawlers, cranes, draglines, shovels and other equipment, announces the appointment of C. R. Dodge as sales manager, effective Oct. 15. From 1910 to 1917 Mr. Dodge was in charge of the Milwaukee Concrete Mixer Co.'s business in the East, and also operated his own organization handling a general line of contractors' equipment in New York under the name of C. R. Dodge & Co. Early in 1917, when the Lakewood Engineering Co. took over the sale of the Milwaukee concrete mixers, Mr. Dodge opened the first Lakewood district office in Philadelphia where he remained until 1918, when he became field sales manager for the Lakewood organization in charge of all district offices and agencies. Since 1920 he has been western sales manager for Lakewood. W. W. Mutter, vice-president of the Northwest company, who has formerly handled sales organization, will devote his attention to production and special problems.

THE INTERNATIONAL COMBUSTION ENGINEERING CORP. announces through its president, George E. Learnard, the acquisition of the entire capital stock of the Green Engineering Co., East Chicago, manufacturer of chain gate stokers, auxiliary boiler-room equipment, special furnace arches, and general foundry work.

Equipment and Materials

Demand Grows for Rubber Tires on Concrete Mixers

A growing demand for rubber-tired wheels, instead of the usual standard steel wheels, on concrete mixers of the smaller type, especially the one-bag size, has been noted by the Chain Belt Co., Milwaukee. This is especially true on city work where the mixers must frequently be hauled for considerable distances over hard surfaced roads, often brick or stone, across street-car tracks and other obstructions.



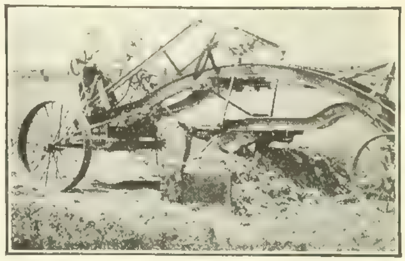
The mixer, at right, in the illustration is one of seven Rex concrete mixers operated by the City of Milwaukee, while the Rex paver shown is operated by the Milwaukee Electric Railway & Light Company. Both are equipping a great deal of their construction machinery with rubber tires and find that it reduces the wear and tear considerably.

Double-Ender Attachment Extends Road Grader Blade

An attachment called the "double-ender" has been developed by the Austin-Western Road Machinery Co., Chicago, by means of which a road grader blade may be extended 3 ft. on each end, or, with the attachment set at right angles to the blade, converted into a wheeled scraper, as shown in the accompanying illustration. While blade extensions are not new, previous types have been rigidly bolted onto the end of the blade necessitating for their removal a number of tools and much time. Such extensions, when detached, are frequently mislaid or lost.

The feature of the double-ender attachment is its hinged construction. It may be permanently attached to any size of Austin grader and when not needed may be swung back out of the way, by withdrawing a bolt in the quadrant hinge which holds the extension out. In this position, however, it is still attached to the blade. A pair of these attachments adds 6 ft. to the width of a grader blade, 3 ft. on each end. If desired, only one end may be extended.

To convert the grader into a wheeled scraper the double-ender attachments are swung through an angle of 90 deg. and held perpendicular to the plane of the main blade by dropping an adjusting bolt in the proper hole of the quad-



rant hinge. The wheeled scraper thus formed holds from 1 to 2 cu.yd. of earth and is useful for cutting off ridges in the road and carrying the earth forward into hollows. For all graders the 3-ft. extension attachment is uniform. They are furnished as extra equipment on new machines or may be attached to old graders by drilling a few holes in the blade.

All-Steel Logging Wheel Hauled by Crawler Tractor

An all-steel logging wheel designed for use with the crawler type of tractor has been in use for three months on the Pacific Coast. It is manufactured by the Reliance Trailer & Truck Co., of San Francisco. The height in the clear between the wheels is 6 ft. and the width between wheels 6 ft. 6 in. The outstanding feature of the design are the steel wheels 5 ft. 6 in. high, with tires 10 in. wide, and Timken bearings

in the hubs. Another feature is the rack-and-gear slip-tongue arrangement for raising and lowering the load. The gear ratio is such that the load is readily lifted clear of the ground as soon as the tractor pulls on the tongue and quickly dropped on down grades when the wheels tend to crowd up against the tractor.

Publications from the Construction Industry

Roof Insulation—UNION FIBRE CO., Winona, Minn., in a 10-p. illustrated bulletin, presents data to aid in the determination of the kind of insulation and thickness required to prevent condensation on the inner side of a roof. The information also may be used to calculate the saving in fuel and radiation effected by roof insulation. A psychrometric chart indicates the allowable difference in temperature between the air in a building and the inner surface of a roof before condensation will occur. There is also a table showing the conductivity and resistance of roofs, uninsulated and insulated with the Union company's product. The method of using the data is clarified by the working out of an actual problem.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Credit Men's Executive Doubtful as to Business Boom

In a survey of business conditions relating especially to the question of commercial credit J. H. Tregoe, executive manager of the National Association of Credit Men, points out for the benefit of the members of his association that all in the business world is not rosy and that even since the upturn of a month ago difficulties have arisen.

Mr. Tregoe declares that there is nothing in the situation either at home or abroad that would suggest an imminent boom. The wheat crop, he contends, has been disappointing both as to yield and price, due possibly to competition with a fine Canadian crop which, together with reduced purchasing power abroad, has affected the price of our own yield. The cotton crop, he believes, will undoubtedly be short of original expectations and, although the carry-over may be dangerously reduced, he fears that unfavorable export conditions will militate against a good price for this staple.

Mr. Tregoe does not derive much confidence from the settlement of the coal strike. He sees only an enormous economic sacrifice without any compensation and quotes with approval the opinion that due to high prices and high costs the situation in the industry is unsound. All this is despite the fact that an active fall business is forecast. If we are to get the full and lasting benefit from this, however, present problems must be handled with skill and prudence. Mr. Tregoe believes that a large share of the outcome now rests in the hands of the banks who are in position to encourage sound enterprise and to discourage speculation.

Favorable Factors

Mr. Tregoe summarizes the favorable factors in the present situation as follows:

1. Increased volume of business. This increase is reflected by carloadings, bank clearings and other indices of business volume. 2. Adjustment of the coal strike and the collapse of the shopmen's strike. We put these in the favorable column merely because of their immediate effect, and not because they betoken a permanent settlement of the questions involved. They might just as well be placed in the unfavorable column of this summary. 3. Large increases in the production of basic commodities, apparent in iron, steel and other commodities of basic importance. 4. Increased production in some of our larger industries. This is discernible in quite a few industries. 5. Increase in orders for railroad equipment. 6. The President's veto of the bonus bill. This action removes what might have been a serious burden to our recovery. 7. Improved condition of credit. This improvement is very noticeable in the reserves of banks and the credit available for sound enterprises and aside from speculative purposes.

The unfavorable factors, in Mr. Tregoe's view, are: 1. Disparities still existing in the relation of prices to one another, particularly the disparity existing between prices of farm products and manufactured products. 2. Low prices of farm products. This situation is limiting the buying power of the farmer, although this condition is very much improved over a year ago. 3. Advance in prices of production costs. Undoubtedly, and as we have pointed out many times, advances in fabricated commodiities, and particularly where they are based on higher production costs, will unfavorably affect our recuperation. The price must be steadfastly watched. 4. High prices of fuel and lighting. In August fuel and lighting stood at 271 as against 155 for the general index. This is serious as affecting home and industrial necessities. 5. Continuing unsettled situation in European and in Near East affairs. Recent complications in the Near East are serious and must have their effect on world production.

Bureau Public Roads Get Big Freight-Rate Reduction

The Western States will save considerable money in payment of freight on surplus war material through new rates which have been secured by the Bureau of Public Roads. Large quantities of material are still being received by the Bureau and alloted to states for use in road construction. Recently through representation of the Bureau as to the character of the material and the use to which it is to be put considerably lower rates were granted. On transcontinental shipments, motor vehicles now take a rate of 95 cents per hundred against a former all rail rate of \$5.35. Machinery takes a rate of 60 cents per hundred and similar reductions have been made on other classes of material. These rates have been effective only a short time but have been immediately reflected in requisitions from the West.

British Will Build Roads to Relieve Unemployment

The British Ministry of Transport has under consideration various schemes to improve highway services and at the same time to alleviate unemployment to the extent of £7,000,000. The ministry is authorizing first those schemes which will meet urgent public needs in the matter of road transport. Most of this work is in the nature of driving straight roads between the large cities, for instance the Manchester-Liverpool road, which is estimated to cost £3,000-000. Work on this road will largely be carried out by unskilled labor and would solve one of the most difficult traffic problems in the country. On the certificate of the Minister of Labor that serious unemployment not otherwise provided for exists in the areas concerned in the schemes, the Minister of Transport has already approved projects estimated to cost £1,500,000.

Immigration Restriction Affects Labor Supply

Construction Industry Among First to Feel Effect of Cutting Down Supply of Common Labor

Reports from many cities indicate a well-defined shortage of common labor, particularly in the construction field. Whereas a year ago seventeen of the twenty-one cities in which construction conditions are reported by *Engineering News-Record* showed an actual excess of labor, with men out of work in large numbers, a condition wholly reversed prevails today. Labor shortage and general wage increases are the rule, not only in the construction field but also for industry in general. The Department of Labor reports an increase of employment in sixty-five cities and a decrease in only seventeen.

Immigration Reports

Some measure of this increased employment and the accompanying increased wages is due to a revival of business, but the impression prevails that a very important factor is the effect of the restriction of immigration upon the supply of common labor. The reports of the Department of Labor show that for the twelve months ending last June the net immigration—that is, the excess of immigration over emigration—was only 110,844. When we inspect the records kept on the basis of occupation we find that those immigrants classed as laborers numbered 32,726, while the laborers who emigrated were 100,058. This shows a net loss of 67,332 in this class of essential labor. It should be noted also that of the net increase here given, 104,326 were females, while only 6,518 were males. Unquestionably some part of the males were children. Taken as a whole, the figures for immigration based on occupation, either professional, skilled, or miscellaneous, show a net decrease of 6,534, while those for immigrants of "no occupation (including women and children)" show a net increase of 76,106. These figures are to be contrasted with an average net gain of between 700,000 and 800,000 annually in the years preceding the war.

It may be worth-while to recall at this point that legislation now in force limits the number of persons who may come into this country from the various foreign countries to 3 per cent of the total number of aliens of those countries who were living in the United States in 1910. This contemplates the annual entry of 360,000 people, but as a matter of fact the actual immigration falls considerably below this figure, as the law does not permit a deficiency in one nationality to be made up by an excess of another. The result is that instead of admitting 45 per cent of the normal increase due to immigration of other years we admit only 11 per cent, of which only a small part may be counted upon to improve our supply of common labor.

It is estimated that the population

of the country increases at the rate of about 1,400,000 annually, or about fourteen per 1,000, so that we require an addition of fourteen manual laborers annually per 1,000 of those already in the trade. Applying this ratio to the manufacturing and mechanical industries we must find annually 154,000 additional laborers to add to the 214,000 who are required to replace losses caused by death and retirement. This makes an annual need for 368,000 new workers annually in these fields.

The situation is aggravated, of course, by the fact that a relatively small number of those born in this country, even those of foreign parentage, may be relied upon to augment our supply of common labor. Although in Europe the tendency is for sons to follow their fathers' occupation, this is not true with us; and in order to supply the deficiency in common labor caused by this condition we are peculiarly dependent upon immigration. But as the ranks of skilled labor are recruited from those of the unskilled, it is a question of time only when the dearth will be felt there also.

Although few would go so far as to advocate a return to the free and unrestricted immigration of other days, a widespread opinion prevails that the present legislation is likely to work more for evil than for good. It is felt that rather than an arbitrary limitation of numbers upon the immigration from various foreign countries, we need a more scientific and discriminating selection of workers on the basis of the country's industrial needs. Owing to the business depression that has prevailed for the last year or two, this whole question has been in the background, but with the present revival and with the promise of a further awakening, attention has been focused sharply upon it. If the slight increase of recent months can make itself felt to the extent already reported, it is believed by those well informed that the prospects justify most serious consideration on the part of the most constructive thought that can be brought to bear upon the problem.

Heaviest September Bond Issues in Last Thirty Years

Sales of long-term municipal bonds during September, totaled $94,590,507 as against $66,360,551 for August and $88,656,257 in September, 1921. This represents the highest total value for the month of September, realized in any similar period during the last thirty years. The total for the nine months, $905,770,787, represents the highest total for that period, since 1892. Short-term securities totaled $47,831,000, of which $42,410,000 was issued by New York City alone.

Records kept by the *Commercial and Financial Chronicle* further show that the number of municipalities issuing permanent bonds and the number of separate issues made during September were 442 and 615, respectively as against 516 and 663 for August and 377 and 478 for September, 1921.

Among the more important issues were: Chicago, $8,095,000 4s at 98.639, a basis of about 4.16 per cent; Illinois, $6,000,000 4s at 99.686, a basis of about 4.03 per cent; Detroit, $5,009,000 4¼s; Missouri, $5,000,000 4½s at par, plus a premium of $32,215, equal to 100.644, a basis of about 4.35 per cent; Milwaukee County, Wis., $4,300,000 5s at 107.36, a basis of about 4.20 per cent; Buffalo, $3,580,000 4¼s at 103.109, a basis of about 3.90 per cent; Michigan, $2,000,000 4s and $1,000,000 4¼s at 100.012, a basis of approximately 4.08 per cent.

Of the forty-three representative issues shown in the accompanying table, six sold at par, thirty-five above, and only two below par; the yields ranging from 3.93 to 5.89 per cent. The rates varied from 4 to 6 per cent. All those drawing 5½ and 6 per cent were in the Southern and Western states; the 4¼s, 4½s and 5s were mostly in the Middle Atlantic states with several in the West, while the 4s were confined to Massachusetts, Illinois and Michigan.

RECENT REPRESENTATIVE PUBLIC BOND SALES

State	Purpose	Amount	Maturity	Rate Per Cent	Basis	Sold For	Dated	Purchased By
Illinois	Highway	$6,000,000		4	4 03	99.686	Sept., 1922	Dillon, Read & Co.; Wm. R. Compton and Hakey, Stuart & Co., all of Chicago.
Missouri	Road	5,000,000	.	4½	4.35	100.644	Sept., 1922	Watkins & Co., Hornblower & Weeks and others of New York.
Michigan	Highway imp't.	2,000,000	.	4	4.08	100.012	Sept., 1922	Eastman, Dillon & Co. and others
		1,000,000	.	4¼	4 08	100.012		
County								
Allen, Ind.	Road	16,000	1923–32	5	4 76	101.14	Sept. 15, 1922	Fletcher Savings & Trust Co., Indianapolis; Thos. D Sheerin, Indianapolis
		15,000			4.74	101.21		
Auglaize, Ohio	Road	8,200	1927	5½	4.93	102.73	Oct. 3, 1922	W. L. Slayton & Co.
		10,500	......	5½		102.73		
Benton, Ind.	Highway imp't.	16,000	1923–32	5		101.30	July 15, 1922	J. F. Wild & Co., State Bank of Indianapolis
Clay, Ind.	Highway imp't.	10,100	1923–32	5	4 75	101.16	May 22, 1922	Thos. D. Sheerin & Co. of Indianapolis
Cuyahoga, Ohio	Road	95,925	1924–32	5	4 75	101.67	Oct. 1, 1922	Hayden, Miller & Co. of Cleveland
		91,634	1923–31	5	4.64	101.67	Sept. 1, 1922	
Dubois, Ind.	Highway	14,500	1923–32	4½		100.	Aug. 15, 1922	To contractors
Hudson, N. J.	Road	380,000	1923	4½		100	.	Sinking Fund Commission
Lafayette, Mo	Road and bridge	258,000	1923–42	5	. .	105.01	Nov. 1, 1922	W. R. Compton Co. of St. Louis
Mahoning, Ohio	Road imp't.	67,000	1924 32	5½		103.38	Sept. 1, 1922	W. L. Slayton & Co. of Toledo
New Castle, Del.	Highway	140,000	1933–37	4½	4.38	101.0656	July 1, 1920	Graham, Parsons & Co., Wm. R. Compton Co.
North Saint Lucie River Drainage Dist., Saint Lucie Co., Fla.	Ditch	500,000	1927–47	6		95	May 1, 1922	J. L. Arlitt of Austin
Pulaski, Ind.	Highway imp't.	10,000	1923–32	5	4.74	101.20	Aug. 1, 1922	W. Sabel
Trumbull, Ohio	Road	55,000	1924–32	5½	....	103.88	Oct. 22, 1922	W. L. Slayton & Co.
Weldon River Drainage Dist., Decatur Co., Ia.	Ditch	28,000	1926–35	5¼	....	101.30	Sept. 5, 1922	Geo. M. Bechtel & Co. of Davenport
Municipality								
Ada, Minn.	Electric lights	25,000	.	5		101.26	....	Hanchett Bond Co., Chicago
Aguadilla, Porto Rico	Improvements	85,000	1927-51	5		102.47	July 1, 1922	John Nuveen & Co., Chicago
Ashland, Ky.	Water	90,000	1957–61	4¾	4.55	103.31	Jan. 1, 1922	Richards, Parish & Lamson of Cincinnati
Beacon, N. Y.	Water	39,000	1923–38	4¼	4.24	100.04	Oct. 1, 1922	Sherwood & Merrifield of New York
Bucyrus, Ohio	Street imp't.	17,400	1923–31	5½		102.21	Sept. 1, 1922	Richards, Parrish & Lamson of Cleveland
Cortlandt, N. Y.	Water	6,500	1924–36	5	4.82	101.03	Sept. 29, 1922	Geo. B. Gibbons & Co. of New York
East Grand Rapids, Mich.	Water extension	25,000	1937	4¾	4.53	102.33	Oct. 15, 1922	Detroit Trust Co.
	Sewage treatment	12,000	.			......	....	....
Eaton, Ohio	Street imp't.	12,000	1924–29	5½	5 17	101.14	Sept. 15, 1922	Preble County Nat. Bank
Fostoria, Ohio	Street imp't.	38,000	1924–32	5½	4.82	103.51	Sept. 1, 1922	Detroit Trust Co., Detroit
		8,400	1924–32				.....	. . .
		2,400	1924–31			..		
Fulton, Ohio	Highway	14,502	1924–28	5½	5.10	101.45	Nov. 1, 1922	Durfee, Niles & Co. of Toledo
Grand Rapids, Mich.	Road	23,220	1924–32	5	..	100	June 1, 1922	....
Hamler, Ohio	Street imp't.	9,361	1923	6	5.89	100.85	Sept. 15, 1922	Prudden & Co. of Toledo
	Sewer	1,900						
Honolulu, Hawaii	Public imp't.	500,000	1932	5	. . .	102.082	July 1, 1922	Geo. B. Gibbons & Co., N. Y. C.
Hempstead, N. Y.	Water extension	15,000	1925–32	4¼	....	100	Nov. 1, 1922	First National Bank of Hempstead
Leland, Miss.	School and light	14,000	1923–36	5½	. . .	100.89	Oct. 1, 1922	Bank of Leland
Loveland, Wyo.	Water	50,000	1937–57	4½	..	100.30	....	James A. Cansey & Co. of Denver
Madell, Okla.	Waterworks	41,000	1940–50	6	. ..	104.19	Jan. 15, 1922	The Brown-Crummer Co. of Wichita
Mayville, N. D.	Septic tank	7,500	1937	6	...	108.20	Oct. 1, 1922	Merchants' Trust & Savings Bank of St. Paul
Nichols, N. Y.	Bridge	10,000	1924–33	5	4.69	101.623	Sept. 15, 1922	O'Brian, Potter & Co. of Buffalo
Red Bank, N. J.	Gen'l. imp't.	167,000	1923–51	4½	4.30	102.155	Sept. 1, 1922	Red Bank Trust Co.
Saugerties, N. Y.	Water	40,000	....	4½	.	101	Sept. 30, 1922	Saugerties Savings Bank
Somerville, Mass.	School	250,000	1923–42	4	3.93	100.569	Oct. 2, 1922	Stacy & Braun and Parkinson & Burr of Boston
Trinidad, Col.	Water	365,000	1937–57	4¾	....	100	Oct. 1, 1922	E. H. Rollins & Sons of Denver
Wilmington, Ohio	Street imp't.	6,000	1923–32	5½	.	103.006	July 1, 1922	Clinton County Nat. Bank
Winterville, N. C.	Light and imp't.	10,000	1945	6	...	100	Sept. 1, 1922	George & Fetner of Cherryville
Yanco, Porto Rico	Imp't.	130,000	1924–40	6		106.50	July 1, 1922	John Nuveen & Co. of Chicago

Engineering Employment Reflects Upward Turn of Business

Engineering business is better. At least that is the indication from the August report of the employment service of the American Association of Engineers just issued. Sixty-eight fewer applications were received than the 1,484 in July; but 467 positions were available in August as against 413 in July. Only 1,140 men were referred, less in number by 290 than in the previous month. Of the men placed 219 were put to work, against 206 in July. Compared with these figures are the August 1921 statistics noting 2,320 applicants, 360 positions, 2,250 men referred and 204 men placed. The average salary of positions in August was $188 per month.

Living Cost Changes Slowly

Changes of cost of living in thirty-two cities, and in the United States as a whole, from June to September, 1922, were very slight, ranging from 1.6 per cent decrease to 1.4 per cent increase, according to the United States Bureau of Labor Statistics. In many cases the change was under a half per cent.

Road Bond Issues in Texas

Harris County (Texas) will vote on a $6,000,000 good-roads bond issue and a $3,000,000 issue for the improvement of the Houston Ship Channel at the next general election to take place Nov. 7. Other issues being considered include the following: Anderson County, actively at work for a proposed $1,500,000 good-roads issue to be voted upon in the near future; Collin County one district alone, working for a $450,000 issue for good roads; Orange County, where a $700,000 issue of special road bonds has been approved.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of October 5; the next, on November 2.

Steel Products:	New York	Atlanta	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.14	$3.95	—$2.90	$3.15	$3.80	$3.25	$3.75	$3.75
Structural rivets, 100 lb	3.85	4.60	3.35	+4.00	4.80	4.50	5.00	6.50
Reinforcing bars, ¾ in. up, 100 lb	3.04	3.85	—2.80	3.05	3.97½	3.00	3.75	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	57%	61.15%	59½%	58.9-5%	43%	47.9%	45%	30.00
Cast-iron pipe, 6 in. and over, ton	55.30	51.00	48.70	55.50	+63.00	51.00	54.00	55.00
Concreting Material:								
Cement without bags, bbl	2.60	2.54	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd	1.75	2.00	2.00	1.75	1.75	2.25	1.00	1.50
Sand, cu.yd	1.00	1.35	2.00	1.00	0.75	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	1.60	2.25	3.50	2.25	3.00	1.90
Miscellaneous:								
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	59.00	42.00	51.00	41.00	39.75	35.00	24.50	50.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	18.00	—25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	2.75@3.14½	1.85	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	18.00@19.10	12.00	11.00	18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.1101	.09	.065	....	.11	.08@.16
Hollow partition tile 4x12x12, per block	.1230	.0776	.0808	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	.93	.97	.97	.98	1.08	1.04	.86	1.06
Common Labor:								
Common labor, union, hour	.60	.35	....	....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.44@.60	.30	.72½	.35@.50	.35@.50	.47½@.50	....	.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par.) Bag charge is 80c. per bbl. Discount of 10c. per bbl for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Cast-iron pipe up $3 in Denver and $2 in Atlanta, with market in the East unusually active. Transportation in the South is so unsatisfactory as to be discouraging to the placing of new business, as well as to prevent delivery of pipe long on order.

Plain shapes down 12½c. per 100 lb. in Chicago warehouses. Mill shipments are $2.10@$2.34, Chicago. Bars are also down 12½c., warehouse. At Pittsburgh the accepted market on large tonnages is $2, with not many important jobs appearing. Rivets advanced in both Minneapolis and Atlanta, 22½c. and 15c. per 100 lb., respectively. Structural and heavy ship rivets in Pittsburgh, $3.15. Despite poor movement of finished steel from the mills, four more blast furnaces have opened in the Central West.

Production of lumber is being restricted by the scarcity of cars and many mills are unable to operate due to lack of storage space until shipments are increased, according to the weekly analysis of the statistical bureau of the American Wholesale Lumber Association. For the week ending Sept. 30 the output of the combined producing associations showed a decrease accompanied by a marked drop in shipments and orders. Shipments from the southern pine field have been the most hampered of any of the sections, being the lowest since the first of the year. On the West Coast the car situation is not so serious as in the South; the production is still well up and the mills are endeavoring to catch up with earlier delays due to forest fires. Prices same as reported last week.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

Volume 89 NEW YORK, OCTOBER 26, 1922 Number 17

Lost Time Committee Action Urged

JOINT committee action by national associations of engineers and contractors is called for in this issue in the concluding article on lost time in construction. While *Engineering News-Record* is not committed to the precise plan outlined, it believes that organized action along the lines of inquiry which are indicated should be prompt and energetic. The waste from winter idleness and weather and management delays is a plain challenge of the efficiency of construction engineering which cannot be ignored.

The Search for Stability

THE prime functions of money are to provide a trustworthy standard of value and a stable medium of exchange. Both these are essential to trade, which, in turn, is so essential to the economic health of the world. When the paper symbols of money are perverted from those necessary and legitimate purposes to the endless creation of "capital" out of thin air, money becomes worthless for its true functions, and a substitute must be found. One of these is a reversion to barter. This remedy, however, is so clumsy and so limited in its application that for general use a more convenient one must be sought. Most satisfactory of all appears to be the use of a foreign currency of more stable worth. The growing conviction of the European peoples to the worthlessness of their own currencies is reflected by the increasing transaction of domestic business in terms of foreign coinage.

The Ultimate Issue

ISSUES of vast importance to American business are involved in the work that has been undertaken by the President's coal commission. In the first place, the findings of that body will go far toward determining whether the coal industry shall follow the railroads into the tangle of government regulation. The alternatives now lie before it. On the one hand, self-government for the industry and prosperity for operators and miners alike, provided only that the requisite wisdom and courage can be found in the industry itself. On the other, political regulation, with all its demoralizing handicaps, should short-sighted and selfish interests prevail. But a further responsibility, greater even than that of self-preservation, rests upon the coal industry. It must convince the commission of its capacity and its good faith for the sake of American business in general. The verdict in this case will, in the eyes of many, indicate whether we have reached the limit of private administrative ability. The transportation system of the country has passed almost beyond the pale of private management. Public utilities of every description are close behind it. Should the coal industry be forced to join them, how long would it be before others would follow the same road? As our civilization becomes more and more complex, more and more of our industry becomes of fundamental importance, and more and more of our business activities are woven into the very life of the community. And if American business genius should be adjudged incompetent to deal with these overhadowing problems on a business basis we may expect to see private enterprise increasingly replaced by public control Unless the coal industry can rise to its present responsibilities, the President's commission may yet become the thin edge of a wedge that would exert a far-reaching effect on American industry.

Courageous Beginning

IN TAKING up the thorny subject of building failures and how to prevent their recurrence, the New York section of the American Society of Civil Engineers has begun most courageously a long and hard task. Building failures do not arise from any one single cause, and no simple formula will solve the problem of eliminating them. Whatever the ultimate solution, moreover, a persistent campaign will be required to put it into effect. The task could easily have been evaded, since building failures rarely involve engineers and so do not constitute an obvious engineering responsibility. But a clear, courageous view of the situation was bound to reveal the underlying responsibility of the engineering profession for the structural safety of buildings—for their due strength and stability. And out of this responsibility springs a public obligation to correct faulty conditions, an obligation which rests primarily on structural engineers but in the last analysis on the undivided civil engineering profession, since after all this profession stands as a unit in its relation to the public. Frank recognition of this obligation was the motive that led to taking up the work of reform. So far the effort is local, and the magnitude of the work ahead is scarcely yet appreciated. In its progress, however, there will be occasion for engineers throughout the country to join with their New York colleagues; joint effort, vitalized by the spirit of discharging an obligation of professional honor, will make ultimate success assured.

Asphalt Varieties

IN LAST week's issue was concluded a discussion of a proposal made in *Engineering News-Record*, Sept. 28, to reduce the number of varieties of asphalt commonly specified for road and paving work. In the presentation of the case from the manufacturer's point of view it was asserted that non-uniformity in specifications and ultra-refinements in tests placed a needless burden upon the producers without resulting in any compensating advantages in improved construction. With this point of view federal, state, and city highway and paving officials seem to be in general accord. Nine representative engineers in the highway field expressed their opinions; of this number, one represented the federal government, three the state highway departments, four the city paving departments, and one an asphalt pro-

ducer. No one of the nine objected to the reduction in varieties of asphalt to seven grades (by the penetration test), while one went even further by suggesting five grades as being ample for all practical purposes. However, the opinion of those who discussed the subject was not merely negative; in most cases positive endorsement to the plan was given. While those who contributed to the discussion constitute only a small percentage of the country's asphalt users, they are all men of standing to whose opinions importance must be attached. If, therefore, the points made in the original article and endorsed in the discussion are sound, action along the lines indicated should be taken by our specification making organizations such as the American Association of State Highway Officials, American Society for Testing Materials, and American Society for Municipal Improvements. With the evidence available a decision should be reached.

The Dangerous Forties

SUMMER this year in most sections of the country is dying hard and the calendar and thermometer show a certain lack of teamwork. Just the same, frost is in the air and November coming on so the annual warning about cold weather concrete is due. Hammering on the dangers of cold weather concreting and emphasizing the effectiveness of precautionary methods has had its effect in the past few years and more and more contractors realize their responsibilities and capabilities in winter concrete work. The next two months are the critical ones, however. Definite freezing weather carries its own warning. It is when the mercury hovers between thirty and fifty that the bars are let down and it is in this snappy weather that concrete takes so long to set up and makes of itself a menace. Watch out for the concrete which is placed in the dangerous thirties and forties.

Spreading Pipe Purchases

JUDGED by the discussion which begins this week in the department, "From the Manufacturer's Point of View," water-works officials are in sympathy with the desire of cast-iron pipe manufacturers, expressed last week in this journal, to have purchases spread over the entire year instead of concentrated in the summer months. It is generally conceded that a substantial economic loss results from the present practice of seasonal buying of pipe, and that, to some degree at least, the peaks and valleys in the curve can be made less steep. Location and climate are important factors in winter work and practices which can readily be put into effect in the South become impossible under the conditions of a cold New England winter. Then, too, the matter of municipal financing and appropriations enters into the problem, and, while water-works departments might be willing to place their orders well in advance, such a course may be rendered impracticable due to delays beyond the control of water department officials, in making appropriations available. Valid as some of these objections are, there is no doubt that the producer and the consumer of pipe can co-operate more closely than they have done in the past and to mutual advantage. Customs, long followed, are often allowed to govern the conduct of work merely because they *are* customs and not always because the facts justify their continuance. The present discussion on winter purchase of pipe is useful, therefore, in bringing out statements of fact and opinion which may serve as a basis for desirable changes in practice where conditions make such change possible.

Sound Doctrine for Organized Labor

HARD upon his declaration of faith in the efficacy of direct negotiation between railroad employees and executives as opposed to political intervention, W. G. Lee, head of the trainmen, has announced the decentralization of the train-service brotherhoods in handling matters of strikes, wages and working rules. The trainmen and conductors will handle their business hereafter through regional groups; and Mr. Lee believes that under this plan he will be able to look after the interests of his men more effectively. He is right. Everyone knows that nation-wide labor combinations, organized without respect to regional or occupational lines, serve no economic purpose. They are strictly offensive weapons, calculated to overawe the community or, failing that, to beat it into subjection by brute force. Even in this respect they are treacherous weapons, for as Mr. Lee points out, an undiscriminating attack against the general welfare is too likely to arouse a community resistance, often difficult to overcome. By handling industrial controversies on their merits, with due regard to regional economic conditions, and with respect for the community welfare, organized labor stands a better chance in the long run of prevailing over the "hard-boiled" employer and of retaining the public respect while it is doing it.

Impulse Wheel Improvements

FOR MANY years no radical changes have been made in the design of impulse wheels. Great improvements have been made in details, in governors and in other auxiliary apparatus, but so far as general principles and fundamentals are concerned, one might conclude that this type of prime mover had reached its ultimate state. Such conclusions as to finality, however, are never safe. Elsewhere in this issue appears a note describing a new departure in the design of impulse wheels. Despite the recent trend to higher and higher heads on reaction wheels and the development of higher specific speeds for impulse wheels, there is still a field ranging between heads of 800 to 1,000 ft. to which neither impulse nor reaction type is exactly suited. That is, at these heads both types have certain disadvantages or limitations. In the attempt to apply the impulse wheel to the larger units toward which modern practice is tending, certain obstacles have not heretofore been overcome. The restriction of specific speed, more particularly, imposes on the large impulse unit a low angular velocity with the consequent heavier machinery and increased size of power house structure. On the other hand, the Pelton wheel has distinct advantages over the reaction type when the water contains sand or other impurities in considerable quantity, or when the unit is called upon to operate part of the time under partial load. In other words, the Pelton wheel has such advantages in resisting hydraulic wear and corrosion, and maintaining efficiency under varying loads that there is incentive to adapt this type to all heads. Considerable advance has been made in reaction wheel design in decreasing leakage through the clearance spaces around the runner and in prolonging the life of the seals, but

the impulse turbine does not have to meet the problem of leakage at all and hence no amount of improvement can put the reaction wheel on an equal footing with the impulse type so far as this feature of design is concerned. A closer approach to the ideal type of unit than anything yet available would be a runner having the hydraulic advantages of the impulse wheel and at the same time developing specific speeds approaching those obtainable with the reaction wheel. If and when the experiments referred to elsewhere in this issue lead, as the early results indicate, to the production of units in commercial sizes that fit these requirements, the whole field of hydraulic prime movers will be affected in a most beneficial way.

More Railway Work for Contractors

A FIELD for contract work which has been developed only to a relatively limited extent as yet, but which seems to give promise of considerable expansion in the next few years, is suggested by the article on another page dealing with the contracting of reconstruction and maintenance work on existing railway. This field is taken to include only the heavy class of work which is done ordinarily by railway floating gangs or extra gangs, but which is done more or less also by contract. It does not include the important but lighter work done by section gangs, since this appears to be more properly assigned to forces employed and controlled directly by the railways. In fact, recent attempts to introduce the contract system for this latter class of work have been the cause of unrest on the part of railway labor.

For the heavier work done by floating gangs, however, the conditions are different and appear to be becoming more and more favorable for the introduction of the contract system. This work is mainly seasonal so that new gangs must be built up and organized every year by the railway. A few of the skilled men may be regular employees, perhaps recruited from the shop or other permanent forces; but in general the gangs are composed of such outside men as can be picked up when required. Under such a condition the trouble and expense of organizing, training and maintaining a gang is likely to be disproportionate to the amount of work to be done. This situation may be improved materially if the railway can award the work to an experienced contractor, either by private contract or by competitive bidding.

Many railways have already employed the contract system in work of the class under consideration. It is true that opinions vary widely as to the desirability and success of this practice, but undoubtedly this is due in part to the fact that the contract work has been too scattered and too limited in the aggregate to develop the best methods of practice in handling and controlling it. With wider use and longer experience there will be a basis for the establishment of standard or uniform rules, specifications, contracts and means of control, thus conducing to higher efficiency and economy. Since the railways are being hampered increasingly by wage and working restrictions of their forces it seems highly probable that they may realize substantial advantages by adopting the contract system, particularly in reduction of labor problems and cost of work.

Special factors or conditions are involved in railway work of this class, notably as affecting the operation and safety of traffic. There is a strong and natural objection on the part of many railway officers to entrusting such work to outside interests. But as those conditions have already been met satisfactorily under the contract system they need not constitute a serious difficulty. It is essential, of course, to have the work done under close and continuous supervision and control of the railway officers, both as to quality and progress and as to possible interference with traffic. This is a matter of organization and control, however, which is one of the factors to be considered in drafting the contract.

To some extent this field is one for specialization. Some firms have already made railway improvement work a specialty but the field has barely been touched as yet and there is plenty of room for many others. Not every contractor is qualified or equipped to operate in this field. But as some contractors specialize in sewers, foundations, buildings or drainage work, so others may specialize in railway maintenance and improvement.

It is certain that the contract system at least merits special study and consideration by both the railway engineer and the contractor. The railway engineer may find a method of lightening his difficulties and reducing his expenses, while the contractor may find a wide expansion for his activities.

Successful Small-City Paving Practice

THE streets of small cities of 10,000 to 50,000 people offer one of the most difficult paving problems which engineers are called upon to solve. Such communities have a large mileage of streets per unit of population, they are in line with the main paved roads of state and country systems and, ordinarily, they possess only moderate funds for paving purposes. These are conditions which are difficult to harmonize.

With the people so generally owning automobiles the city engineer of the small city cannot as easily as he once could concentrate expenditures on a few main streets and give the other thoroughfares only superficial attention ordinarily, with perhaps a more thorough-going renovation every few years when complaint becomes insistent. Now, the car owners, who are on every street, are keen in demanding good surfaces and freedom from dust. Paving funds must be widely spread to meet this situation. On the other hand since the main streets of the town are links in county or state paved roads they are subjected to a heavier traffic than ever before and have to be kept in better shape to prevent adverse comparison with the state-maintained approaching roads. The facts stated complicate the city engineer's paving task, particularly if his funds, as is most generally the case, are limited. Successful solutions when they are found are, therefore, worth observing and one of them appears to be the development of tar treated gravel streets in Richmond, Ind., described in this issue. Apparently in this city about the cheapest of street surfacing is kept in excellent shape, smooth and dustless at a moderate annual expense. There is absolutely nothing new or radical in the methods. The work is simply well done and maintenance is meticulous. The last statement needs to be grasped completely because it is the key to success in keeping low class pavements fit to serve traffic. It is, too, the one requirement which the small-city street official most often fails to satisfy.

Experience with Breakwater Design on the Great Lakes

Types Include Rock Rubble-Mound, Mass Concrete and Concrete Caissons — Costs and Cross-Section — Quality and Requirements of Marine Concrete

In BREAKWATER construction on the Great Lakes both stone-rubble and shaped concrete construction have been used extensively and successfully, but for both materials there are certain advantages and limitations, the selection in any one case being based on the cost and suitability under the conditions of that particular case or structure. An instance of this is afforded by the breakwater for the harbor at Great Lakes, Ill., which includes both rock rubble-mound and concrete-block construction, as described in *Engineering News-Record* of Dec. 29, 1921, p. 1069. Concrete was used on either side of the entrance in order to give practically uniform depth for the entire width of channel, while the slopes of a rubble mound would have required much greater width of opening. A review and comparison of some of the features of the two systems of construction is the purpose of this article, which is based on an extended inquiry.

It is of particular interest to note the opinion expressed by Maj.-Gen. W. M. Black (former Chief of Engineers, U. S. A.) to the effect that although breakwaters have been used for centuries, engineers have not yet fully adapted the design to the results required. He considers that through conservatism or lack of knowledge they have made these structures unduly expensive to build and maintain. Further, he points out that since the power of wave action is exerted most strongly for only a short distance below and above the water level, it is evident that economy of construction requires the minimum height which will afford the desired degree of shelter.

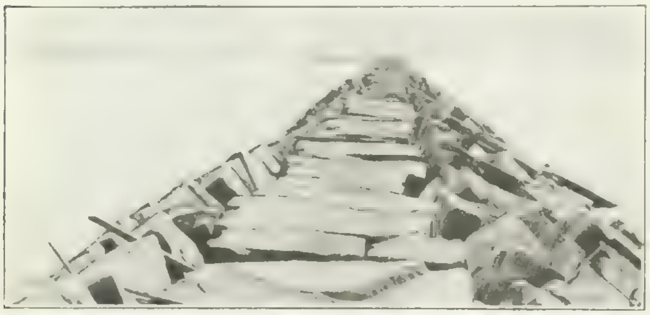


FIG. 1—ROCK RUBBLE-MOUND BREAKWATER AT ASHTABULA, OHIO

Rock Rubble-Mound Construction—Stone breakwaters are almost exclusively of the rubble-mound type, consisting of a base and core of small stone, faced and capped with massive rough quarry blocks to finish the structure to the required height and section. Care is required in placing the blocks so that they will interlock and support each other against the attacks of heavy waves, but repair work is required at times on account of damage done by storms. This construction for the outer breakwater at Chicago was described in *Engineering News* of Oct. 14, 1915, p. 740.

Typical rock rubble-mound breakwaters are those at Ashtabula and Conneaut, Ohio, shown in Figs. 1 and 2 respectively. Granite is usually considered the best stone for this purpose, as it absorbs very little water, is hard and does not disintegrate, while the rough and irregular shape of the blocks helps the interlocking of the mass of stone. Fig. 3 shows the placing of a massive keystone block in a breakwater of this type. The specifications of the Corps of Engineers, U. S. Army, for the work at Conneaut, Ohio, called for: "Hard, close-grained quarry run stone of quality suitable for the purpose and which will not disintegrate under the conditions to be met; its weight shall not be less than 135 lb. per cubic foot."

As an example of work of this kind the following particulars are given of the Conneaut breakwater,

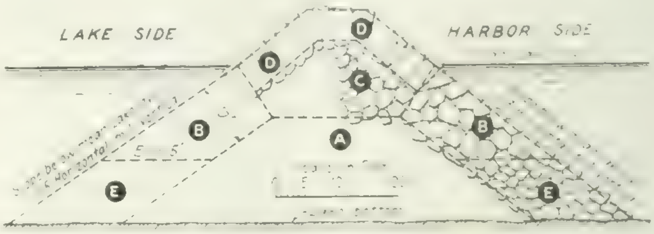


FIG. 2—RUBBLE-MOUND BREAKWATER AT CONNEAUT
A, quarry-run stone of any size. B, minimum 5 tons. C, minimum 500-lb., 50 per cent by weight to be 1 ton or more. D, minimum 3 tons. E, minimum 500 lb.

shown in Fig. 2, this information being summarized from the government specifications. Quarry run stone of any size is used for the lower part of the core, not more than 10 per cent of foreign matter being permitted. The upper part of the core is a mixture of such sizes as to insure dense construction, the minimum weight of stones being 500 lb. and 50 per cent by weight being 1 ton or more.

On the slopes of the core is a 10-ft. covering of heavier rock, with a minimum weight of 500 lb. in the lower portion and 5 tons up to lake level. The top of breakwater and upper parts of the slopes are formed with stones not less than 12-in. in least dimension and weighing about 3 tons, 10 per cent of less weight being permitted if properly interspersed with large stone. These large stones should extend at least 5 ft. into the work, perpendicular to the slope, but in not more than 10 per cent by weight this requirement may be reduced to 3½ ft. When the top of the breakwater is formed by stones weighing not less than five tons, a minimum thickness of 3 ft. is permitted. In the upper part of the core and the covering of the side slopes no stone is to be used whose greatest dimension is more than 3½ times its average thickness.

In construction, the lower part of the core and slope covering may be placed by dumping from deck or dump scows, derrick buckets or skips, or by tripping or lowering in place "or in any other manner which the contractor may select." Derricks must be used for the upper part of the covering, each stone being lowered in place before being released. For the top covering, all stones must be set securely and in as close contact with each other as practicable, with joints approximately normal to the surface of the breakwater. The maximum permissible variations from grade or between adjacent stones is 18 in. on slopes and 12 in. on top, measured at right angles to the surface.

One engineer of extended experience states that the rock rubble-mound is the best where the waterway is sufficiently large to permit its use, owing mainly to

ease of construction in exposed locations and the ease with which repairs can be made without disturbing the original work, together with the fact that any slight displacement or settlement is less apparent and unsightly than an equal movement in a concrete structure having straight lines and surfaces. Further, General Black considers that the rubble-mound has an advantage in the facility of changing the height and width of crest to meet conditions which may develop after construction has been started.

Concrete for Lake Marine Works—Concrete breakwaters and piers on the Great Lakes are of different types, approximately as follows: (1) Mass concrete, (2) poured or precast concrete blocks; (3) hollow reinforced-concrete caissons filled with stone or lean concrete and capped with concrete. In these three types the concrete work is mainly the superstructure, being placed upon a foundation bed of loose rock or upon timber cribs filled with rock. The caisson construction, as invented and patented by Col. W. V. Judson, Corps of Engineers, U. S. A., was described in *Engineering News* of Oct. 15, 1908, p. 419, 421, and in *Engineering News-Record* of Aug. 8, 1918, pp. 258 and 287. A typical caisson ready for launching is shown in Fig. 4. Concrete block rubble-mound construction, as used at some foreign ports, has been used very little by American engineers (except on the Panama Canal work) and not at all on the Great Lakes. Such work is not comparable directly with the stone rubble-mound, as its blocks are usually cubical instead of having the rough and irregular form of quarry blocks.

A theory advanced as to deterioration of concrete in marine work on the Great Lakes is that spray freezing upon the surface will build up great masses of ice and that when these are broken loose during a storm they carry small pieces of concrete with them. Also, that water will penetrate the surface and in freezing will split off small flakes, leaving a fresh surface for similar attack. It is obvious that deterioration from such causes must be very slow. Experience indicates that these effects are limited and that in general the injury is not cumulative. Investigations indicate also that actual abrasion of concrete by floating ice is very slight.

Climatic conditions are specially severe on Lake Superior, but concrete marine structures which have been in service for several years are reported officially to be in excellent condition. For example, it is stated that in the Marquette breakwater, built 1893-1905, there has been no deterioration of concrete where portland cement was used. In a portion of the work built with natural cement the surface disintegrated to some extent, but this occurred soon after construction and no change has occurred since. Further, at the piers of the Duluth ship canal, built in 1898-1902, there is no raveling, but the pier at Superior (1904-1913) shows some raveling at the water line. This action is attributed to the washing out of part of the cement by the motion of the water before the concrete had set thoroughly, which would produce a weak or lean surface concrete. But as the concrete back of this is of normal character the raveling is not expected to extend. In recent work means are taken to protect fresh concrete from wave action. These piers and the Marquette breakwater are shown in Fig. 5.

Quality of Concrete—That damage from ice and water may be reduced to a negligible factor if the concrete is made with a view to resisting these destructive influences is indicated in a report reviewing experience

FIG. 3—PLACING KEYSTONE AND TOP BLOCKS OF RUBBLE-MOUND BREAKWATER

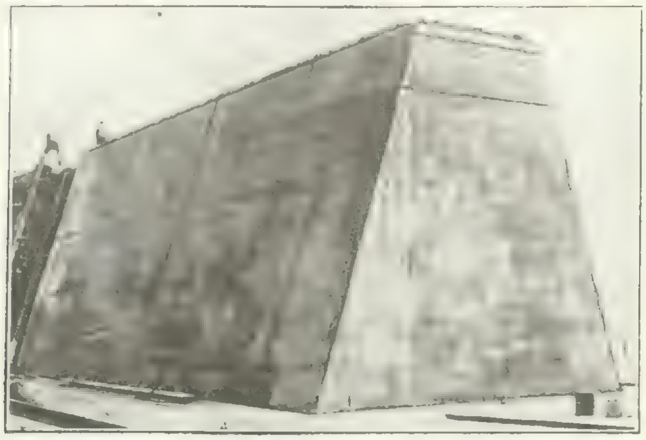


FIG. 1—CONCRETE CAISSON FOR BREAKWATER READY FOR LAUNCHING

with concrete in breakwater and pier construction on Lake Michigan, by J. A. B. Tompkins, principal assistant engineer, U. S. Engineer Office, Milwaukee, Wis. An abstract of this is given below:

The first concrete construction in connection with works of harbor improvement on Lake Michigan was in 1888, when 95 ft. of concrete superstructure was built on the Chicago timber crib breakwater. The outer face of this concrete, which has been exposed to the elements for 32 years, is practically unaffected. The concrete superstructure on the timber crib breakwater at Milwaukee was begun in 1903 and completed in 1909. Quarry screenings were used instead of sand in this work, the proportions being 1:3:6 and 1:2½:5 for cement, screenings and broken stone. The screenings, or "stone dust" consisted of the product resulting from crushing limestone, all of which would pass through a screen with ¼-in. mesh and some was so fine as to pass through a No. 100 sieve. There is considerable disintergration of the superstructure in places, especially at the joints between monoliths. This may be due in part to movements of the timber cribs under heavy wave impact. In some places where superstructure blocks adjoin the damage extends for two or three feet into the blocks. The effect of the wear has been to form rounded surfaces which appear to have reached a sort of equilibrium, the annual damage being small. Such damage as has been done affects the appearance of the concrete more than anything else.

Reinforced-concrete caissons provided with concrete superstructure have been used at Algoma breakwater (1908), Manitowoc breakwaters (1909), Milwaukee south pier (1909-1910), Racine north breakwater (1912-1913), Sheboygan breakwater (1914-1915), Racine south breakwater (1916-1918), Indiana Harbor outer breakwater (1920). All caissons were of 1:2:4 mix, and generally "stone dust" was used instead of sand, the exceptions being that sand was used for the upper five feet of the caissons and for the entire superstructure for Racine south breakwater and entirely for the caissons for Indiana Harbor (see Figs. 4 and 6). At Algoma the outer surface of the caissons near the waterline has been worn to a depth of from an inch or two to six or eight inches. The rate of wear is very small and as there is 14 ft. of solid concrete behind the wearing surface, it may be safely said that the breakwater will last a hundred years, although its appearance is far from satisfactory. There has been less wear at Sheboygan, at Milwaukee south pier, and at Racine north breakwater, but apparently no wear at Racine south breakwater, which is in excellent condition. Many other concrete structures on Lake Michigan have well withstood the action of the elements.

While there are numerous examples on Lake Michigan where concrete made of "stone dust" has given excellent wear with little or no sign of disintegration, all concrete which has seriously disintegrated was made with "stone dust." Where well graded sand was used there has been practically no distintegration. Experiment has shown that concrete made with stone dust will absorb from 30 to 50 per cent more water than similar concrete made with sand. The use of stone dust or quarry screenings for making concrete, which will be exposed to freezing temperatures, is not recommended. The leaner the concrete, the greater the absorption, the percentages of absorption when sand is used being about as follows: 3¼ per cent for 1:1½:3 concrete; 5¼ per cent for 1:2:4; 6⅜ for 1:2½:5; 8⅓ for 1:3:6 and 9⅞ per cent for 1:5:10 concrete.

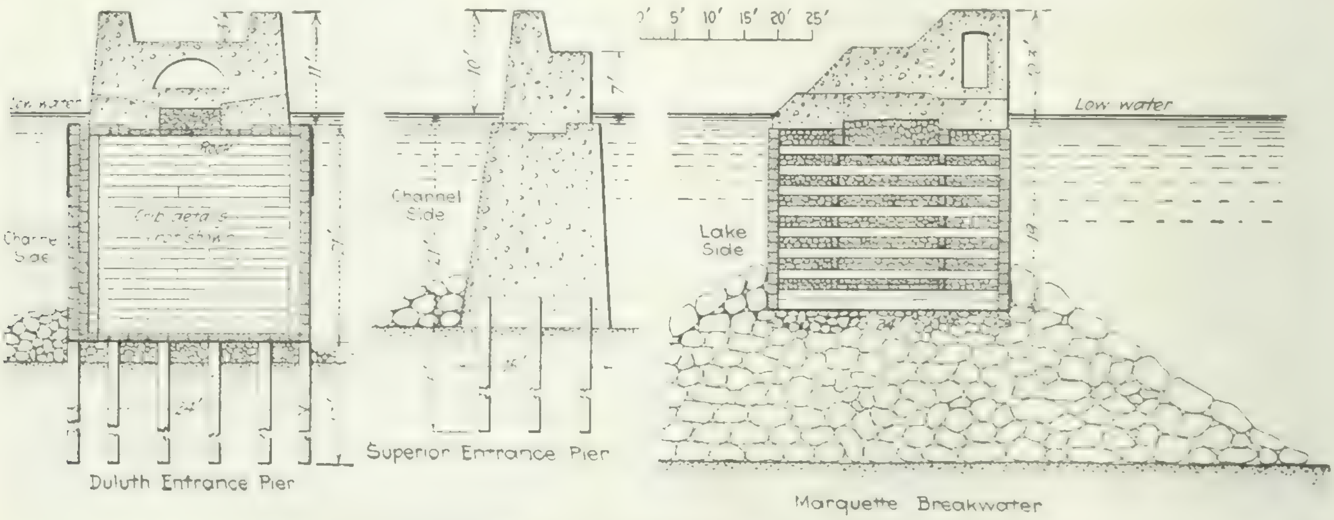


FIG. EXAMPLES OF CONCRETE PIERS AND BREAKWATER

A careful inspection of all concrete harbor work on Lake Michigan leads to the confident belief that with mixes, aggregates and methods now employed no serious disintegration or wear by the elements need be apprehended. When wear has occurred, nothing is involved but the appearance of the structure and this can be restored, if desired, at relatively small cost.

Frost Effect on Concrete—An example of surface disintegration of concrete by frost is shown in Fig. 7, representing a portion of the north breakwater at Racine, Wis. This structure is composed of concrete caissons which are filled with rubble stone to within 3½ ft. of the top, this upper portion being filled with solid concrete. In this case the 1:2:4 mix was made with stone dust, and it has been pointed out above that

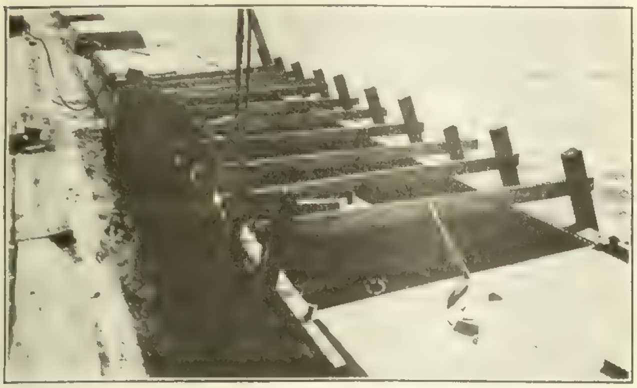


FIG. 6—BREAKWATER OF HOLLOW CONCRETE CAISSON BASE AT INDIANA HARBOR, IND

such concrete absorbs more water and is thus liable to greater surface damage by freezing. High prices of sand are given as one reason for the use of stone dust.

Mr. Tompkins states that while the disintegration may extend to a depth of four or six inches in eight to ten years, beyond that depth the concrete is perfectly sound. In his opinion, the imperfections in the Racine breakwater are no greater or more serious than would exist in a rubble-mound breakwater after a similar length of exposure to wave action. Worse examples may be found, but the injury is usually local rather than general and being superficial the stability of the structure is not impaired or threatened. No repairs to concrete have been made on a large scale but small patch repairs are said to have stood for years.

Quality of Marine Concrete—High quality of concrete, both as to materials and manufacture, is of the utmost importance in marine structures. On this point, the following is an abstract of the report already mentioned, supplemented by a later statement from Mr. Tompkins:

The trouble with concrete, especially when used in marine construction is that its manufacture is not yet standardized, but experience indicates that with intelligent care at each step in manufacture a thoroughly durable concrete may be produced. Poor cement is not a probable cause of concrete failure, as cement manufacture has reached such a degree of excellence that it is rare to find cement which does not come up to the requirements of standard specifications. But the choice of aggregate is most important. Both stone and sand must be well graded and free from dirt. Our best results have been obtained by using a well-graded washed gravel with clean well-graded sand; but entirely satisfactory results have been obtained with crushed dolomitic limestone. "Stone dust" or quarry screenings should never be used in marine construction, at least above the frost line. No mixture leaner than 1:2:4 should be considered for marine construction, and a richer mixture is desirable if the concrete is to be deposited in water.

Mixing concrete with water polluted by sewage is frequently a cause of poor concrete, as evidenced by work at different localities. Where the water is relatively pure, the concrete is apparently of better quality than at localities where large amounts of sewage are discharged into the water. It certainly appears desirable to use as pure a water as may be economically attainable. The tendency has been to make entirely too wet a concrete. The proper water content should be ascertained and mechanical or other means taken to insure only the proper percentage of water in each batch.

It is of the utmost importance that concrete should be thoroughly mixed, and it has been found that with a $\frac{3}{4}$-yd. batch mixer at least twelve turns should be made after the materials have been charged. More turns and consequently longer mixing periods are advisable with larger mixers, but for ordinary work the use of rotary drum mixers of greater capacity than 1 yd. is not recommended. Much of the concrete on the Racine breakwater which has disintegrated (see Fig. 7) was made with a 2-yd. mixer. Contractors and foremen are usually in a hurry, and poorly mixed batches are sure to find their way into the mass unless the work is watched carefully and ample mixing is insisted upon.

Where concrete is to be deposited under water or even near the surface it is our present practice to use a canvas dam or curtain in the form. No attempt is made to deposit concrete in the dry, but the dam gives still water, free from waves and splashing which might wash out the cement. When this precaution has not been taken the result has been in some cases a honeycombed concrete subject to rapid deterioration.

Disintegration of concrete in marine construction is caused principally by the freezing of absorbed water, a contributing cause being erosion by floating ice. It is necessary, therefore, that concrete should be as dense as possible, with hard and fairly smooth surfaces. This requires that the sand and stone must be well graded and of proper quality, that the concrete is thoroughly mixed and that great care is taken in depositing it in the forms. Although the exposed surface should be hard and smooth, such special finish as is obtained in sidewalk work is not desirable. The surface should be made by working fine material to the outside, smoothing with a spade or other suitable tool, and taking care that no stone fragments extend through the surface skin, as all such places form points for the beginning of disintegration.

FIG. 7—FROST AND ICE EFFECT ON CONCRETE BREAKWATER AT RACINE, WIS

Cross Section a Design Factor—An advantage claimed for the rubble-mound breakwater is that it presents a combined sloping and irregular surface to absorb the shock and break up the solid mass of water in the waves, with the further and consequential advantage of reducing the reflex action due to the stoppage of the waves. In breakwaters of this type for the U.S. Government the outer slope is usually 0.66 on 1, or 1 on $1\frac{1}{2}$. It is claimed that with smooth surfaces of the same inclination, the waves would shoot over into the protected area and cause undesirable disturbance. Stepped slopes might check such action by breaking up the solid body of the wave.

At certain places, however, such as harbor entrances, the flat slope would be undesirable on account of the great width of opening required for a channel of given

depth. This is instanced in the breakwater at Great Lakes, Ill., noted above. Concrete structures with such a flat slope for the full height are rarely if ever used and would require a greater cross-section than a structure with more nearly vertical sides and having equal resistive strength. In some cases the narrower structure is desirable or necessary, so that rubble-mound construction is not universally available. Concrete breakwaters have been made for some years with a face slope of about 3 on 1 for the body and a flatter slope for the superstructure, so that the waves generally flow over the breakwater.

It has been stated by General Black that if waves are to be excluded entirely from the sheltered area the breakwater must be high and of very heavy cross-section in order to kill the energy of the waves. In such case the energy is expended partly in throwing the water high into the air and partly in causing downward pressure and scour. If the breakwater is relatively low and with a flat slope, the wave will be tripped and the water thrown downward on and across the structure. This will cause a splash and slight disturbance in the sheltered area, but the wave energy will be dissipated. The rougher the resisting surface the more the energy of the wave will be broken up, but on the other hand the heavier must be the individual blocks and the better must they be bonded together.

Comparative Cost—Direct comparison of cost of stone and concrete construction is not easy, since conditions vary at different points. For the former it has been claimed that the cost of stone rubble-mound construction is less than that of concrete caisson work in shallow water and about equal to the latter in depths of 25 to 30 ft. An engineer who has used concrete extensively considers that the rubble-mound construction as designed by the U. S. Engineers may be cheaper in depths not exceeding 16 ft., but that in depths of 30 to 40 ft., for which breakwaters are now contemplated, the concrete caisson type will be much cheaper and will enable the breakwater to be built in much less time. He estimates that as a very general rule the cost of concrete caisson construction will vary as the depth, while that of stone rubble-mound construction will vary as the square of the depth. On behalf of stone, however, it is claimed that this rule may hold true for quantities but not for price, since the unit price per ton of rubble-mound construction decreases somewhat with the depth, partly on account of the use of a larger percentage of core stone which is of relatively low price, and partly on account of the reduced overhead expense due to the greater quantity. At Great Lakes, Ill., the average cost complete was estimated at $224.50 per lineal foot for the rock mound and $222.25 for the concrete caisson work.

Engineers to Control Forest Fires

The forest fire problem of Minnesota is to be studied by a commission of engineers appointed by Governor Preuss, in view of the frequent and extensive losses of property and life. Premature drainage of land, far in advance of agricultural requirements, with the result of lowering the water table and leaving dry peat bogs, is suggested as one factor in the fires that occur every few years. This suggestion is made by J. R. Stack, in the October *Bulletin* of the Minnesota Federation of Engineering Societies, at St. Paul.

Justifiable Highway Expenditures Determined by Traffic

Percentage of Expenditure for Railway Maintenance-of-Way Basis for Determining Expense Justified for Road Improvement

By N. W. Dougherty
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THERE is a popular fallacy, sponsored by many organizations and individuals, that no matter what the expenditure, it may be justified on the general basis that good roads pay for themselves. My object, in this paper, is to show that this is sometimes true and many times it is not true.

Is there a method by which expenditures may be shown to be justifiable or excessive? The answer is that there is no absolute method, and one may never be developed, but there is certainly some way of balancing one expenditure against another to the end that money may be expended where most needed.

The new federal highway law fixes the federal system at 7 per cent of the total road mileage. This means that in many states 93 per cent of the roads will have to be cared for by the counties and in all the states 93 per cent of the roads must be cared for by the counties and the state. With the appropriation now authorized, the 7 per cent program will not be completed, in many cases, during a period of fifteen years. There will be a large mileage of the federal-aid system that will have to wait until toward the end of the program. In the meantime the traffic must pass over the roads. It is, therefore, time to study well while we are at the beginning of the work. In most states, somewhere between 80 and 90 per cent of the roads will fall to county or township charge. The real problem then is going to be one for the counties and the townships rather than one for the state and nation.

Roads of One County—Let us consider a specific example. In Davidson County, Tenn., 25 per cent of the road mileage is waterbound macadam with carpet treatment, constructed and maintained by the county highway department. Approximately 7 per cent of the total mileage has been designated as state and federal-aid roads. The map shows the weighted average daily traffic for the year on a large number of the main roads. The thickness of the line is proportional to the total number of vehicles passing both ways and the numerals show the average daily traffic for the year.

By taking the average of the counts at adjacent stations and multiplying by the distance between stations, a rough approximation to the total vehicle mileage may be obtained. Counts were made on enough of the minor roads to get an estimate of the average traffic on each road. The total estimated vehicle mileage is as follows:

	Vehicle Miles
Roads on which count was made	77,230
Estimates on main roads where no count was made	7,460
Estimate on district roads	14,600
Total	99,290

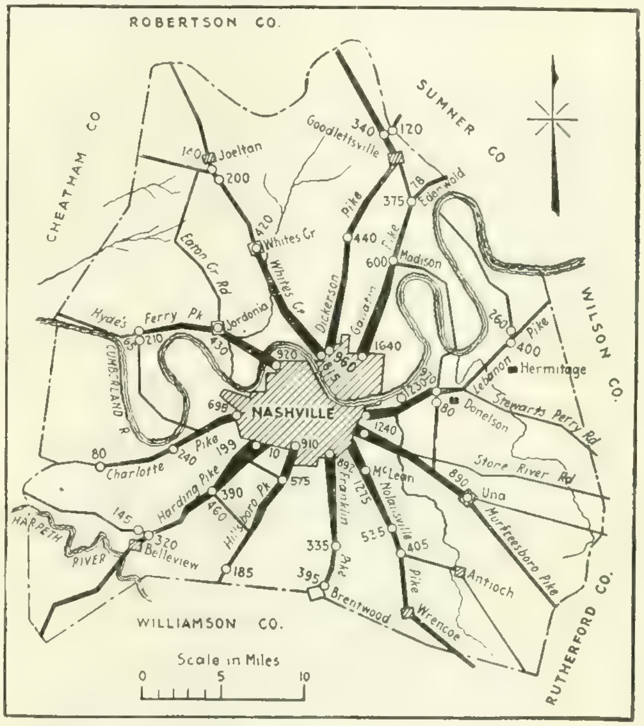
The main roads comprise approximately 25 per cent of the total mileage while the traffic on them comprises 85 per cent of the total traffic. The problem of economical expenditure is, therefore, with the 75 per cent of the mileage carrying the 15 per cent of the traffic.

The county's annual expenditure is about $420,000, or 1.16c. per vehicle mile. The average daily traffic varies from less than 25 vehicles per day to 2,000 vehicles per day. In the summer months the Harding Pike has a traffic of over 3,000 vehicles per day. If the average cost is 1.16c. and the traffic variation is so great, there must be a large range in individual costs. The County Highway Commission estimates that the main roads cost $750 per mile per year, exclusive of interest charge on original investment. Then 2,000 vehicles per day make a vehicle mile cost of 0.103c. 200 vehicles make a cost of 1.03c. and 20 vehicles make a cost of 10.3c. The expenditure on the district roads is less than $750 per mile per year. Half the above amount would give a vehicle mile cost of 5.1c. on the 20-vehicle roads. The investment in the main roads will average $6,000 to $8,000 per mile. If interest on this investment be charged as a part of the annual cost, the above amount should be increased by $300 to $400, making the vehicle mile costs increase accordingly.

Are Costs High or Low?—Is it possible to determine whether these costs are high or low? An approximate solution seems possible. In railway operation 20 per cent of the cost of operation is charged to maintenance of way and structures. In highway work the business of the highway departments is to furnish a traveled way with structures. It would, therefore, seem reasonable to assume that 20 per cent of the cost of operation would be a fair charge for highway costs. Few, if any, accurate costs of operation over the highways have been kept. The average cost of operating an auto or truck over the Davidson County roads will not be less than 10c. and it may be more than 15c. per vehicle mile, (83 per cent of the traffic in the county is motor traffic). Twenty per cent of 10c. is 2c. and 20 per cent of 15c. is 3c. Two to three cents per vehicle mile is not excessive because the public is paying two to five cents per vehicle mile on the toll roads in an adjacent county. If the charge were extortionate the toll roads would be avoided and use made of parallel, though less desirable, routes. This is not saying that the charge is what it should be, because the same or better service can be given for less than 2c. per vehicle mile. A service charge of between 5 and 10c. would be questionable and a charge of more than 10c. would probably drive much of the traffic off the roads.

In determining a fair vehicle-mile expenditure that a highway department may make, due consideration should be given to the saving in cost of operation due to improvement of surface. The difference will be greatest when the change is made from the mud to a hard surface and has been estimated to be as great as 10 to 15c. per ton-mile. The difference in the cost of operation for the various hard surfaces is not known. Engineers have usually assumed that it was not very great and have made their selections of type on other considerations. Suppose the life of a $2,000 automobile to be 100,000 miles, or 2c. per mile; now reduce this to 80,000 miles by a different type of surface and the cost will rise to 2.5c. per mile. Other costs would probably be increased accordingly. On the heavy traffic roads, where the unit traffic costs are low, this item may be the controlling factor in the selection.

Taking the 2 to 3c. as a reasonable vehicle mile expenditure, 2,000 vehicles per day would justify an annual expenditure of from $14,600 to $21,900 per mile; 200 vehicles per day would justify $1,460 to $2,190 per mile, and 20 vehicles per day would justify $146 to $219 per mile. Most of the main roads in the county have 200 or more vehicles per day throughout their whole lengths, which is enough traffic to justify a hard surface. Some of the district roads will have less than 20 vehicles per day, making it difficult to justify enough expenditure to furnish a hard surface. The county commission finds that it will cost about $500 per mile per



TRAFFIC DATA CHART FOR DAVIDSON COUNTY

year to furnish a macadam surface on the district roads. Now $500 per mile per year at 3c. per vehicle mile requires a traffic of 45 vehicles per day. There are probably 70 per cent of the roads in the county which average less than 45 vehicles per day. A larger expenditure than 3c. per vehicle mile must be justified or a smaller amount than $500 per mile per year expended.

Conclusions—It is thus seen that the total budget of $420,000 for this county may be justified, since the average cost is 1.16c. per vehicle mile, but it is doubtful whether all the expenditures on the district roads can be justified. Since the cost is so low on the main roads, the high cost on the district roads is apt to be overlooked. The traffic demands that a sufficient expenditure be made on the main roads. Where the traffic is over 200 vehicles per day, any surface necessary to carry the traffic may be justified, but only that type of surface should be chosen which will make the traffic costs a minimum. When the traffic is between 45 and 200 vehicles per day, enough money may be justified to furnish a surface that will carry the traffic, though the surface may not be of the highest class. When the traffic is less than 45 vehicles per day a high vehicle-mile cost will be necessary or the type of surface must be cheaper than waterbound macadam. It is with this class of road that the large saving in operating cost may come. Ten cents per vehicle mile on ten vehicles per day would justify an annual expenditure of $365. Such a sum can get the traffic out of the mud and place it on a dry surface paved, in many cases, with gravel.

Flow of Fluids Through Commercial Pipe Lines

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This analysis of fluid flow is a condensation of a much more extensive treatment of the same subject by the authors and M. Seltzer, published in the "Journal of Industrial and Engineering Chemistry," Feb., 1922. In that form it was known as "Contribution No. 40 from the Research Laboratory of Applied Chemistry, M. I. T." In the present form it is "Contribution No. 19 from the Department of Chemical Engineering, M. I. T."

THIS paper presents in condensed form the working method recommended by the authors for calculating the quantitative relations between pressure drop and rate of flow of fluids (gases, vapors and liquids) through commercial pipe lines. Those interested in the data from which the curves given were derived, and in a more detailed discussion of many of the more theoretical aspects, are referred to the more complete paper on this subject.

For many years engineers have used some form of the Fanning equation for this purpose. The form often used employs absolute units and is:

$$(1)\quad P = \frac{f w L v^2}{2\,g m} = \frac{4\,f w L v^2}{2\,g d}$$

where P = pressure drop due to friction in lb. per sq.ft.
w = density of fluid in lb. per cu.ft.
L = length of straight pipe in feet.
v = average velocity of the fluid expressed as ft. per sec.
d = actual inside diameter of pipe in feet.
m = hydraulic radius in feet, namely, the cross-sectional area in sq.ft. divided by the wetted perimeter in feet.
g = acceleration of gravity = 32.2 ft. per sec.
f = a variable coefficient, called the "friction factor," *which has no dimensions.*

Usual Methods—In using this equation for a given fluid, engineers obtain the numerical value of the friction factor for the conditions in question from suitable tables or charts showing f as a function of certain variables. Thus, for the flow of air, f is often shown as an hyperbolic function of *diameter only*, as in the familiar Unwin[1] equation. There are some similar equations for steam, but practically no data for other gases, other than the complicated equation of Fritzche.[2] In the case of water, f is shown as a hyperbolic or other similar function of *both velocity and diameter*, and a factor of safety is introduced to allow for the formation of "tuberculations" or growths in the pipe. The variations of viscosity with temperature have been ignored, although they should not be. For the flow of oils having viscosities not widely different from that of water, f is sometimes corrected for viscosity, as well as for velocity and diameter, which necessitates a very complicated treatment.

It is found that empirical equations for f having fractional exponents of v and d can be derived, and the resultant equation combined with the Fanning equation. This is sometimes done, and thus the use of tables of f are avoided. To avoid the use of tables of logarithms for the fractional exponents, flow charts on logarithmic paper have come into vogue for air, water and steam, but no information is given as to their application to other fluids.

One great danger in using these exponential formulas and charts derived therefrom is that most of them were based on experimental data, were not in general highly accurate for a variety of reasons, and at best covered only a comparatively limited range of diameter, velocity and viscosity. Furthermore, use of complicated types of empirical equations for each different fluid has obscured the important fact that the flow of all fluids is essentially a single phenomenon, definitely predictable from the viscosity and density of the fluid in question.

Again, many engineers have not realized that with liquids of medium and high viscosity the flow, instead of being "turbulent" (such as is usually the case for air and water) may be "straight line" (or "viscous"), in which case the equation of flow is given by Poiseuille's law, which is quite different from equation (1). Even where this was known, it was not possible to calculate the relation between pressure drop and rate of flow for all fluids under all rates of flow; first, because there was considerable uncertainty as to which type of motion would prevail; and second, due to lack of reliable data for the numerical value of the friction factor for use in equation (1) when the motion is turbulent. Such data were desired, especially for the flow of oils of medium and high viscosity.

UNITS USED IN THE DIAGRAMS, FIGS. 1 TO 4

D = Actual inside diameter of pipe in inches.
f = Friction factor for the Fanning formula in the form of equations (1), (2) or (3). *The numerical value of f as taken from Fig. 1 may be used in any of the equations in this article, regardless of what units are used for the other terms in the pressure drop equations quoted.*
l = Length of straight pipe in feet, plus equivalent length (in feet) of elbows, etc.
p = Pressure drop as pounds per sq.in.
Q = Flow in U. S. gallons per minute.
s = Sp.gr. of fluid at its average temperature.
v = Average velocity of fluid in ft. per sec.
z = Viscosity of fluid at a definite temperature in "centipoises" (= viscosity relative to water at 68 deg. F.).

Basis of the Recommended Method—The following facts are now well established:

1. By using proper values of f equation (1) can be used for all fluids, regardless of the character of the motion.

2. The value of f in equation (1) for all types of motion is a function of velocity (v), diameter (d), density (w), and absolute viscosity (μ), and to a lesser extent of the surface roughness.

3. Fortunately, however, in pipes of similar roughness, f is not an *independent* function of each of these variables, but only of the ratio dvw/μ. *Therefore, in a given case on the numerical value of f of halving (or doubling) either velocity diameter, or density is the same as that of doubling (or halving) absolute viscosity.* Note: An inspection of equation (1) shows that f has no "dimensions." Hence, it should be a function of variables combined in such a fashion that the combination has no dimensions. From experiments, it was found that f varied with d, v, w, and μ. Taking these four variables in English absolute units, it is seen that the arrangement $\frac{dvw}{\mu}$ is the *only possible combination* in which the units cancel:

$$\frac{(d)\,(v)\,(w)}{(\mu)} = \frac{(ft.)\left(\frac{sec.}{ft.}\right)\left(\frac{lb.}{ft.}\right)}{\frac{(lb.)}{(sec.)\;(ft.)}}$$

4. *For straight line motion* in pipes of all materials, f is inversely proportional to dvw/μ, the proportionality constant being known, at least for very smooth tubes.

5. *For turbulent motion* in all kinds of pipe, the value of f is an *inverse* function of the ratio dvw/μ, but this function must be determined experimentally for pipes of varying degrees of roughness.

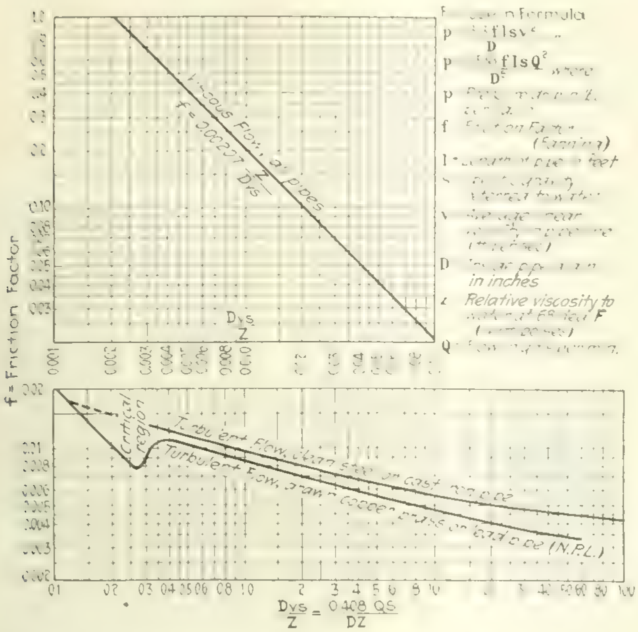


FIG. 1. RECOMMENDED FRICTION FACTORS (f) FOR COMMERCIAL PIPE LINES

These curves are based on the flow of air, steam, water and various oils in pipes of steel, wrought iron, lead, copper and brass. As compared with the very limited range covered by the ordinary tables of friction factors, the extreme range of diameter, velocity, viscosity, and density covered by the data used is very great, as is shown by the following:

Variable	Range
Inside diameter	Capillary tubes to 36 in. pipes
Velocity	0.1 to 100 ft. per sec.
Viscosity	0.02 to 3,000 times as viscous as water at 68° F.
Density	0.075 to 62.3 lb. per cu.ft.
Friction factor	0.003 to 6.0.

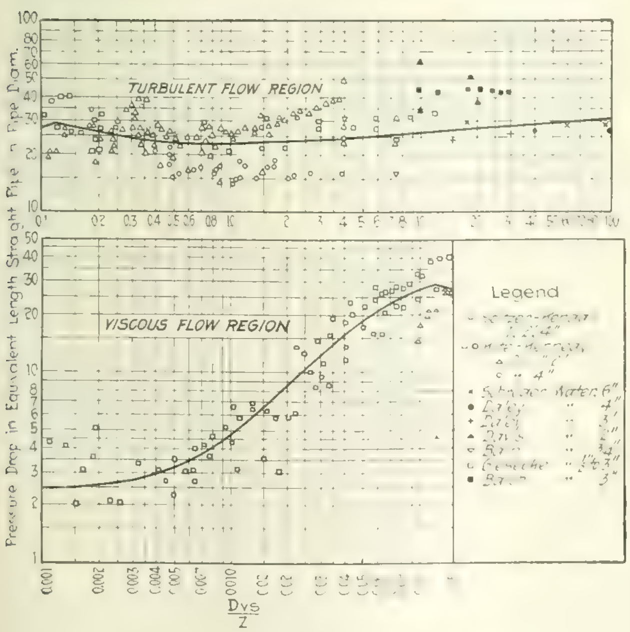


FIG. 2. ELBOW CONNECTIONS FOR COMMERCIAL PIPE

Balch, Univ. Wis. Bull., Eng. Series, 7, No. 3, p. 253.
Giesecke, Univ. Tex. Bull., Oct. 20, 1917.
Daly, Schoder and Bain, Cornell Civ. Eng., 20, p. 107 (1911-12).
Davis, Univ. Wis. Bull., Eng. Series, 6, No. 4, p. 115.

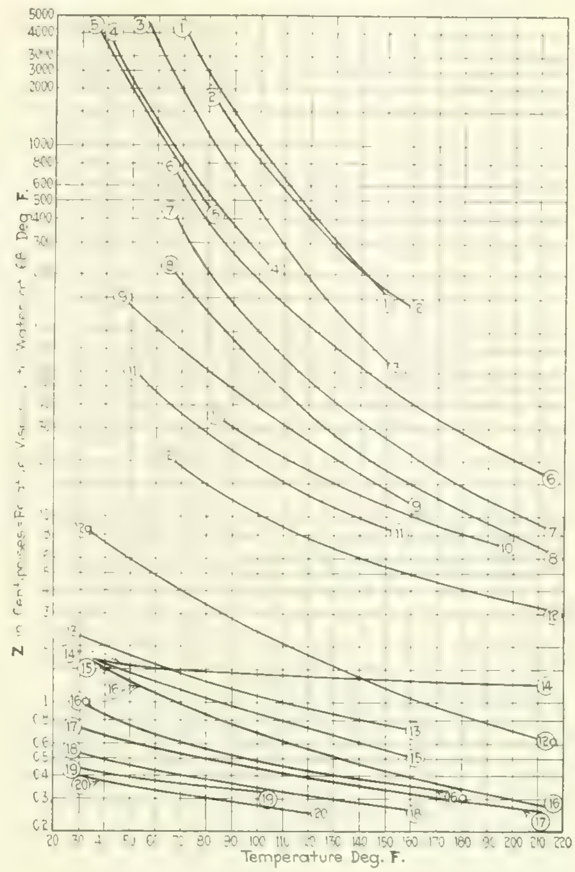


FIG. 3. TEMPERATURE VISCOSITY CURVES FOR TYPICAL LIQUIDS

1. Mexican petroleum (Mex. Pet. Co.).
2. Meprolene (Parks-Cramer Co.).
3. California heavy crude, 15.2° Bé. (Standard Oil Co.).
4. Castor oil (Smithsonian Tables).
5. Glycerol (Smithsonian Tables).
6. Mobiloil B (Vacuum Oil Co.).
7. Mobiloil A (Vacuum Oil Co.).
8. Texas engine oil (Vacuum Oil Co.).
9. Olive oil (Smithsonian Tables).
10. Linseed oil (Smithsonian Tables).
11. Cal. Light Crude, 24.4° Bé. (Standard Oil Co.).
12. Nonviscous Neutral (Vacuum Oil Co.).
12A. Amyl alcohol (Opt. inactive) (Smithsonian Tables).
13. Mercury (Smithsonian Tables).
14. Turpentine (Smithsonian Tables).
15. Ethyl alcohol (Smithsonian Tables).
16. Water (Smithsonian Tables).
16A. Benzene (Smithsonian Tables).
17. Octane (Smithsonian Tables).
18. Heptane (Smithsonian Tables).
19. Carbon disulphide (Smithsonian Tables).
20. Hexane (Smithsonian Tables).

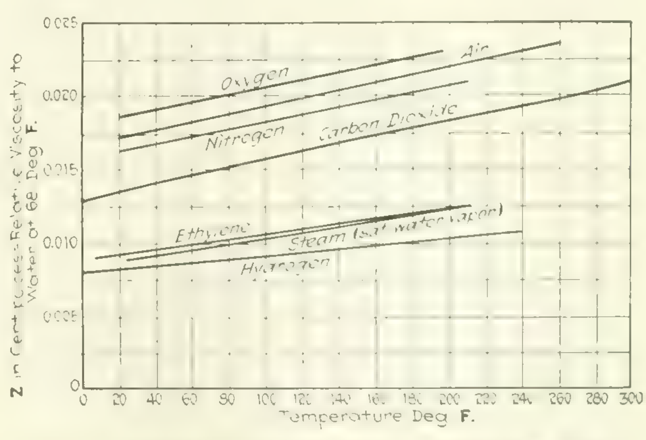


FIG. 4. TEMPERATURE VISCOSITY CURVES FOR GASES

Some or all of these facts were predicted long ago by several writers[3] who presented highly mathematical papers on this subject. However, their significance has not been appreciated by engineers, nor have they been verified experimentally over any considerable range of velocities and pipe sizes, until very recently. In 1912 Blausius[4] gave a good review of the theory, recalculated the data of Saph and Schoder[5] for water in *smooth* brass and galvanized-iron pipes and the data of Nusselt[6] for compressed air, and showed that f was a function of dvw/μ, *as required by theory*. This paper seems to have been almost completely overlooked outside of Germany.

In 1914 Stanton and Pannell[7] published the results of experiments made by them with air and water flowing in *smooth* tubes of drawn copper and brass, ranging in size from 0.713 to 12.62 cm. This work substantiated the prediction that for both types of motion, f is a function of dvw/μ, and they presented a chart showing numerical values of f for an equation similar to equation (1), employing c.g.s. units. In 1916 the National Physical Laboratory published additional[8] data for air and water, and a little for shale oil, again using tubes of drawn copper and brass. In 1920 the Kinney Mfg. Co. of Boston issued a pamphlet[9] based on the N.P.L. data for smooth pipes, using different units, and Preston[10] published a paper summarizing their results.

Several years ago the Research Laboratory of Applied Chemistry at the Massachusetts Institute of Technology began a series of experiments using primarily liquids of high viscosity in *commercial steel pipe* with the purpose of filling in the gaps in the existing data for pipes of a commercial degree of roughness. (For details of experiments, see Contribution No. 40, etc., mentioned in sub-title to this article.) The results of these experiments, together with those obtained by recalculating the available reliable data of many experiments (on water, oil, steam, air, etc.) made elsewhere, form the basis of the recommended curves (Fig. 1) for f as a function of the other variables.

As noted above, the value of the friction factor (f) in the Fanning equation can be calculated in the usual manner from experimental observations on drop in pressure, length of pipe, density of fluid, average velocity of fluid, and diameter of pipe. It has been pointed out that f for both types of motion should be a function of four variables grouped as dwv/μ.

For the practical application of the recommended method of treatment the authors find it desirable to make use of convenient engineering units, rather than absolute English units, on which the discussion has thus far been used. This is especially true in the case of viscosity, where the absolute units, pounds per second per foot (or its equivalent, second poundals per square foot) are difficult to visualize. The accompanying table gives the units used in all charts.

Since the above changes were made in the units for the variables determining the friction factor, similar changes were made in those units appearing in equation (1) and the form equivalent to (1) using the new units is as follows:

$$p = \frac{0.323\ flsv^2}{D} \qquad (2)$$

Sometimes it is more convenient to use discharge in gallons per minute (Q) instead of velocity in ft. per sec., giving

$$p \quad \frac{0.0538\ flsQ}{D} \qquad (3)$$

where s = specific gravity.

z = absolute viscosity in centipoises (= relative to water at 68° F.)

D = actual pipe diameter in inches.

The upper line in Fig. 1 is recommended for use for the flow of all fluids in "commercially smooth" pipes, such as standard steel pipe, while the lower line applies to "very smooth" pipes, such as drawn brass, copper or lead pipes, or glass tubes. Obviously, values still higher than those given by the upper line must be used for corroded or tuberculated pipes, or conduits lined with pebbles, or those with linings which appear quite rough to the naked eye. As shown in the more complete paper on this subject, the ordinary hydraulic data are quite discordant for reasons which are readily explainable; however, the widely quoted values of f for "clean cast iron pipe" taken from the Fanning tables check fairly well with the recommended line.

Recommended Methods of Calculation—A. General Procedure for Calculating Pressure Drop in Any Pipe Line: With the data and charts previously presented the calculation of the pressure drop through a pipe line under any specified set of conditions is a very simple matter. The steps involved may be outlined as follows:

1. Calculate the value of Dvs/z for the fluid and pipe in question.

2. By referring to Fig. 1, find the value of f which corresponds to this value of Dvs/z, using the curve corresponding to the degree of roughness of the pipe in question.

3. Usuing the same value of Dvs/z refer to Fig. 2 for the equivalent length of straight pipe corresponding to each 90 deg. elbow. Multiply this by the number of elbows, convert the correction from pipe diameters into feet, and add to it the length of *straight* pipe. (Note that two elbows very close together, or a return bend, have less effect than two elbows some distance apart.)

4. Insert this value of f in the modified Fanning equation $\left(p = \frac{0.323\ flsv^2}{D}\right)$ and obtain the pressure drop directly. *This method and this formula should be used regardless of whether the liquid is in viscous or turbulent motion.*

B. General Procedure for Calculating Other Quantities: The foregoing procedure must, of course, be slightly modified in case the permissible or available pressure drop is known and it is desired to calculate any one of the other five quantities which may be unknown in a given practical problem. This requries only simple rearrangements of the equations and the use of the trial and error methods which are obvious to any engineer, though they are discussed more in detail in the original article.

C. Auxiliary Data (Elbow Losses, Viscosity and Specific Gravity. 1. Elbow Losses. Fig. 2 shows experimental values obtained mostly in this laboratory, for the "equivalent length" of standard 90 deg. elbows plotted against Dvs/z, and it is seen that the equivalent length averages about 30 diameters in the turbulent range (i.e., for values of Dvs/z greater than 0.12), while for lesser values of Dvs/z in the viscous flow region, the equivalent length decreases, finally reaching a value little greater than the *actual* length of the elbow.

2. Viscosity: For use throughout this paper viscosity (z) is expressed in centipoises—which may be more readily visualized as the viscosity relative to water at 68 deg. F., at which temperature water has a viscosity of one centipoise. Data in the literature are frequently expressed in poises and these results should be multiplied by 100 to give the viscosity in centipoises.

For many definite chemical compounds entirely satisfactory viscosity data are available in the literature, and data for a number of these and for some commercial oils are presented graphically in Fig. 3. For most commercial purposes, however, it is desirable to make an independent determination of the viscosity of the fluid. To determine this directly in absolute units is difficult and time consuming, but it is possible, for liquids that are distinctly more viscous than water, to employ one of the standard instruments familiar in the oil trade, such as the Saybolt viscosimeter, which measures the time of efflux of a given volume of liquid. A chart for converting these observed times into true viscosity in centipoises is given in the more extended article and elsewhere.

Since the same method of calculation is applicable to most problems involving the flow of gases, data are also appended (Fig. 4) for the viscosity of a number of common gases, including steam. It will be noted that whereas the viscosity of liquids decreases rapidly with increase in temperature, the viscosity of gases *increases*. It is also important to remember that the viscosity of gases is practically independent of the *pressure*, though of course the lat-

ter factor does affect the density, s, in direct proportion, and hence changes the value of Dvs/z, as would be expected.

3. Specific Gravity: The value of the specific gravity, s, should be expressed in units relative to water at 39 deg. F—in other words, it is equivalent to the true density in grams per cubic centimeter.

To convert true Baumé readings to specific gravity use the formula $s = \dfrac{140}{130 + Bé}$ for liquids lighter than water.

The density of liquids is usually known with fair accuracy, and the density of gases can be calculated with sufficient accuracy for practically all purposes by using the formula $s = \dfrac{0.001496\, p_0\, M}{t + 460}$ where M is the molecular weight, t the temperature in degrees F., and p_0 the *absolute* pressure in lb. per sq.in. In dealing with gases, care should be taken to use an *average* value if the pressure drop through the line is enough to cause appreciable variations in the density.

D. Limitations of the Recommended Method of Calculation: The data and methods of calculation given in this article cover substantially the entire field of the flow of all fluids, including gases and dry vapors, through commercial pipe lines. There are, however, a few exceptions which should be carefully noted before attempting to use the formula in certain special cases. These may be noted as follows:

1. The method is not directly applicable to the flow of gases where the drop in pressure along the pipe line is more than 10 per cent or 15 per cent of the final *absolute* pressure, because the density and velocity of the fluid is thereby changed. If, however, *average* values are used for the density and velocity, instead of the initial or final values, this formula may be used for pressure drops up to 40 or 50 per cent without serious error.

2. The method is not applicable to flow through short sections of pipe opening into large chambers where the entrance and exit losses are appreciable in comparison with the friction losses through the pipe. These losses become inappreciable when the pipe is more than 1,000 diameters long, and may generally be neglected for approximate calculations for lines longer than 300 diameters. For shorter tubes the reader is referred to the recent comprehensive treatment of Herschel.[11]

3. The method is not applicable to the flow of semi-solid plastic materials, such as asphalt, clay suspensions, very viscous, colloidal solutions, etc., where the laws of flow are modified by the tendency of the material to behave like a solid under certain conditions.

4. Precautions must be observed, and highly accurate results cannot be expected in cases: (a) where the pipe is badly corroded or tuberculated, and the apparent value of f may increase to double that given in the formula, due partly to a decrease in the effective cross-sectional area; (b) where a hot oil is passing through a pipe line in *straight line* flow, and the existence of a large temperature gradient from the inside to the outside makes accurate calculations practically impossible; and (c) where there is any tendency to precipitate out solids (such as paraffin wax) on the walls or in the bottom of the pipe lines.

With these exceptions it is believed that the recommended method of calculation is applicable with an entirely satisfactory degree of accuracy to all commercial problems involving the flow of fluids through pipe lines.

Illustrative Calculations—To illustrate the practical utilization of the foregoing charts and tables, a typical example (calculation of required pressure drop) follows:

Example: It is desired to transmit 20 U. S. gal. per min. (686 oil bbl. of 42 U. S. gal. each per 24 hr.) of a very viscous oil at 70 deg. F. through a standard 6-in. steel pipe line. What will be the pressure drop as lb. per sq.in. per mile?

Data: The oil at 70 deg. F. has a time of 9,050 sec. in a Saybolt Universal viscosimeter and a gravity corresponding to 15.2 deg. Bé.

Solution: Using any convenient table of pipe diameters, one sees that $D = 6.07$ and $D^2 = 36.78$.

Since the average velocity $= \dfrac{0.408\ Q}{D^2}$

$$v = \frac{0.408 \times 20}{36.78} = 0.222 \text{ ft. per sec.}$$

From a viscosity conversion chart it is seen that the value of z/s, corresponding to a time of 9,050 Saybolt seconds, is 1,990.

Hence the numerical value of $\dfrac{Dvs}{z} = \dfrac{607 \times 0.222}{1{,}990} =$ 0.000677 and the value of f corresponding (Fig. 1) is 3.06 (extrapolation made by multiplying ordinates and dividing abscissae scales by 10).

The specific gravity at 70 deg. F. $= \dfrac{140}{130 + 15.2} = 0.964$.

The value of p is figured from the modified Fanning equation

$$p = \frac{0.323\, f\, l\, s\, v^2}{D}$$

$$= \frac{0.323 \times 3.06 \times 5{,}280 \times 0.964 \times (0.222)^2}{6.07}$$

$$= 40.8 \text{ lb. per sq.in.}$$

Thus it is found that this oil flowing at an average velocity of 0.222 ft. per second gives a pressure drop of 41 lb. per sq.in. per mile.

Acknowledgment—In conclusion the writers desire to repeat in briefer form their acknowledgment of the helpful assistance of Drs. W. K. Lewis and W. H. Herschel, and Messrs. Seltzer, Kendall, Kite, Kennedy, and Danforth; and also of the co-operation and financial assistance furnished by the National Tube Co., the Hammel Oil Burning Equipment Co., the Parks-Cramer Co., and The Texas Company.

REFERENCES IN THE TEXT

[1]Unwin "Compressed Air Transmission."

[2]Fritzche, Mitteilungen uber Forschuangsarbeitun, 60.

[3]Stokes, Math. and Phys. Papers, Vol. 111, p. 17, (1850); Reynolds, Phil. Trans. Roy. Soc., p. 935, (1883); Helmholtz, Wissenschaftliche Abhandlungen, Vol. 1, p. 158 (1873); Rayleigh, Phil. Mag., Vol. 48, p. 321 (1899); see also Lamb, Hydro-Dynamics of Fluids, 3rd ed., Camb. Univ. Press, (1916).

[4]Blausius, Z. V. D. I., 56, 639-643, (1912).

[5]Saph and Schoder, Trans. A. S. C. E., 51, (1903).

[6]Nusselt, Mitteilungen uber Forschungsarbeitein, 44,

[7]Collected Researches, National Physical Laboratory, Teddington, England, Stanton and Pannel, Vol. 11, (1914).

[8]Collected Researches, National Physical Laboratory, Pannel and Higgins, Vol. 13, (1916).

[9]Friction Pressure Loss in Oil Pipe Lines, The Kinney Mfg. Co., Boston, Mass.

[10]A. C. Preston, The Flow of Oil in Pipes, Chem. & Met. Eng., Vol. 23, No. 13, (Sept. 29, 1920).

[11]The Flow of Liquids Through Short Tubes, A. S. C. E., Vol. LXXIV, p. 527 (1921).

Forest Products Tests Reach Half Million

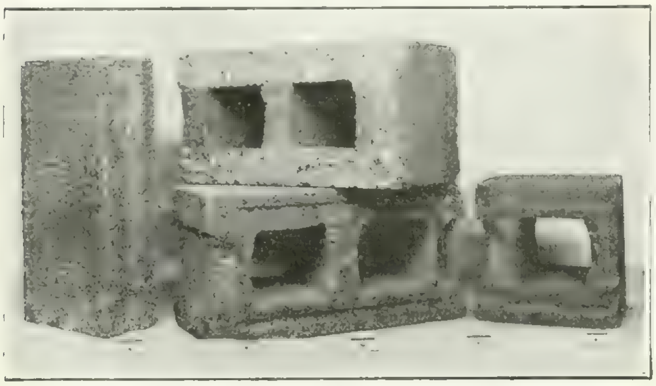
More than half a million tests of the mechanical properties of native wood have been carried out at the Forest Products Laboratory, Madison, Wis., in the 12 years since the work was initiated. Specimen 500,000 was of white ash grown in Bennington County, Vermont, and it was broken by impact with a 100-lb. hammer. The insert shows the felling of the white ash tree from which the specimen was taken with other test pieces needed in a study of the influence of growth conditions on the properties of wood, now in progress at the laboratory. The markings of the particular specimen shown indicate that it came from the south side of the tree, at a distance of 2 in. from the center, and between 12 and 16 ft. above the stump. The care used in marking this piece is typical of the care with which all specimens are marked in order to relate test data with growth conditions.

Fire Tests Favorable to Cinder Concrete Block

Underwriters Laboratories Report that the Straub Block Has Exceptional Structural and Fire-Resisting Qualities

AS A result of a series of fire tests made last summer, the Underwriters Laboratories has issued a report favorable to the structural and fire-resisting qualities of the cinder concrete block made under a license of F. J. Straub of New Kensington, Pa., the holder of U. S. patent No. 1,212,840. These blocks are made in the usual block machines in standard 8 x 8 x 16-in. and 8 x 8 x 8-in. hollow shapes and standard 4 x 8 x 16-in. and 8 x 8 x 16-in. solid shapes of a mixture of one part portland cement and six parts crushed cinders. The 8 x 8 x 16-in. hollow shapes weigh about 32 lb. each.

The tests made were the standard fire tests conducted by the Underwriters Laboratories; that is, a straight fire exposure of 3 hr. 42 min. on a 10x11-ft. panel, a fire and hose stream test on the wall after being subjected to fire test for 1 hr., impact test of the panel, and absorption and compression tests of the individual blocks.



TYPICAL CINDER CONCRETE BLOCKS USED IN TEST

In the description of the test block the report reads:

The cinders which were stated to be ordinary run-of-boiler product resulting from the more or less complete burning of soft coal were a mixture of material of varying grades of fineness ranging from dust that would pass a 100-mesh sieve to pieces that would just pass a ⅜-in. screen. Approximately 40 per cent by weight passed a 20-mesh screen. The presence of a considerable amount of unburned carbon was apparent on visual examination. Chemical analysis showed the presence of sulphur amounting to about 0.7 per cent of the dry weight of the cinders and of coal and coke amounting to between 18 and 19 per cent.

The 700 blocks examined in the Chicago freight house after shipment from York, Pa., were undamaged except in minor particulars. The blocks were of a dull slate gray color and of a rough pitted texture characteristic of lean cinder concrete. (See view.) The particles of cinder aggregate appeared to be completely covered by the cement. Rough handling of the dry blocks caused the separation of small particles from the surfaces, but no ordinary rough usage caused breakage. Nails were driven into the blocks without difficulty and without causing spalling, chipping, or cracking.

As a result of the tests, the report makes the following conclusions:

Fire Retardant Properties—Straub cinder concrete blocks constructed of the materials and by the methods described in this report, can be employed for the construction of exterior or interior walls, bearing or non-bearing, which when exposed to fire on either side will prevent the passage of flame through the walls and function as a barrier to the spread of fire by heat conduction for at least 2½ hours. Application of a hose stream to either side of the wall during the first hour of fire exposure will not seriously impair its fire resistance.

No flame passage occurred during the fire endurance test and no through openings were found. The critical temperature of 300 deg. F. was reached on the unexposed face at 2 hr. 58 min.

Practicability—The blocks may be shipped in bulk without material injury. They may be handled without difficulty and installed rapidly by any competent bricklayer using ordinary tools. Each of the two 10 x 11-ft. test walls erected in the laboratories was completed in about 2½ hours.

Durability—The blocks are capable of withstanding long-continued exposure to weather conditions without material deviation.

Specimen blocks were subjected to rather extensive series of tests involving saturation, freezing, thawing and drying. No visible deterioration was caused by any of these tests. Compression tests made on blocks subjected five times to saturation, freezing and thawing, and then three times to saturation, and drying, showed an average crushing strength of 750 lb. per square inch and a minimum of 580 lb. per square inch of the gross sectional area. These valves may be compared with the average of 815 lb. per square inch and the minimum of 650 lb. per square inch the case of blocks that had not been saturated. It is believed that these differences are not significant in view of the characteristic variations in compressive strength commonly shown by tests of concrete products.

Strength—The strength of the blocks is sufficient to warrent their use in bearing or non-bearing walls, within the limitations commonly recognized as applying to materials of this character.

In general concrete blocks are considered suitable only for buildings of moderate height and with types of floor construction and of occupancy that will impose loads on the walk well within safe limits for Straub blocks.

It is believed that there are not thus far any generally accepted specifications regarding the crushing strength of cinder concrete blocks. The building code recommended by the National Board of Fire Underwriters states that the average compressive strength for concrete blocks when tested with the cells vertical, shall be not less than 800 lb. per sqare inch. The blocks forming the subject of this report had an average crushing strength of 815 lb. per square inch.

The effects of the impact test were purely local.

Uniformity—The blocks can be produced commercially with the degree of uniformity sufficient for the purposes for which the material is intended.

The dimensions of the blocks are determined by the dimensions of the forms in which they are cast. The density and the compressive strength are subjected to variation within rather wide limits. In the case of the blocks employed in the examinations and tests described in this report, all being the product of the same plant, examination of 12 blocks showed weights varying from 16 to 25 per cent. Compression tests showed ultimate crushing strength varying from 650 to 1,140 lb. per square inch of gross sectional area. The cinders employed in the mixing of the concrete were of rather inferior grade with 18 to 19 per cent combustible material, the presence of unburned coal or coke being evident on visual examination. Approximately 40 per cent by weight of the cinders passed a 20-mesh sieve. The results of the tests made on the blocks employing this inferior aggregate and a rather small proportion of cement, were so favorable, notwithstanding the variation in some important properties, as to justify the opinion that the variations noted are within permissible limits.

Cleaning a Mixing Conduit of Lime Deposits

Hard Material in Mixing Conduits of St. Louis Plant Disc Harrowed Then Removed by Flushing Into Settling Basins

By C. M. Daily

Engineer in Charge, Supply and Purifying Section, Water Division, St. Louis, Mo

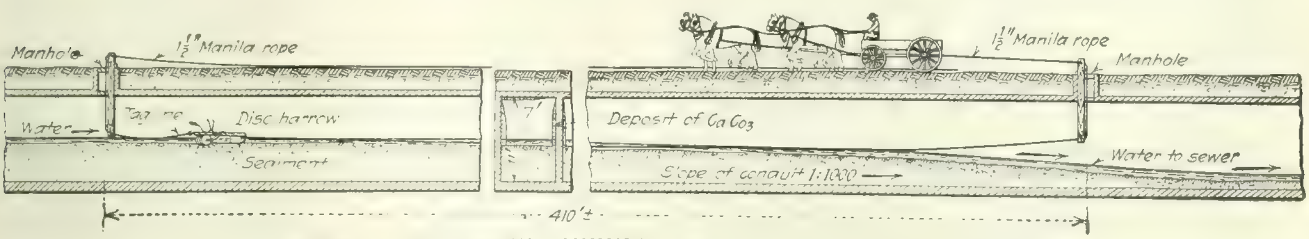
HARD deposits of calcium carbonate in the long mixing conduits of the St. Louis water purification plant were removed in April by disc harrowing and flushing after seven years' operation. The Water Department commenced to use lime and sulphate of iron for clarifying the water in 1904. Milk of lime and a solution of iron were first added to the water in the tunnel before reaching the pumps; but on account of lime deposits in the pumps and discharge pipes the point of application was changed to the outlet of the delivery well.

In 1915 a grit chamber and mixing conduit were built. The grit chamber has a cross-sectional area of over 800 sq. ft. and the velocity of the water through it is less than 0.3 ft. per second for a period of 7.4 minutes, which allows all of the heavy particles that will not pass through a 200-mesh sieve to deposit in its hopper bottoms. The water passes from the grit chamber into the mixing conduits, where milk of lime is now added. The mixing conduit of four compartments, rectangular in section, each 7 ft. wide, 11 ft. high and 2,388 ft. long, are arranged to operate in series or in parallel as desired.

A few months after putting the conduit in service an inspection was made and the west section was found to contain 2 ft. of soft mud on the bottom and a small amount of lime deposit on the sides. The accumulation on the bottom did not increase much in depth but the deposit of calcium carbonate on the side increased and after attaining a thickness of 6 to 12 in. would fall from the sides in heaps and remain undisturbed by the flowing water. This condition continued into the two western sections, which had been operated in parallel for the past two years, until last April, when the depth of the deposit was 5½ ft. on the north end of the west section and 4½ ft. at the north end of the adjacent one; the depth at the south end of both sections was about 3 ft. The surface of the bottom was very uneven, especially near the north end where heavy deposits fell from the side walls. The material was cemented together to such an extent that it could not be shoveled without first loosening it with a pick. The other sections contained only 18 in. of soft deposit on the bottom and very little on the side walls.

Cleaning Methods—The two western sections were taken out of service last April and the work of cleaning was commenced. About 200 ft. of the north end of the west section was cleaned by hand. The material was loosened with picks so that it could be shoveled into wheel barrows, in which it was wheeled to an opening at the north end, hoisted by means of a steam derrick, dumped into wagons and hauled away. This hand work was expensive and the next 150 ft. was cleaned by shoveling the material into water jets discharging into one of the settling basins, which was cleaned later by the usual method of flushing and scraping.

While this work was going on experiments were made in flushing and loosening the material by playing a hose on it, by men working with shovels stationed 15 to 20 ft. apart and by plowing. All of these methods were effective, as the water flowing 6 to 12 in. deep washed the loose material away. For loosening the material by plowing a disc harrow was employed. The tonnage was removed, runners were placed in front and the harrow was pulled through the conduit by teams on top, by means of a rope passing over pulleys arranged in frames at each end of a 410-ft. division of the conduit, the teams traveling in the opposite direction to that of the harrow. A tag-line on the harrow served as the pulling line on



METHOD OF CLEANING MIXING CONDUITS WITH DISC HARROW

the return trip. Two men rode the harrow and adjusted the discs to suit the character of the material encountered. The flushing water was maintained at a depth of 12 in., flowing perhaps 4 ft. per second, which was sufficient to transport the material to the 24-in. sewer at the south end of the conduit. The work was begun at the south end and each division was harrowed until the depth of the deposit was reduced to about 9 in. when the next division was treated in like manner. Both sections were cleaned by this method except the 350-ft. stretch at the north end of the west section which was cleaned by hand. It is doubtful if the harrow would have been effective on the material encountered there owing to its hardness. About 380 cu.yd. of material was removed by hand at a cost of $2,199, and 2,870 cu.yd. by flushing and harrowing at a cost of $1,201. The amount of water used for flushing is estimated at 10,000,000 gal., costing $124.

Distribution of War Surplus Material

Every effort is being made by Senator Townsend, of Michigan, to prevail upon the Committee on Military Affairs to report favorably his bill providing for the distribution among the states of surplus war material so that Congress can pass the measure without delay. The plan of distribution provided in the bill would give to the states surplus material valued at $1,000,000,000 on the basis of population, and it would cost the states practically nothing. The Military Affairs Committee has had the bill before it since April 20, but, up to this time, has failed to make a report.

Lost Time in Construction—4

Management Delays

Interruption of Operations—Poor Utilization of Time Worked—Plant Delays—Service Delays—Delays Due to Poor Direction

By C. S. Hill
Associate Editor, Engineering News-Record

Fourth of a Series of Four Articles

IN ENUMERATING the causes of lost time in construction, brevity is gained by grouping a number of the lesser causes under the heading "management." Such a classification is arbitrary, because in a broad sense all lost time is due to industrial mismanagement. Planning the operation; scheduling progress; selecting, operating and maintaining equipment; directing the supply of materials; directing employment; standardizing practices; controlling costs and performance; and developing organization morale and proficiency constitute management as it is here assumed to be a cause of lost time.

It has to be made clear at the beginning that lost time, as it may be involved in the procedures named, is due (1) to interruption of operations and (2) to poor utilization of the time worked. A plant breakdown, for example, interrupts operations while poor plant co-ordination reduces the output in a unit of time. Time is wasted as effectually by inefficient methods or plant as it is by actual interruption of work, but there is a marked distinction between the two causes. Correction in the first instance puts more "days worked" into a year, while in the second, the "days worked" are merely better utilized. The distinction being made, lost time due to actual interruptions, will be considered first.

Management Delays Characterized—Lost time due to management is the cumulative result of many small delays. In the aggregate it is comparable with the time lost through winter idleness and by rain and mud delays. A schedule of the various kinds of management delays helps to make the situation plain. It is as follows:

1. Plant Delays:
   (a) Interruption of operations by plant breakdowns; (b) time lost shifting plant units on the job; (c) time lost waiting for other parts of the plant.
2. Service Delays:
   (a) Engineering restrictions on the kinds of materials that may be employed; (b) failure by producers to make deliveries as required; (c) inadequate railroad transportation facilities.
3. Labor Delays:
   (a) Interruption of operations by (1) strikes and (2) accidents; (b) seasonal unemployment.
4. Delays of Direction:
   (a) Faulty construction practices; (b) inadequate planning of operations; (c) poor engineering co-ordination and co-operation; (d) poor contracting direction.

This schedule is by no means exhaustive. It, however, includes the leading kinds of delays in the class being considered which interrupt construction operations and all that can well be considered in the space limits of an article.

Plant Delays—Plant delays—machine breakdowns, moving equipment and waiting by one unit for another—are commonly assumed to be greater than they really are. Of the 35 per cent lost time on highway work in Iowa in 1921 plant delays of all kinds contributed only 3.65 per cent and most of this was time lost shifting equipment on the job.

Persistent improvement of equipment design in recent years has done much to decrease the frequency of breakdowns. Most machines now produced by the larger manufacturers show remarkable improvement compared with practice even five years ago in simplicity, workmanship and materials and general sturdiness of design. It is common knowledge of those who know the manufacturers thoughts that this advance would have been greater except for commercial considerations. It has been impossible to put into general equipment the quality demanded for the most economic and reliable service and produce it at a price that contractors generally were wiling to pay. It is almost the first task, therefore, in reducing plant delays to

> 1. Express the worth of quality in equipment design and construction in terms of increased service so that contractors may have undisputed evidence that extra strength and durability is worth the greater cost.

Manufacturers generally have done less toward standardizing equipment than they have toward improving its quality. This is natural. The whole practice of machine design has been in a state of flux. Within limits, it is also wise. Any effort at standardization which might discourage invention and improvement would be disastrous to progress. On the other hand, it would be quite possible and certainly advantageous to standardize on sizes or capacities. An excellent example is the work done by the Mixer Manufacturers Association in settling on a few commercial sizes of concrete mixers and adopting a rule for expressing size. The second method of seeking to reduce plant delays follows:

> 2. Determine the limits and methods of possible standardization of construction equipment to facilitate repairs and to reduce the danger of mistakes in operation.

Machine breakdowns, or shutdowns for repairs, are a direct function of plant selection, operation and maintenance. If well built, sturdy machines are selected, if they are handled by skilled operators and if the maintenance is good, experience has shown that breakdowns will be a rare occurrence. The inference is obvious.

> 3. On any plant operation of magnitude a competent mechanical superintendent is required.

With all the mechanical care that can be given equipment, however, accidents will occur and operations will be interrupted particularly if the machine which breaks down is a link in a chain of equipment required for a single construction process as for example, would be the pump supplying water to a concrete roadbuilding outfit. In case of equipment breakdown, lost time is reduced:

1. By having a stock of replacement parts and a repair car or repair truck outfit ready to restore the machine to working condition.

2. By having duplicate plant, or important plant units, which can be thrown into service the moment failure occurs.

These are not extravagant precautions. In digging the Culebra cut of the Panama Canal machine shops mounted on cars were highly profitable in keeping the big fleet of steam shovels in repair. One western road contractor always has an extra paving mixer where he can swing it into action in an hour or two in case of a bad breakdown of the regular paver, and his pumps for water supply are installed in duplicate. A large concrete building contractor of Chicago commonly installs twin materials handling, mixing and hoisting outfits, each designed for considerable overload, so that if one unit breaks down the other can be speeded up and nearly maintain the normal output.

While individual contractors are doing these things and finding it profitable contractors generally are not. The reason is that the first cost of the extra units looms so large in their vision that they cannot see the loss due to frequent machine breakdowns. Naturally some of the precautions, such as the duplication of plant, are practicable only when the operation is large (and they are always more profitable on large operations), but others of them are practicable and profitable on any operation where mechanical devices control production. There are enough data in the possession of contractors to prove this assertion beyond dispute and they should be collected and analyzed.

The moving of equipment is a fruitful cause of lost time in some operations and amounts to little in others. Except for shifting forms and chutes the ordinary concrete building operation is often carried through without change in plant location. In concrete roadbuilding, on the contrary, some of the units are continually on the move and others have to be shifted every few miles of completed road. Mobile equipment, generally, has been highly developed and all the contractor has to do is to exercise intelligence in equipping himself with it.

It is the class of equipment ordinarily defined as portable or semi-portable that has to be considered most carefully. The shifting of derricks and hoists, of bins and conveyors, is a serious interruption to construction on many operations. In Iowa road work in 1921 moving plant accounted for 2.56 per cent of the total 35 per cent lost time and was the largest item of lost time except delays due to rain and mud.

A determination of methods of shifting various sorts of equipment and the designing of equipment which can be easily knocked down and re-erected require attention. More particularly statistics need to be presented of the time required for and the cost of shifting plant so that contractors may see the importance of planning carefully.

1. To decrease the number of shifts and

2. To conduct the necessary shifts as quickly and cheaply as possible.

Poor plant co-ordination causes lost time chiefly because the units of larger capacity have to wait for the units of smaller capacity to deliver their product. An example is furnished by steam shovel operation where there are not enough trains to remove the earth as fast as the shovel can excavate and load it and the shovel idles between trains. Such a condition is perhaps more truly a poor use of working time than it is an actual loss of time but it is by any measure a waste of time.

Service Delays—Delays in serving construction operations with materials, supplies and equipment may be a greater cause of lost time than any other thing. For example in building concrete roads in Illinois in 1920, with 100 paving outfits in service there were never more than 50 in operation at the same time because the railways could not deliver the materials. In other instances producers cannot provide the materials wanted in the quantities required when and where they are needed.

The principal reasons for the inability at times of the railways and the producers to serve construction may be stated as follows:

1. The demand for service is confined largely to the summer construction season and during that period is very large.

2. Construction materials are considered low-classification and non-preferential freight both by the railways and by railway regulatory bodies.

3. Local products and perishable and seasonal freights receive preferential consideration as a matter of business expediency. For the same reason producers supply first the permanent market provided by the local dealers.

Other reasons can be thought of but all reasons are unimportant compared with seasonal demand and the classification of construction materials as non-preferential freight. These are the conditions which have to be altered or other means of supply and transportation have to be developed.

Very little has been accomplished toward co-ordinating production, transportation facilities and demand to reduce the peak load due to seasonal construction. In road construction it was undertaken a year ago, by letting contracts in the fall to induce winter shipment and storage of materials. While this policy was inaugurated primarily as a means of reducing unemployment the argument was also urged that it would reduce transportation delays by encouraging the winter accumulation of materials and so cut down the summer peak. The undertaking was largely a failure because it involved a partial shift to winter operations in a kind of construction which practice has set down as peculiarly a summer task, without having previously paved the way by demonstrating its practicability and securing co-operative action of producers, railways, contractors and state highway departments. For the same reason the efforts of a number of states to induce winter stockpiling of road materials by paying estimates on the material in stock have been only partially successful. There is hardly a better recent illustration than these experiences of the need of opening up by research and analysis the entire possibilities of winter construction as an economic practice.

All the traditions of railway transportation practice hold construction materials and particularly sand, gravel, broken stone and similar low-classification freight, as non-preferential freight. There can be no better evidence of this than the latest ruling of the Interstate Commerce Commission made after repeated protests from producers' and contractors' organizations against previous similar rulings. Obviously any change in this situation requires concerted study by the construction and transportation industries.

Regarded in its most favorable light the way to co-ordinating production, railway facilities and demand is long and has many turns. It can be avoided under favorable conditions by developing local supplies and other means of transportation than railway. Again the best illustrations are furnished by roadbuilding. Example after example of the successful utilization of local aggregates, requiring only short hauls, are furnished by whole states, by counties and by individual operations. In addition, investigations like that in Iowa on the use of high-sand, pit-run gravel and in Kansas on fine river gravels indicate possibilities of extending the range of usable materials so as to make construction in many states virtually independent of railway transportation facilities and rulings.

Briefly the problem of lost time due to service delays resolves itself into:

1. Co-ordinating production, railway facilities and demand.
2. Activating railway managements and railway regulatory bodies to place construction materials among the products having preferential consideration in time of transportation shortage.
3. Developing local supplies of construction materials (a) by widening the range of materials approved for use; (b) by working out the best methods of mining, preparing and delivering materials from local deposits, (c) by determining limits of economic production and delivery.
4. Investigating the mechanics and economics of truck and industrial railway haulage from local pits and quarries.

Labor Delays—Strikes and seasonal employment are responsible for the greatest part of the lost time chargeable to labor. Winter idleness has only to be overcome to correct in a large measure seasonal unemployment, and means of doing this have been considered in a preceding article. Strikes, turnover, incompetency, insubordination and inefficiency generally, as causes of labor delays, constitute a sociological problem primarily —a problem of adjusting human relations that waits on time for a solution. There are factors of the problem, however, which engineers and contractors may determine. One is the volume and rate of construction labor turnover. Another is accident prevention as a means of reducing lost time.

Delays of Direction—There are arbitrarily embraced under this heading a number of allied causes of lost time involved in the personal direction of construction.

In construction the individuality of every considerable operation places an especial responsibility for personal planning on the works managers—engineer and contrator. Unless they work together to schedule work, to keep close records, to determine and agree upon performance, to settle on qualitative standards, time is lost. Time is lost, also, unless the engineer promptly approves finished work and pays for it promptly; unless he renders decisions and supplies information as soon as they are needed. It is lost when any similar neglect is shown by the contractor in carrying out his obligations. To ensure the reduction of these time losses:

1. Finance the operation so that the scheduled progress can be maintained and a surplus of money be available to meet contingencies of extra work or exceptional performance.
2. Unify contract requirements and construction practices so that plant and organization require the least modification in passing from operation to operation.
3. Promulgate the laws, rules and practices of construction management as they are formulated and executed by the leading construction organizations.

Delays of Inefficiency—Efficiency methods reduce lost time in the sense that they utilize time more intensively—or at least they have this purpose. Working night shifts utilizes more of the 24 hours of a fair day but it does not help to retrieve a rainy day from total loss. Nevertheless no consideration of the problem of reducing lost time in construction is complete unless these efficiency methods are made a factor. Unfortunately for contractors and construction "scientific management" in one period was so exploited that it appealed to the strong sense of derision of the men who labor under the rough conditions of the caisson chamber or an ocean breakwater. The term "unfortunately" is used seriously because there are determined principles and laws of construction management and there are developed rules for reducing costs that will help the contractor.

These methods and the decrease of inefficiency are not properly in the scope of this series of articles. The subject is mentioned here, however, to point to its importance and to encourage the development in this direction of a collateral line of inquiry.

Proposed Organization for Research

IN THE preceding articles lost time in construction has been considered sufficiently to present the problem which has to be solved. It is a difficult and in its economic aspects a complex problem. Enough possible ways are evident, however, to demonstrate that a solution is possible by processes no more difficult than engineers have mastered in solving many of the purely technical problems of their profession. The line of procedure is obviously the same: (1) Determine the facts by research, (2) correlate and analyze the results (3) formulate procedure.

In the last analysis, however, the question is not whether engineers and contractors can find a solution but whether they will undertake to find it. Unless they adopt the indefensible attitude that solution is not worth while one cannot see how they may in self respect avoid the task. Every phase of the construction industry is now well organized for group action. Engineers, contractors, producers, manufacturers and workers have prosperous and well equipped associations through which they can function collectively. There are co-ordinating bodies. The stage is set for quick action because the public is in a receptive mood toward any intelligent plan for reducing waste.

Suggested Organization—To inaugurate the study of lost time in construction it is suggested as a basis of

discussion, that five national research committees be organized with local contributing committees and a general co-ordinating committee. The five research committees and the subject they are to investigate may be as follows:

1. *Possibilities of Increasing Winter Work.*
   A joint committee of the American Society of Civil Engineers and the Associated General Contractors.
2. *Methods of Reducing Rain and Mud Delays.*
   A joint committee of the American Society of Civil Engineers, the American Association of State Highway Officials and the Associated General Contractors.
3. *Methods of Reducing Equipment and Plant Delays.*
   A joint committee of the Manufacturers Division, American Construction Council, and the Associated General Contractors.
4. *Methods of Reducing Delays in Service.*
   A joint committee of the American Railway Association, the American Society of Civil Engineers, the Associated General Contractors and the American Construction Council.
5. *Methods of Reducing Delays of Direction.*
   A joint committee of the American Society of Civil Engineers and the Associated General Contractors.
6. *Co-ordination of Committee Activities.*
   A joint committee of the American Construction Council, the American Society of Civil Engineers and the Associated General Contractors.

Each committee, as it completes organization and develops its subject, will create the requisite subcommittees of its own body and will outline its requirements in respect to contributing committees of local and subsidiary technical and industrial associations. Its function will be to express its subject nationally while the contributing committees express it as related to one locality or to one industry.

Each committee will function independently except in its relationship with other committees where the co-ordinating committee will exercise an allocating and co-ordinating service. This committee, too, will express the group action of all committees and their group needs as for example, special financing, when these are determined.

Additional committees may be organized as the progress of the investigation discloses their necessity. Their objects and allotments of duties and their co-ordination with existing committees will be determined by the co-ordinating committee in conference with the chairman, or a substitute delegate, from each of the other committees.

In developing the thought behind the exposition of lost time in the preceding articles, two obstacles have manifested themselves in every discussion held with engineers and contractors. They are in doubt whether (1) a working organization is practicable and (2) money can be secured to finance the work. Having an organization which will function aggressively and enough money, it is conceded that a program can be developed which will justify the support of the construction industry. It is submitted that the organization which has been outlined will meet the requirements. Now what about the money to finance the organization?

Plan for Financing—There is no money in sight. None of the engineering societies or industrial organizations has on hand any considerable resources to devote to any activity outside its routine functions. These are the very first assertions that meet any proposal of a plan to investigate lost time. Instead of being discouraging they merely indicate what was to be expected. There is never a fund awaiting any enterprise. It has to be created when the enterprise presents itself. No one knows this condition better than do engineers and contractors. They have to use no different methods in meeting it when a research program is proposed than when a water power development or an irrigation enterprise is involved.

Specifically, the first action to be taken is to "sell" a plan to investigate the possibility of reducing lost time in construction. There is enough money in the industry to pay the price if once it is convinced that the purchase will be profitable. The sole question is:

Obviously a clear description of the commodity offered is the first necessity. Next, ability to deliver has to be shown; third, value has to be demonstrated, and, finally, the price has to be named. Concretely these involve a prospectus, an organization, a program and an estimate of cost. In brief, the procedure is that which engineers and contractors are following in every considerable undertaking which they attempt.

With the previously outlined organization completed, which can be accomplished at very little expense, a program and an estimate of cost are not difficult tc arrive at nor will they cost much. Committees whose members are appointed (1) because of their belief in the value of the investigation and (2) because of their reputation for earnestness and industry in performing an assigned task will demonstrate that they need very little money to achieve results. When the program is formulated and its estimated cost is determined, that is, with something tangible to sell and a clear statement of its price, the task of finding customers does not present difficulties which any number of salesmen in the construction industry are not accustomed to meet and overcome all in a day's work.

Inspectors Reduce Truck Overloading

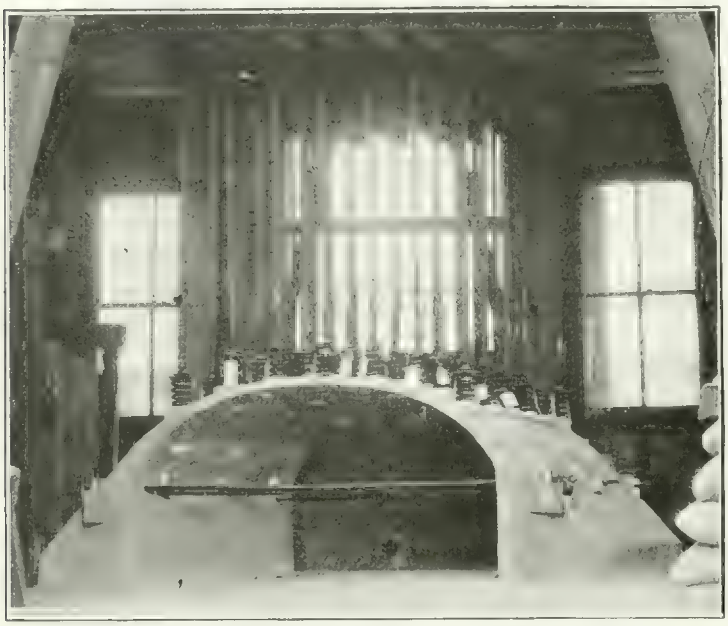
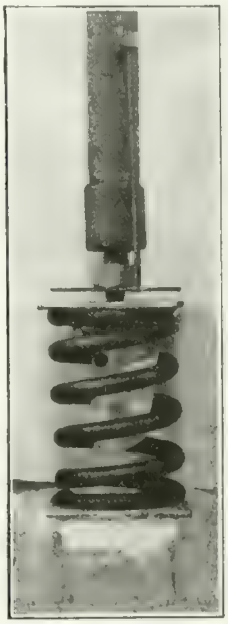
A crew of five deputy inspectors each equipped with an automobile and two loadometers have been working on California highways under the direction of a superintendent in a campaign intended "to protect state and county roads from abuse by overloaded and speeding trucks and from impact by defective and insufficient rubber tires."

These men work under the newly organized traffic-regulation department of the California highway commission. Between March 1 and May 1 they inspected 277 trucks, finding 27 or 9¾ per cent violating the gross weight limit of 30,000 lb.; 111 or 40 per cent overloaded on a basis of tire width and 35 or 12⅝ per cent using solid tires on which the rubber was too thin. Fifty-one convictions were obtained and 104 overloads were adjusted or removed. These percentages are appreciably less than those for the previous inspection periods. Regarding the attitude of truck owners and operators the commission states: "The inspectors have found that the majority of violations have been due to ignorance and when advised of the legal requirements drivers have evidenced a willingness to bring their vehicles and loads within the law."

Test Arrangement for Measuring Skew Arch Thrust

EXPERIMENTAL study of the distribution of thrust at the abutment of skew arches is being undertaken by the Bureau of Public Roads at its Arlington Experiment Station, near Washington. The plan to carry out such an investigation was announced a few weeks ago, but information as to the methods to be used in the study has just become available.

The test object is an arch of 7-ft. span, 4½-ft. width from face to face, 2-ft. rise and 2-in. crown thickness, resting on abutments 2 ft. high. The arch barrel is reinforced with ¼-in. bars. The abutments are tied together at the springing line by a number of tierods parallel to the arch faces and two diagonal rods, which are to hold the arch against spreading in the direction of the span or distorting in the direction parallel to the abutments. The arch is to be loaded by a group of adjustable springs shown in the views herewith, and the deformations of the arch are to be measured by strain gage. One abutment will be held against horizontal and vertical motion, while the other will be supported vertically by four steel blocks with spherical face, resting on plane steel surfaces coated with lampblack, by means of which the reactions can be measured. These gages are of a type originated by Professor Kreuger of Stockholm. Pressure of the spherical on the flat surface produces a circular mark on the coated surface, whose diameter (measured by microscope) corresponds to the amount of the pressure. The device gives a measure of force with practically no motion of the measuring device. Similar pressure gages will be used to measure the horizontal thrust of the movable abutment, for which purpose the abutment is surrounded by steel angles secured to the floor, between which and the abutment the gages are to be inserted.

AT LEFT, COMPLETE 7-FT. SKEW SPAN, WITH TIERODS AND LOADING DEVICES
AT RIGHT, ONE OF THE LOADING SPRINGS WITH ADJUSTING SCREW

The multiple-spring loading arrangement serves for applying load in a convenient, easily controllable manner. There are 42 individual springs, each capable of carrying a load of 1,500 lb., which bear on concrete lugs formed on the arch extrados. Over each spring there is a vertical 2-in. pipe bearing against a solid overhead structure, and allowing adjustment of the spring pressure by means of an adjusting screw fixed in the end of the pipe and bearing down on the top of the spring The springs being previously calibrated in a testing machine, it is possible to adjust the load applied to any one spring very precisely, without the trouble of manipulating weights.

Thomas H. MacDonald, chief of the Bureau of Public Roads, says concerning the test program: "As progress is made with the plan, modification may be necessary. A number of measurements will be taken under different loadings, so that it will be some time before the arch is finally loaded to destruction."

Water Power Possibilities of the Hudson Being Studied by New York Commission

THE New York State Water Power Commission has issued a report entitled "Water Power and Storage Possibilities of the Hudson River" which is the result of an extended study of the hydrology of that river. The report was prepared under the direction of Frank M. Williams, state engineer, at the request of the New York Water Power Commission, under recent laws directing the continuance of investigations heretofore conducted by the Conservation Commission of the water-power resources of the state.

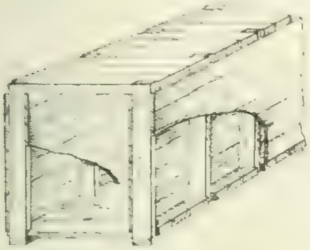
Statistics given show that 362,000 hp. on the Upper Hudson are available of which a little over one-third is developed. Thus excepting only the Niagara and St. Lawrence Rivers, the Hudson River is the most important stream from a water-power viewpoint in the State of New York. The development of a large part of the undeveloped water power depends, to a greater or less extent, on the construction of a system of fourteen storage reservoirs, having a total capacity of 70 billion cubic feet. It is estimated that these reservoirs, the principal ones being the Sacandaga, Gooley, Piseco Lake and Schroon Falls, would cost $24,292,000. Estimates are given which indicate that the value of the storage in these reservoirs will many times exceed the cost, and that the reservoirs would not only increase the available water power on the Hudson, Sacandaga and Schroon Rivers, but also mitigate flood damage, with the consequent insanitary conditions. It it also expected navigation will be improved.

Included in the report, which consists of some seventy-five pages, are fifteen tables giving data relating to drainage areas, rainfall stations, streamgaging stations, storage reservoir possibilities, and effects of storage on the water powers. It also contains eighteen maps and diagrams together with several photographs.

Creosoted Pine Storm Sewers at Lafayette, La.

By L. J. Voorhies
District Manager, J. B. McCrary Engineers, Atlanta, Ga., and Lafayette, La.

In 1919, Lafayette, a growing municipality of Southwest Louisiana, voted a bond issue of $425,000 for various municipal improvements in which was included an item of $75,000 for drainage. The area of the city is approximately 1,500 acres and the topography is very flat. The two main drains which needed improvement consisted of large open ditches along some of the streets. Neither of these ditches could be enlarged and deepened without narrowing the streets materially, to say nothing of the danger to traffic of large open ditches. One of the drains serves the business district and this ditch had to be deepened over 3 ft. to take care of the sub-surface drainage of an area about to be paved. The other drain serves a residential section of about 600 acres which was flooded for hours and sometimes for a whole day following frequent heavy rains. It was, therefore, necessary to construct storm sewers in both cases. To do this with concrete, brick or segmental sewer tile would have cost $160,000 at that time, but only $75,000 was available. Both sewers were built of creosoted yellow pine with the $75,000. It is expected that the pine sewers will last at least 15 or 20 years, at the end of which time the saving in first cost of $85,000 plus interest will be more than sufficient to rebuild the sewers with concrete or other permanent material. In the meantime a crying need for drainage is being taken care of. Moreover, since these trunk sewers were constructed on the established grades developed in the design of a complete storm sewerage system for the entire city, lateral sewers of terra cotta pipe or concrete in sizes up to 33 in. in diameter can be constructed at the proper grades as the more important streets of the city are paved. In fact, there is now nearing completion the paving of several blocks aggregating 20,000 sq.yd. which could not have been properly drained had not the main storm sewers been constructed. Domestic sewage is taken care of by a separate system and sewage-works which make it impracticable to admit even a small quantity of storm water in that system.



TYPICAL DESIGN OF SEWERS

Main storm sewers to replace open ditches in Lafayette, La., ranged from 2½ ft. wide by 3 ft. high to [illegible] x 6½ ft., inside measurements. The dimensions of the lumber were, sills and posts, 2 x 4 and 2 x 6 in., according to size of sewer, bottom, 2 x 6-in.; walls, both inner and outer, 1 x 6-in., top, 2 x 6, 3 x 6 and 4 x 6-in.

BUILDING STORM SEWER

Sills, posts, walls, bottom and top of creosoted yellow pine.

The specifications called for long-leaf yellow pine, square edge and sound, treated with 16 lb. of creosote per cubic foot, the oil to be a distillate of coal-gas or coke-oven tar, complying with the following requirements:

1. It shall contain not more than 3 per cent water.
2. It shall contain not more than 0.5 per cent of matter insoluble in benzol.
3. The specific gravity of the oil at 38-15 deg. C. shall not be less than 1.03.
4. The distillate based on water-free oil, shall be within the following limits: Up to 210 deg. C., not more than 5 per cent; up to 235 deg. C., not more than twenty-five per cent.
5. The specific gravity of the fraction between 235 deg. C. and 315 deg. C. shall not be less than 1.03 at 38-15.5 deg. C.
6. The residue above 355 deg. C. if it exceeds 5 per cent shall have a float test of not more than 50 seconds at 70 deg. C.
7. The oil shall yield not more than 2 per cent coke residue.
8. The foregoing tests shall be made in accordance with standard methods of the A.W.P.A.

If a creosote-coal tar solution is used the specifications will be the same as above with the following exceptions:

2. 2 instead of 0.5 per cent.
3. 1.05 to 1.10 instead of 1.03.
5. Residue above 355 deg. C. if it exceeds 25 per cent shall have a float test of not more than 50 seconds at 70 deg. C.

The design and specifications were prepared under the direction of the writer by the J. B. McCrary Co., municipal engineers of Atlanta, Ga., and Lafayette, La., who also supervised the construction for the city. The construction work was done by local contractors. The lumber, aggregating 430,000 ft. b.m., was purchased by the city direct and furnished by the Creosoted Materials Co. of New Orleans.

Corrosion Under Oil Due to Chlorides

Rusting of rifle bore surfaces under the oil with which they were coated for protection has been found chargeable to the presence of potassium chloride, according to an investigation recently reported by W. J. Huff in a technical paper of the Bureau of Mines. A very common difficulty with gun barrels is that after they have been fired the interior of the barrel corrodes, and no method of preventing this corrosion has been developed, although certain grease mixtures appear to have some effect. The corrosion proceeds under the oil film just as though the oil were not there, but it does not continue indefinitely, as the corroding agency seems to exhaust itself after a time. A carefully planned series of experiments revealed the fact that this after-corrosion does not occur at low or normal degrees of humidity of the atmosphere, but only when the humidity is high, well over 50 per cent. Still other experiments showed that the cause of the corrosion could not be removed by wiping out the barrel after firing, but that it could be removed by washing out with water or aqueous solutions. These and other studies finally led to the conclusion that potassium chloride, formed by decomposition of the potassium chlorate in the powder in its explosion, is the cause of the after-corrosion. The author points out that sodium chloride, or ordinary salt, is likely to be similarly troublesome as a cause of erratic corrosion in the case of other steel objects. Bright steel articles coated with oil or grease to protect them during shipment may rust under the oil film as a result of the action of sodium chloride deposited in workmen's fingermarks made in handling the article before it is oiled.

Contract System for Railway Maintenance Work

New Field for Contractors Seems Widening—Management and Cost of Work by Contract and by Railway Force Account—Practice, Experience and Opinions

By E. E. R. Tratman
Associate Editor, *Engineering News-Record*

SHOULD railway maintenance and improvement work be done by contract? What are the advantages and disadvantages of the contract system? How is contract work managed and paid for? How does it compare with railway force work in efficiency and economy? To what extent has it been employed, and what have been the results of experience? These are questions which have become prominent during the past two or three years and which are of direct importance in relation to recent railway labor developments.

The following review of the situation is based upon an extended inquiry as to practice, experience and opinion on a number of railways. Great variations in practice and opinion are to be expected in view of the relatively small proportion of this work which has been done by contract, so that the contract system can hardly be considered as established definitely, while uniform and effective means of handling it remain to be further developed. Furthermore, there is a rather wide objection to adopting the contract system for work which may be affected by or may interfere with traffic on operated lines, although this difficulty has been overcome in several cases.

To supplement the summarized information given herewith, reference may be made to two previous articles dealing with contract work of this kind. One relates to the ballasting of some 2,000 miles of line on the Missouri Pacific Ry. (see *Engineering News*, May 4, 1916, p. 828), and the other relates to general heavy maintenance work on about 400 miles of the Canadian Pacific Ry. (see *Engineering News-Record*, March 9, 1922, p. 399).

Classification of Work—In the first place, the different kinds of railway work need to be divided into certain classes to which the contract system has been applied in varying degree. This classification may be made as follows:

1. Building branch lines, industry spurs, second track and sidings; also track elevation or elimination of grade crossings, and extending or enlarging freight yards and engine terminals. Such work is done already to a large extent by contract and has little relation to maintenance or operation of existing lines, except in double-tracking and the elimination of grade crossings.

2. Track work such as is done usually by extra or floating gangs. This work includes heavy ditching and widening of cuts, renewing ties and rails, ballasting, surfacing, relaying switches or turnouts, building fences and renewing spikes, rail joints, tie-plates and rail anchors on long stretches of line. Several railways have employed the contract system for different items of work in this class to a varying extent for years.

3. Track maintenance of the kind done by the regular section gangs. This work includes general daily inspection and policing, respiking, tightening bolts, clearing ditches, cutting weeds, maintaining track in line and surface, and repair of fences and crossings. Few railways have tried contracting for this general work of maintenance and the actual experience with the system has been so small as to be negligible. A recent attempt to introduce it more widely led to very strong opposition by railway labor, with the result that this step was either abandoned or postponed indefinitely. With such contracts the work probably would be done largely by floating gangs such as are employed for that in class No. 2.

4. Bridge and building work; repairing bridge decks and trestles; building water stations, coaling stations and engine houses; renewing old bridges and replacing old trestles with concrete structures. All such work is done extensively by contract, although some railways do most of it by their own bridge and building departments. Large bridge construction and renewal is rarely done by company forces.

5. Watching road crossings. This has been done to only a limited extent by contract and was included in the controversy noted in relation to class No. 3.

6. Operating coaling and water stations and pumping plants. In this line of work the contract system has been introduced only to a small extent and mainly in the way of making contracts with employees who are engaged in other lines of work but can handle this conveniently in addition to their other duties. It has been suggested that in many cases it would be much cheaper for the railway to contract for maintaining a supply of water in the tanks at a water station than to keep a pump-man on a monthly-pay basis.

Practice and Experience—Of twenty-four large railways sixteen have used the contract system more or less in maintenance work, but only eight have used it to any large extent. Rail and tie renewals and track ballasting are the most usual items of work done by contract. Other work includes track surfacing, placing tie-plates and rail anchors, replacing worn splice bars, ditching, widening cuts, cutting weeds, and building and repairing fences. One road contracted for ballasting at a time when it could not obtain men for work that needed to be done that season. In most cases the contracts have covered specific kinds of work.

The extent to which the contract system has been employed on different roads varies from small jobs to 80 per cent of the ballasting and 75 per cent of the rail renewals in a given season. Prospective economy is given almost universally as the reason for introducing or experimenting with the contract system. Labor conditions are given as the reason in two or three cases. Opinions differ widely, however, as to whether ultimate economy is really obtained, and whether the efficiency of work done by a contractor's force is equal to that of work done by railway forces.

Two roads which have not used the contract system for actual work have used it in securing men, labor contractors being employed to furnish men at times and places when an adequate force could not be obtained directly by the railways. This practice was followed to some extent during the World War. But in these

cases the men worked as employees of the railways, so that these are not instances of work done under the contract system.

Opinions on Contract Work—Returns from the several railways indicate that opinions are divided about equally as to the merits of the contract system in track work of the kind done ordinarily by extra or floating gangs. Of seventeen direct statements, nine are favorable and eight unfavorable, but two engineers giving favorable replies have no experience of their own on which to base the opinion.

The general substance of the favorable replies is to the effect that with contract work there is greater economy combined with greater production and equal efficiency, but one railway engineer of wide experience with such contracts adds the cautionary phrase "provided that the work is rightly handled." Another estimates an average saving of 25 per cent in cost for such work as rail renewals, ditching, widening cuts and replacing trestles with concrete structures. This saving he considers due to the advantage of lower rates of pay and longer working hours for contractors' forces, besides securing greater efficiency as a result of better supervision than is given usually to railway forces.

On contract work also there is less liability of interference by the railway labor unions in regard to rates of pay, hours of work and what work the men may or may not be allowed to do. Further, a contractor can increase and reduce his force more rapidly to meet changing conditions. It is this difference in wages and working hours, together with the greater flexibility in adjusting the force to the work, which is considered one of the main factors resulting in economy by contract work.

Some of the engineers who favor the contract system express the opinion that increased efficiency or output of the laborers will give them increased earnings but will reduce the cost to the railway company. On the other hand, other engineers consider that the actual cost of the work will be greater if done by contract. In fact, some of those who have tried the contract system for reasons of economy are doubtful as to whether there is any ultimate economy. One reply says definitely that comparisons of force account costs with contract bids show a decided economy in favor of the former. Again, one engineer considers that there is no economy if the railway is equipped with modern machinery. As an instance of this, with the introduction of ditching machines a certain railway abandoned the contract system previously employed for team and hand work in ditching and widening cuts.

A difficulty noted by two or three engineers is that of getting a contractor to keep the price down when any cost-plus system is used. But where contractors bid in competition or unit prices, as is the practice on some roads, this difficulty should not be experienced. It has been stated also that the contractor naturally would endeavor to obtain the maximum output from his men and might get more work or higher labor efficiency than the railway company could obtain from its men. But while some engineers consider that this would effect a saving in cost to the railway, others question whether the real efficiency would be as high as if the work was done by railway employees.

There is no doubt that strict and continuous supervision by railway officers is essential to success with contract work, and this is especially the case where this work interferes in any way with the operation of traffic. In fact, one of the strong arguments made against the contract system is that it may put work on an operated line into the hands of outsiders, with consequent difficulty in placing responsibility for train delays or safety of operation. This objection is offset, however, by the fact that in actual practice many cases of this kind have been handled by contract with satisfactory and successful results.

Another slightly different argument is that the contract system is "wrong in principle and detrimental to the service" in putting railway work in the hands of men who have no interest in the railway as their employer, with the resultant loss of loyalty and team work and other advantages due to a force of contented employees. Furthermore, contract laborers are not likely to be skilled in such work as tamping, track lining or switch renewals. An obvious answer to this objection is that under present conditions it is difficult in many cases to organize and to maintain a force of skilled men as railway employees. And for work of the class under consideration a permanent force is not maintained. Taking, for example, the case of an extended stretch of rail renewal and track surfacing which requires a large gang, it seems unlikely that there would be much difference in the quality of a railway force or a contractor's force. Relative economy and efficiency must depend largely on the organization and methods in individual cases.

Cost of Contract Work—Few definite replies are made as to cost of work or systems of payment. Cost-plus-percentage is considered by one engineer as being the most convenient, but he states that this gives the contractor an incentive to keep the cost up, while on the other hand, cost-plus-fixed-fee gives no incentive to keep the cost down. The cost-plus-percentage system has been used on different roads in paying for spacing and renewing ties and for gathering up old material after relaying rails. Cost-plus-fixed-fee is mentioned definitely only in one case, and that was for relaying rails. The fee ranged from a minimum when the total cost was high to a maximum when the cost was low.

Unit prices are sometimes per mile and sometimes per piece. In the former case, the price covers all work of the specified character within a specific territory. This method has been applied for rail renewal, for spacing ties in advance of rail renewal, for ballasting and for surfacing track. The price for surfacing varies with different amounts of lift. In piece-work payment, the unit price may be per tie renewed, per switch or turnout relaid, and per tie-plate or rail-anchor placed.

One road reports that where rail renewal by contract has been paid for at a unit price and at cost-plus-10-per-cent the results were about the same. In both cases they were slightly below the engineer's estimate based on paying railway labor the same price as that paid by contractors. Unit prices are likely to be low when work is let by competition based on the railway's detail specifications, stating explicitly what part of the work the contractor is to do and what part the railway will do. As contractors become more experienced in work of this kind the contracts and prices will tend to become stabilized.

Railway contract work is usually under control of the contractor's foreman or superintendent, subject to supervision by railway inspectors or timekeepers who are on the job continually and by the roadmaster or division engineer, who should make frequent visits. It is considered important that in addition to inspection

by these local officers there should be occasional inspection by a superior officer, such as the chief engineer or chief engineer of maintenance or their representatives.

Payment to contractors is made usually on the division engineer's monthly or semi-monthly estimates of work done, but small jobs may be paid for on completion. In either case a certain percentage is usually retained to protect the railway company against liens that may be filed for labor or material. This percentage is paid within a period specified by the contract. One engineer points out that the monthly estimates of work should be regarded as of a partial or preliminary character, since the engineer is more ready to give an estimate satisfactory to the contractor when he knows that it is not to be taken as final or conclusive in regard to the amount or extent of work done.

In regard to cost and management of the work, another engineer submits the following statement:

On contract work the cost begins and ends with the execution of the job. But with railway force work the cost continues, since other jobs must be found for the extra gang and these may not be the most essential or necessary, compared with the amount of money available. But on the other hand, railways are not so organized as to have skilled specialists and competent inspectors always available who can prepare plans and specifications to cover a repair job with the necessary precision. For this reason, extra bills, cost-plus and other methods are resorted to, which are more or less prejudicial to the efficiency and final cost of the work. There is much added bookkeeping and the work is frequently productive of disputes and disagreements that occupy the time and attention of officers who have other duties.

About 40 per cent of the cost of the job is for material which for various reasons may be delayed or not available in the order and manner required for economical use. As the contractor is concerned financially he must take quick action and get supplies by the most direct means, which is not always possible for a railway. The foreman or other superintendent of work for the railway is not financially interested, and delays which occur through no fault of his have no such significance to him. But the contractor in getting material has a tendency to specialize because it is the essence of his work. This may result in odd or unusual sizes, which later may increase cost of renewal on replacements, whereas if the railway does the work it will get the standard stock even if it is delayed in doing so.

Proper character of the men in charge and proper relations between them are essential features of a successful contract system. With individuality, familiarity and competency on the part of the contractor and the railway representative the work will be successful and the road doing the work by contract will be satisfied. Where these requirements are lacking in either party the railway will not be satisfied and an unfavorable report on the contract system is likely to result.

Tools and Equipment—Little information is given as to details of work, but such details for two important roads will be found in the earlier articles noted above. The railways usually furnish camp cars and work train service for distributing material. Until the present year many of them furnished also the hand tools, but some have now altered their practice and leave the tool supply to the contractor, supplying only such larger tools as a contractor would not be likely to possess. This change is due partly to the fact that the tool equipment will vary with the amount and extent of the work to be done. A stronger reason is that difference of opinion arises as to depreciation from use, since there is no simple and practical means of determining the depreciation value in proportion to the total expense involved in purchasing tools.

Since the essence of the contract should be to get the work done with the least expenditure it is evident that the proper plan is for the two parties to the contract to pool their interests and supply such equipment as they can to avoid increasing the cost. Ditchers, spreader cars, locomotive cranes, motor cars and push cars are furnished sometimes by the railway and sometimes by the contractor. This depends no doubt upon the contractor in individual cases, since only a contractor specializing in railway work would have such equipment. Distribution of material and collection of old material after the work (as in rail and tie renewals) is done sometimes by the railway and sometimes by the contractor.

Bridge and Building Work—In this special kind of repair and maintenance work, there may be economy in having small repairs done by local men under contract instead of by a traveling gang of the railway's bridge-and-building department. One officer of wide experience in this department suggests that if the contract work is based on proper specifications it eliminates the interference of "a long list of uninformed officials" who have authority over the bridge and building forces. This lack of concentrated authority and its result in disturbing a regular program of work is a rather frequent source of complaint in this department. Another complaint is that crude and antiquated methods in the handling of materials and supplies through the railway storehouse are detrimental to efficient work by company forces.

The contract system is considered advantageous on large work requiring special equipment and a larger experienced organization than the railway can afford to maintain. Further, the contractor has greater freedom in hiring and discharging men, so that he can increase or decrease his forces to suit variations, in the work. On the other hand, more than one reply indicates that work which does not require unusual equipment or housing can be handled best by a company force. In a case where a large amount of bridge painting needed to be done when there was a shortage of labor, the work was let by contract. The railway furnished the paint but no equipment. Other roads have furnished work train service and camp cars for contractors on similar work.

Conclusions—It will be evident from what has been said for and against the contract system in railway improvement and maintenance work that opinion is divided as to the merits of this system. Further, experience has been too limited to develop definite methods of handling and controlling such contract work. But it is evident also that highly satisfactory results as to efficiency, economy and general advantage have been obtained in several individual cases. These cases are sufficient proof of the practicability of applying the contract system to this class of work. It remains, therefore, to work out the details which will perfect the system and lead to its more general adoption. Much depends upon the way in which the specifications and contract are drafted and the way in which the work is handled and supervised. Essentials to success are integrity, a fair-minded spirit on both sides and active co-operation between the contractor and the engineer.

Surface-Treated Gravel for Light Traffic Streets

Tarvia B Applied Cold—Good Maintenance Essential —Annual Cost for Four Years Less Than Seventeen Cents a Yard

By D. B. Davis
City Engineer, Richmond, Ind.

As THERE is an abundance of good gravel in the City of Richmond, Ind., that material was used in constructing its streets some 25 to 35 years ago. The gravel was laid to a depth of 12 in. In the course of time these gravel surfaces required resurfacing, and it was decided to do this with the local gravel which passed a 1½-in. ring and contained 13.3 per cent of clay coating the pebbles and not in the form of lumps.

This new gravel surfacing was spread to a depth of from 4 to 5 in. and was rolled and water-bound, as in macadam construction. Special care was given to finishing the surface. In 1919, it was determined to experiment with surface treatments of Tarvia B on two of these gravel pavements. The success attained on these streets resulted in treating others each year.

For successful results the gravel surface must be firm and comparatively smooth prior to surface treatment. Better results are obtained if the gravel street is subjected to traffic for a season.

The preparation of the surface consists in repairing all depressions by filling the same with ⅜-in. stone, tamped to about 1/16 in. below the street surface and sealing with hot Tarvia. If there is dust on the surface it can be removed to the gutter with a rotary sweeper.

The Tarvia B was applied cold by means of a pressure distributor. For initial treatment, ⅓ to ½ gal. per square yard was used, with subsequent treatments of ⅓ to ¼ gal. per square yard. Better results are obtained by not applying any covering material in the initial treatments. This allows the bituminous material to be absorbed by the surfacing gravel, which it is to the extent that, after traffic has ironed out the road, investigation shows that a crust has been formed from ⅜ in. to ½ in. thick. Subsequent treatments are covered with a light sprinkling of pea gravel, to the amount of about 5 lb. per square yard.

The city street department does the gravel resurfacing and applies the surface treatments with its own forces. The cost of resurfacing with gravel at present prices is approximately as follows:

	Per Cubic Yard
Bank-run gravel at pit	[illegible]
Hauling (6 loads per day, 1½ yd. per load; team at [illegible] per hour)	[illegible]
Spreading at 40c. per hour	[illegible]
Extra man at pit loading at 40c. per hour	[illegible]
Cost of gravel on street (per square [illegible])	[illegible]

	Per Square Yard
Gravel delivered and spread at $1.[illegible] [illegible] requires 0.22 cu.yd.)	[illegible]
Scarifying and rolling	[illegible]
Total	$0.40

The cost of the initial treatment of ½ gal. per square yard is as follows:

Gravel covering at $1.50 per cu.yd.	$0.005
Binder f.o.b. track at 13c. per gal.	[illegible]
Cleaning and application	0.020
Cost per sq.yd.	$0.090

The cost of subsequent treatments of ¼ gal. per square yard is $0.058 per square yard of surface.

It has been found that after traffic has used the treated gravel street for some months, a few depressions may develop, due either to an excess of dust, or a damp clayey spot on the surface prior to the application of the binder. These places will require looking after. This maintenance work is taken care of by a maintenance repair gang, consisting of a team hauling a special wagon containing stone and sand, with the necessary tools, and back of which is hauled a tar heating kettle. This wagon was specially constructed for the work, the running gear being from a discarded horse-drawn hook and ladder fire wagon. The wheels are roller bearing, which permits one team to haul the heavy load. The sand compartment in the rear holds 30 cu.ft. and the stone compartment holds 25 cu.ft. Under the driver's seat is a tank for Tarvia B, to be used for very thin patching. The amount of material carried on the wagon will supply stone and sand enough for pouring two barrels of Tarvia X, which is heated in the kettle at the rear. The kettle has a warming rack which holds an extra barrel, over which is a tight hood. The materials thus carried will supply material for the gang for one-half day.

An average cost for this type of pavement, covering a period of four years, is as follows:

Cost of gravel resurface	$0.400
Initial treatment of ½ gal.	0.090
Maintenance first year	0.008
Second treatment of ¼ gal.	0.058
Maintenance second year	0.003
Maintenance third year	0.003
Maintenance fourth year	0.003
Interest on investment at 5 per cent	0.100
Total amount spent in four years, per sq. yd.	$0.665

This does not include any profit, overhead or tool wear.

Four years of experience with surface-treated gravel has established the following points:

1. Do not treat a gravel surface which is damp or dusty, as it will not incorporate and will soon break out.
2. Apply the treatment uniformly the full width of the street, otherwise it will ravel at the edges.
3. Have the surface firm and smooth before applying the binder.
4. Apply the binder on no street which has not an adequate foundation.
5. Do not apply the binder on any street unless the treatments will be kept up when they are needed. (It has been found here, that ½ gal. per square yard the first year with ¼ gal. per square yard the second year, will keep the surface in such shape that no treatments will be necessary for two years. To put one treatment on a gravel street and then leave it alone will make it worse than if no treatments had been applied.)
6. Give the pavements intelligent maintenance.

Panama Canal Shipping in September

During September, 1922, a total of 240 ocean-going commercial vessels passed through the Panama Canal. Tolls on these amounted to $1,020,064.55 as compared with $1,055,336.76 on 257 vessels during August and $892,001.54 for 221 vessels during September, 1921. In addition to these, eleven small launches and seventeen government vessels passed through the canal. The amount of the cargo tonnage passed through was greater by approximately 50 per cent than that which made up the traffic of September, 1921, and for the first time in the history of the canal the cargo tonnage has exceeded 1,000,000 tons for three consecutive months. Tolls, also for the first time have exceeded the million-dollar mark for three consecutive months.

Experiments With a New Departure in Impulse Wheel Design

EXPERIMENTS made recently at the Philadelphia plant of the William Cramp & Sons Ship & Engine Building Co., by the I. P. Morris department and their associate, the Pelton Water Wheel Co., are said to have demonstrated the success of waterwheels built according to a design radically different from anything heretofore on the market. Small wheels of the new type built for test purposes have shown higher efficiencies than can be expected from impulse wheels of ordinary design and are said to be efficient over a wide range of heads, including those in the neighborhood of 800 to 1,000 ft. where the relative merits of reaction and impulse types are frequently in dispute.

The new design follows the principle of the impulse wheel, but instead of a jet or jets tangentially disposed to the periphery of the runner, the flow in the new design is normal to the runner plane. Further, instead of one or more separate jets to which the buckets are subjected during only part of a revolution, the new design applies the spouting water to all the buckets simultaneously and continuously around the entire periphery of the wheel, that is, the water reaches the runner in the form of an annular ring whose diameter is equal to the diameter of the runner. The flow in this annular ring contains both tangential and axial components.

Regulation is effected by an annular plunger moving axially to close the orifice of the nozzle. A section through the annular nozzle as taken in a plane containing the turbine axis shows a contracting water passage somewhat similar in form to a section through the ordinary needle nozzle. A point of difference, of course, is represented by the tangential velocity components about the axis of the jet which are not present in the jet from the ordinary needle nozzle. Air is freely admitted to both the inner and outer surfaces of the jet and the water does not completely fill the runner buckets, but is in contact with only one surface of each bucket, that is, the action is that of a true impulse turbine.

The advantage of the impulse turbine is therefore claimed for the new design in that changes of pressure through the runner are avoided and there are no forced changes of the relative velocity of the water with respect to the buckets as are required in a reaction turbine where the stream must completely fill the area of the conduit at all points. Therefore, the risk of cavitation due to sudden variations in pressure within the bucket is eliminated, and there is no leakage loss due to poorly fitting or worn seal rings.

Runners for wheels of this design can be built of extremely small diameters, it is claimed, as compared to impulse wheels of ordinary design and units of this type are to be put on the market in commercial sizes as soon as the present experiments are completed and details of construction in larger sizes have been worked out.

German Guns as Road Foundation

According to correspondence from London the Rayleigh (Essex) Parish Council has decided that a collection of German rifles and machine-guns are to be used as part of the foundation of the new London to Southend road.

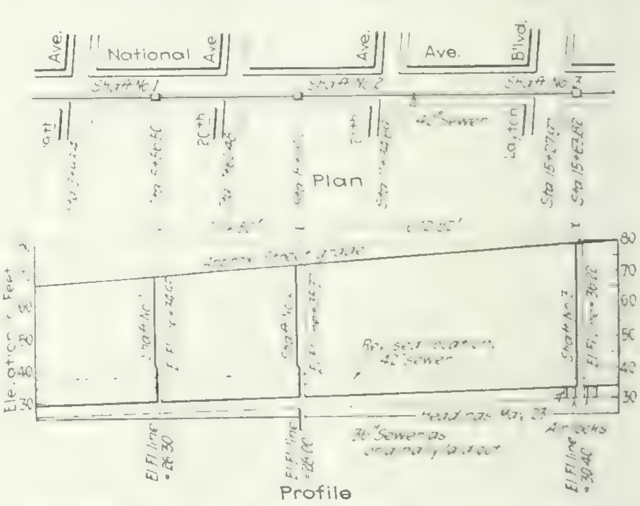
Ferrous Strata Develop CO_2 in Tunnel Shaft

Lowering Water Level Releases Carbon Dioxide—Air Pressure Forces Gas Into Shaft—Men Entering Shaft Killed

By T. Chalkley Hatton
Chief Engineer, Sewerage Commission, Milwaukee, Wis.

CARBON dioxide released by a ferrous earth and forced by air pressure into a pumping shaft of a sewer tunnel killed five men at Milwaukee, Wis.,* on May 24, 1922. The cause of the accident is so unusual and so likely to exist on other work, that the writer feels a full description may prevent the loss of life at other places.

The Sewerage Commission was having built by George E. Zimmermann, a contractor, an intercepting sewer in National Ave. between 18th and 20th Avenues. The



TUNNEL WORKING INVADED BY CARBON DIOXIDE

sewer was to be built of plain, monolith concrete, 36 in. inside diameter and at an approximate depth of 35 ft. below the surface of National Ave., which was surfaced with impervious pavement.

Prior to awarding contracts, test borings had been made which disclosed a fairly dense clay strata to a depth of 18 to 20 ft., grading off into fine gray clay and sand, then to fine sand, then into coarse water-bearing sand and fine gravel. A shaft about 14 ft. square was sunk in National Ave. near 18th Ave., which is designated Shaft 1 on the accompanying plan. After sinking this shaft to a depth of 35 ft. it was abandoned on Feb. 27, 1922, because of the infiltration of huge quantities of water. On Feb. 27 another shaft, similar in size and called Shaft 2 on the plan, was begun near 19th Ave. about 334 ft. west of Shaft 1, with the hope of finding less water, which would permit headings to be begun for the tunnel. After reaching a depth of 32 ft. the quantity of water encountered was quite as great as in Shaft 1. For the purpose of reducing the ground water level, this shaft was sunk with a steel caisson, 9 ft. in diameter, from 32 to 52 ft., the upper 32 ft. being timber sheathing.

Shaft 2 was completed about April 7, and sufficient pumps were installed to pump about 1,000,000 gal. per 24 hours. After several days' pumping at this rate, the water horizon was lowered about 12 ft. and thereafter, until the time of the accident, Shaft 2 was used

solely for collecting and removing the water from the adjacent territory and the top was covered by 2-in. planks loosely placed, Shaft 1 having been covered by planks by spikes to the braces.

Upon the completion of Shaft 2, Shaft 3 was driven to a depth of 49 ft., and 672 ft. west of Shaft 2. Cages, hoists, compressors and other equipment for tunneling were set up. Headings were started east and west from the shaft and air locks in each installed when the headings had penetrated about 30 ft. On May 23 air was put on the headings, but owing to excessive leakage about 3½ lb. pressure only could be maintained in the heading, which was not enough to enable excavation to proceed properly.

Careful and thorough examinations were made to determine the direction of air escape, and Shaft 2 was entered several times during the day (May 23) to investigate the leakage, but without success. The compressor was allowed to run all night of the 23rd but no tunneling was done. About 6.45 of the morning of the 24th, the hoisting engineer at Shaft 3 went down Shaft 2, as was his daily custom, to oil the pump. When he reached the first platform, at 35 ft. in depth, he expired in a sitting posture. A laborer went to look for him, saw him apparently asleep, went down the shaft to arouse him and was likewise overcome. The fire department was then called and upon arrival, the men—believing it to be a case of electrocution—put on rubber boots and gloves and went down the shaft to the first platform. All succumbed before they could be rescued. The rescue squad of the fire department then arrived, donned oxygen masks, went down and brought the bodies of the five men up the ladder.

Investigations was immediately begun by the Sewerage Commission as to the cause of the accident. Samples of the air in the bottom of the shaft were taken an intervals of about an hour, during May 24. At the beginning, these samples showed the following:

	Per Cent by Volume
Oxygen	[illegible]
Hydrogen	None
Methane, CH_4	None
Carbon dioxide, CO_2	8.9
Carbon monoxide, CO	None
Illuminants	None

Samples were also taken in Shaft 1 and showed substantially the same analysis. This analysis disclosed at once the cause of the accident but not the source of the great volume of CO_2.

By the beginning of May 25, the air in Shaft 1 and 2 was normal. Air pressure was then turned on in Shaft 3 at the same pressure as it was on the night of the 24th, and by noon, the CO_2 had increased to 3.3 per cent. The air in Shaft 2 was pumped out until the CO_2 had been reduced to normal and the air in Shaft 3 again put on, with the same result.

This was conclusive evidence that the CO_2 was present in the substrata between the shafts, was in a quiescent state until moved by the air pressure, and, when moved, sought the two open shafts.

Further investigation developed that the water being pumped from these underground strata showed the presence of considerable iron in the ferric state. This water had entirely saturated these strata before operations were begun. As the water horizon was lowered, the space formerly occupied by the water was occupied by air into which the CO_2 in the iron escaped, leaving the iron in the water as it came from the shaft in a ferrous state. This CO_2 would remain in these underground spaces without movement until an agent, such as compressed air, disturbed it.

Without previous experience, it can well be seen how such an accident could occur. The open shafts were simply big holes in the ground, having no connection with the tunnel being driven. Men entered one of them three times a day to look after the pumps, and several men had been down the evening before the accident. No indication of the presence of any gas had been given and no gas was anticipated. The contractor, his men, and the engineers in charge of the work for the Sewerage Commission had, for several years past, been driving tunnels, both in free and compressed air, through all sorts of ground. In many cases the compressed air had escaped in enormous quantities, but no evidence has been obtained of the presence of CO_2 in any considerable quantities although methane was sometimes detected and guarded against. From the light of this experience, my directions have been:

> In all open shafts where tunnels are being driven under compressed air—and whether or not such shafts are connected with the tunnel—and in all tunnel headings, whether driven in free or compressed air, keep a miner's, or other open light, constantly burning. Where the water being pumped from the shafts or tunnel workings shows the presence of iron, as disclosed by the brownish stain on things it touches after reaching the open air, particular care must be observed and frequent analysis of the tunnel air must be taken, especially if the work is being done under free air.

I have gone into the description of this accident in greater detail than some readers might think necessary. My object has been to give the picture so vividly to the construction engineer that he can see where it fits into conditions which he may frequently encounter, and while he may so far have been saved from disaster because one of the controlling agencies was absent, all these conditions may be present when he least expects.

Before closing this description, there is one other danger from the presence of CO_2 in underground strata, where compressed air is used in driving tunnels through city streets, to which it might be well to call the engineer's attention. Had no open shafts existed, in the case above described, into which the CO_2 could readily escape, it might have been blown out through any of the surrounding cellars and cause fatalities to those living in the houses. We have had several instances in our work here in Milwaukee, where the compressed air escaped through the surrounding cellar floors at such volume and pressure as to crack the concrete.

Hydro-Electric Project in the Punjab

Plans are being considered by the Punjab Electricity Board for utilizing the water power of the Sutlej Valley Dam and other irrigation water supplies to develop hydro-electric energy. Applications to the board from British and Canadian power interests for concessions to develop the hydro-electric power involved with a lien on the water powers of the Ravi River have been denied, and a resolution published by the board declaring itself unanimously in favor of a government monopoly of water power for the Punjab. It is proposed to distribute the power to concessionaire companies and by price regulation insure low-cost electric current to consumers. In this manner the board hopes to promote industrial development and at the same time safeguard the public interest in the waters of the Punjab Rivers —*Commerce Reports.*

From Job and Office

Hints That Cut Costs and Time — *For the Contractor and the Engineer*

Charts Covering Design of Abutment Walls of Horizontal Beam Type

By W. B. Walraven
Assistant Engineer, Illinois Division of Highways

The accompanying charts have been prepared by the writer for the design of abutment walls of the horizontal beam type and may prove useful to others who have similar designs to make. Such a wall will be considered as being composed of beams each 1 ft. wide extending horizontally between vertical counterforts. The problem of design is, therefore, to select a suitable thickness of wall and amount of reinforcing to carry the moment and shear developed.

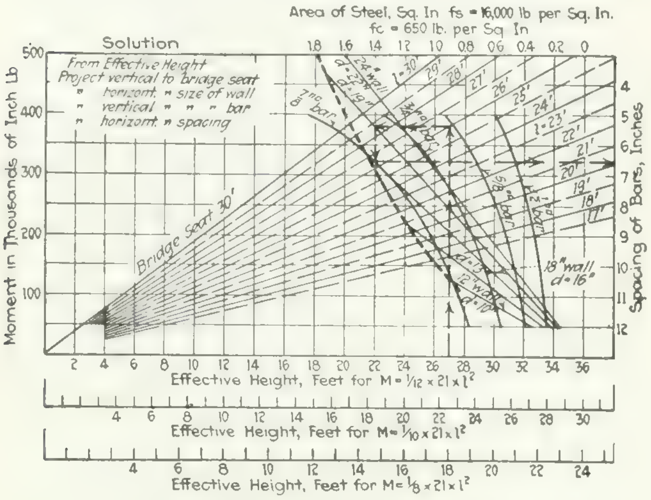


FIG. 1—GRAPHICAL SOLUTION FOR VERTICAL WALLS

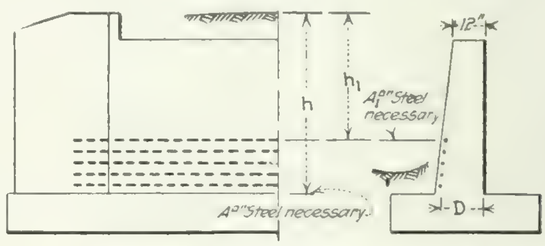
Two assumptions are made: Earth fill imparts equivalent fluid reaction of 21 lb. per square foot for each foot of height; and certain coefficients must be used in moment calculations. For convenience, scales are shown wherein the fixity is such that moment coefficients of $\frac{1}{8}$, $\frac{1}{10}$ and $\frac{1}{12}$ are used.

Fig. 1 gives a graphical solution for the effective depth and the amount and spacing of reinforcing steel necessary to carry the stresses delivered to the wall by the earth filling behind it. Two assumptions must be made in the solution herein given: First, that the earth fill imparts an equivalent fluid reaction of 21 lb. per square foot for each foot of height; and, second, that certain coefficients must be used in the moment calculation. Considering the first of these assumptions, if instead of 21 lb. it is considered wise to use an equivalent fluid pressure of 25 lb., it will be necessary to enter the diagram with an effective height equal to 25/21 times the actual height. By effective height is meant the vertical distance from the crown of the roadway back of the wall to the element of the wall under consideration.

As to the second assumption, since various degrees of fixity may be encountered where the main and wing walls join, it is convenient to show scales wherein the fixity is such that moment coefficients of $\frac{1}{8}$, $\frac{1}{10}$ and $\frac{1}{12}$ are used.

As an example assume an effective height equal to 18 ft. and a fluid pressure of 21 lb., and a support at the wings such as to warrant the use of a moment coefficient of $\frac{1}{8}$. With a bridge seat having a clear span of 26 ft., it is found by tracing the path of the arrow (Fig. 1) that a wall with a 19-in. effective depth requires 1.4 sq.in. of steel to carry the stress. This amount of steel will be provided by $\frac{7}{8}$-in. square bars spaced on $6\frac{1}{2}$-in. centers. If we assume that the wall is to be of the same thickness throughout, the amount and spacing of steel for any other height may be found by working the diagram in the reverse order.

With a battered wall the solution of the problem is complicated because of the decreasing depth to steel with decreasing height. Fig. 2 furnishes a ready means for solving this problem after the amount of steel necessary to the top of the footings has been ascertained. As an example (Fig. 3) assume the effective height (h) to be 19.2 ft.; the length of the bridge seat (l) 25 ft.; and the effective depth (d) 13 in. From h project the line vertically to the l curve, thence horizontally to



$Z \times h = h_1$ — Uniform spacing assumed

Size of Bars reqd at h	Size of Bars reqd. at h_1	$\frac{A}{A_1} = C$	Z for D=10	Z for D=13	Z for D=16	Z for D=19	Z for D=22	Z for D=25	Z for D=28	Z for D=31
$\frac{7}{8}$"	$\frac{3}{4}$"	1.36	0.736	0.681	0.634	0.594	0.558	0.526	0.498	0.472
$\frac{7}{8}$"	$\frac{5}{8}$"	1.96	0.510	0.445	0.394	0.354	0.322	0.294	0.271	0.251
$\frac{7}{8}$"	$\frac{1}{2}$"	3.06	0.327	0.272	0.233	0.203	0.181	0.163	0.148	0.135
$\frac{3}{4}$"	$\frac{5}{8}$"	1.44	0.694	0.636	0.587	0.545	0.508	0.476	0.446	0.423
$\frac{3}{4}$"	$\frac{1}{2}$"	2.25	0.444	0.381	0.333	0.296	0.267	0.242	0.222	0.205
$\frac{5}{8}$"	$\frac{1}{2}$"	1.56	0.640	0.578	0.526	0.484	0.448	0.416	0.389	0.365

$$\frac{10 \times h}{\left[10 + D\left(\frac{A}{A_1} - 1\right)\right]} = h_1 = Z \times h$$

Illustration

Having solved for **D** and the size and spacing at depth **h**, the smaller sized bars may be used at depth $h_1 = Zh$. Assume **D** = 22" and $\frac{7}{8}$" bars required at **h**

$\frac{3}{4}$" bars good at 0.558 × h
$\frac{5}{8}$" " " " 0.322 × h
$\frac{1}{2}$" " " " 0.181 × h

FIG. 2—SOLUTION FOR WALL WITH BATTERED FACE

the d curve, thence to the B curve and thence horizontally to Σo. This shows that the total shear amounts to 5,050 lb., the end shear to 36.5 lb. per square inch, and that the bars must have a Σo equal to 5.50 to develop bond, assuming an allowable bond stress of 80 lb. per square inch. This accounts for the one-foot strip immediately above the footing. Remaining strips may be designed by repetitive uses of the charts.

Figure 3 gives values for unit shear and bond under conditions similar to those met with in Fig.

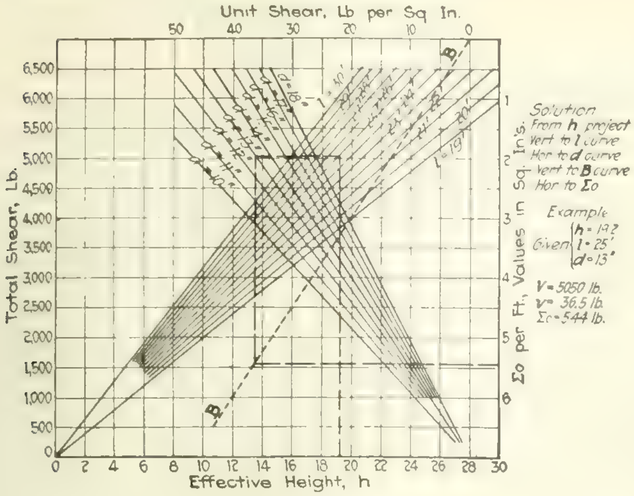


FIG. 3—VALUES FOR UNIT SHEAR AND BOND

1. However, only a few values of the depth to the steel are given so that confusion may be avoided.

The writer can personally point to hundreds of abutments built by a single highway department using the principle herein outlined.

Native Timber Bridges Aid County Highway Program

By R. S. Blinn
Engineer in Charge, Allegheny County Road Work, Sparta, N. C.

BRIDGES built of native white oak for about \$9 a lineal foot and of the design illustrated were a material aid in putting through the 40-mile county road program for which \$135,000 was raised by the citizens of Allegheny County, North Carolina. On this road work the grading averages about 6,000 cu.yd. a mile and bridges and culverts about 10,000 ft. b.m. This grading and bridge work is costing about \$3,500 a mile

The illustration shows a 20-ft. bridge, which cost \$180. Several dozen others have been built at about the same ratio of cost. These structures are located about 30 miles from a railway. All material, except nails and drift bolts, is white oak even to the submerged logs which tie together the mudsills upon which the bents rest.

On account of the excessive haul for cement and sand, this type of structure is the cheapest by far, even in the long run, because the interest saved on the difference in cost between a white oak and a concrete bridge will rebuild the wooden bridge every three years and it is fair to say that the white oak will be in good condition for ten years, and, with slight repairs, may last twenty years.

COUNTY HIGHWAY BRIDGE OF NATIVE TIMBER

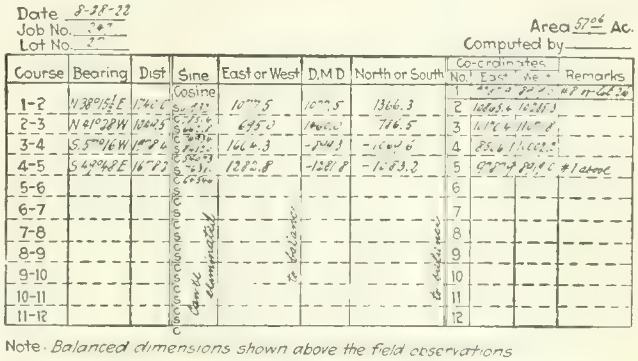
This is one of several dozen built in Allegheny County, North Carolina, almost entirely of native timber. These structures averaged \$9 a lineal foot. This one cost \$180.

Form for Computing Areas Mechanically

By J. R. Jahn
Williams & Jahn, Consulting Engineers, Berkeley, Calif.

THE writer believes that the accompanying form simplifies and systematizes the work of balancing traverses and computing areas sufficiently to warrant its use by surveyors having mechanical calculating machines.

The special features are: (1) the condensing of the usual computation form to one of few columns by the consolidation of East and West departures into one column, North and South latitude differences into another, and the elimination of all partial-area columns —algebraic signs are used wherever necessary to differentiate the terms—; (2) column "E or W" is placed



Date 8-28-22
Job No. [illegible]
Lot No. [illegible]
Area 57.06 Ac.
Computed by

Course	Bearing	Dist	Sine / Cosine	East or West	D.M.D	North or South	Co-ordinates No.	East	West	Remarks
							1	[illegible]	[illegible]	#8 of Lot 26
1-2	N 38°15½'E	1740.0	[illegible]	1077.5	1077.5	1366.3	2	10805.4	[illegible]	
2-3	N 41°28'W	1044.5	[illegible]	695.0	1460.0	786.5	3	[illegible]	[illegible]	
3-4	S. 5°16'W	[illegible]	[illegible]	1664.3	[illegible]	[illegible]	4	[illegible]	[illegible]	
4-5	S 49°48'E	[illegible]	[illegible]	1282.8	-1281.8	-1083.2	5	[illegible]	[illegible]	#1 above
5-6							6			
6-7							7			
7-8			can be eliminated	to balance		to balance	8			
8-9							9			
9-10							10			
10-11							11			
11-12							12			

Note. Balanced dimensions shown above the field observations

FORM FOR TRAVERSE AND AREA COMPUTATIONS

ahead of the column "N or S," and is separated by the column "D M D," which is developed from the column, "E or W;" and (3), the various products of multiplication of terms of the "D M D" column with corresponding terms of column "N or S," are accumulated as an algebraic sum in the machine and the area of the "lot" obtained by dividing this sum by a constant. Where feet are used as units, the constant is 87,120 or twice 43,560.

In practice, the traverse is written into the form in the order in which the courses appear in the field when followed around in a counter-clockwise direction. The sine-cosine column is not filled in, being placed here for those who might desire to use it. The distance term of the first course is set on the keyboard of the calculator and the multipliers (the natural sine and cosine) applied directly to the crank of the machine to obtain the quantities for columns "E or W," and "N or S." The same process is used to fill in all of the terms of these columns. The West courses are now distinguished from the East, and the South from the North, by the minus sign (—) and the algebraic sum of each column is taken. Provided the traverse closes within the allowable limit of accuracy, it is balanced by applying an amount equal to the respective remainders but opposite in sign, to the significant terms of the respective columns, either proportionately or according to accuracy weights. The column "D M D" is now built up in the machine by turning in the first "E or W" term, once for the "D M D" of the first course and again for its

portion of the second one before removing the hand from the crank. This process is continued down the page, the quantity noted after the first turn of the crank being set down in the column "D M D." If the work is properly performed the last two turns of the crank will clear the result dials to 0000.

Now accumulate the products of multiplying each "D M D" by its "N or S" term noting that the product of two plus or two minus terms is positive (i.e., forward turns of the crank) and of two of opposite sign, negative (i.e. backward turns). Divide this algebraic sum by the constant 87,120 for acres from foot measurements or by 100 for acres from chain units.

For mapping, co-ordinates may be computed by starting with the co-ordinates of a known point, such as a corner of pre-computed traverse, and adding algebraically the terms of the respective longitude or latitude differers as illustrated in the form. Here East again precedes North and corresponds to the X of the XY co-ordinate system.

A convenient check on the calculated area within the traverse is possible, by the method of cross multiplication of co-ordinates as follows: accumulate the products algebraically in the machine of the series $(1E \times 2N) + (2E \times 3N) + \ldots - (2E \times 1N) - (3E \times 2N) - \ldots = 2A$ (area), in square feet, which can be reduced to acres by dividing by 87,120.

Intersections can be easily worked out, using coordinates, if the two lines are expressed by their equations $y = mx + C$, where x and y are variables, m, the cotangents of the bearings and C, the values obtained by substituting known values in the equation $C = y' - mx'$. The two equations of the intersecting lines may be solved for x by subtracting one equation from the other. This process works out very nicely on the calculating machine. Y is then found in either of the equations and the length of the two lines found from the respective co-ordinates.

Comparison of Finished-Floor Materials

ONE of the members of the Building Managers and Owners Association of New York has made a study of the various materials for use in floor finishing. Materials are rated as to appearance, durability, slipperiness, cost and other considerations. Though of higher ultimate cost travertine appears to lead, in the estimation of the man who compiled the figures. The comparison, taken from a recent bulletin of the association, is reprinted herewith.

COMPARISON OF MATERIALS FOR FINISHED FLOORS

	Ratings: Appearance	Durability	Nonslip	Approximate Cost per Sq.Ft.	Average Life, Years	Ultimate Cost per Year
Marble—blocks	A	A	C	$2.25	25	$0.09
Travertine stone	A	A	A	2 [illegible]	25	08
Mosaic—marble	B	A	B	1 25	25	05
Tile—hard	B	A	B	1 [illegible]	25	04
Rubber tile*	C	B	A	1 40	20	07
Cork tile—natural*	B	C	A	[illegible]	15	04
Cork composition tile	C	C	A	60	15	04
Linoleum—battleship*	D	C	A	45	15	.03
Terrazzo—brass strips	C	B	C	[illegible]	20	.03
Cement—dustproofed	D	B	B	20	20	01
Composition—magnesite	D	C	B	.45	15	.03
Oak—quartered sawed†	C	B	B	.50	[illegible]	.02½
Maple or yellow pine†	D	B	B	.40	20	02
Treatment of wood floors	..	.		.02	2	.01

*Including cement underfloor.
†Including wood underflooring and sleepers.

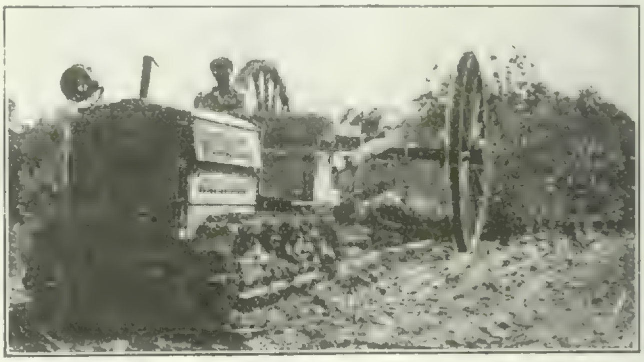
FROM JOB AND OFFICE

Hints That Cut Costs and Time

Tractors Prove Advantage Over Teams in River Bank Protection Work

REDUCED cost and greater working capacity or output due to haulage by tractors as compared with teams was found in hauling trees for current retards along the Missouri River near Dakota City, Neb., during the summer of 1922. These retards, which are to protect the river bank from erosion, are composed of groups of large trees having the trunks lashed to cables anchored to concrete piles sunk below the river bed, as described in *Engineering News-Record* of Dec 15, 1921, p. 966.

As the trees were cut a 5-ton tractor hauled them through heavy underbrush to an open space or a convenient roadway. There the trees were bunched, loaded



TRACTOR HAULING TREES FOR BANK PROTECTION
On a two-mile haul this 10-ton tractor made nine trips over a 10-hr. shift. This was slightly more than five four-horse teams could accomplish.

onto a special two-wheel cart and hauled by a 10-ton tractor through brush, sand and muddy bottom land to the river, a distance of two to three miles. The tractor and cart are shown in the accompanying view. With tractors averaging about 20 working hours per day the trees were delivered with sufficient rapidity to supply two gangs which hauled them into the river to build the retards. Each gang consisted of seven men with a steam hoisting engine or winch. The trees were of various sizes but averaged more than 12-in. butts and were hauled complete, no trimming of leaves or boughs being permitted. With a 2-mile haul the 10-ton tractor made nine trips in a 10-hr. shift. The 5-ton tractor also brought in trees to the camp at noon and night, so that about 60 trees per shift were delivered.

Five teams of four horses each were used at first and their best record was seven trees per team or 35 trees for all teams in a 10-hr. shift. The saving in cost by the use of tractors is estimated at 50 per cent, but of greater importance was the saving in time for work of an emergency character. Teams were often delayed with heavy trees or in getting out trees which fell in such a way as to prevent getting a direct pull But with the tractors these delays and troubles were eliminated.

In moving the hoisting engines, which was done at intervals of about ten days, the 10-ton tractor could do in two hours work which had taken two days with teams. Further, the tractors were used to tighten the

FROM JOB AND OFFICE

For Contractor and Engineer

cables or to drag out anchor cables which had become buried in the sand-bar built up by the action of the retards. Teams require regular periods of rest, but the tractors could work almost continuously. A 4-hr. interval at noon between the two 10-hr. shifts, was utilized for such service work as overhauling, cleaning, lubrication and supply of fuel, water and oil.

On this work at Dakota City a river frontage of seven miles is being protected by 20 current retards or permeable dikes in order to stop the erosion of valuable farming land, the farmers having co-operated in getting the work done for their common benefit. About 20,000 trees were required. The Woods Brothers Construction Co., Lincoln, Neb., was the contractor, with L. A. Day as superintendent in charge.

Time Cards Control Truck Haulage

Control of motor trucks handling material excavated for pier foundations for the Hill to Hill bridge at Bethlehem, Pa., was effected through a simple though very efficient use of time cards. The Hill to Hill bridge being constructed by the Pennsylvania Public Service Commission spans not only the Lehigh River but four principal railroads, the Lehigh Canal and Navigation Co.'s canal and seven streets. Though the main structure is only about 2,000 ft. long with its three approaches and its four approach ramps this length is extended to about 6,000 ft. It is of reinforced

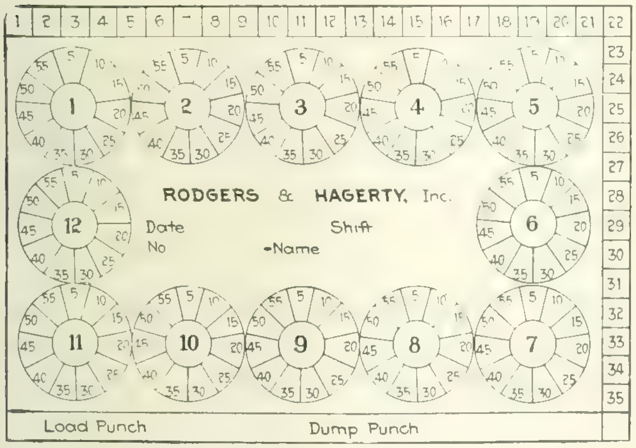


FIG. 1—TIME CARD FOR MOTOR TRUCK CONTROL

By punching the dial at loading point and dump an accurate time check is kept of all truck movements. Horizontal and vertical figures record trips per day.

concrete with piers of massive design and its spans range in length from 100 to 150 ft. c. to. c. of piers.

In excavating at piers it was necessary, because of the narrow right-of-way given the contractor, to dispose of material as excavated. Eighteen motor trucks were used to transport the excavated material from pier sites to the dump located at an average haul of a quarter of a mile from the bridge. The contractor organized a separate trucking concern and appointed a manager to oversee the work of the eighteen trucks that were kept in practically continuous operation.

The foremen on the job were required to tell the manager of the truck department every evening what the truck needs for the next day would be. The value of beginning to operate trucks early in the working day was realized, so no truck was allowed to go on the job after ten o'clock in the morning. This induced all job foremen to size up their needs of each succeeding day at the end of the day's work.

Time Cards—Actual control of truck movements was effected by the use of the time card reproduced in Fig. 1. The circles represent hours of the day. The line of numbers at the top and right of the card was for

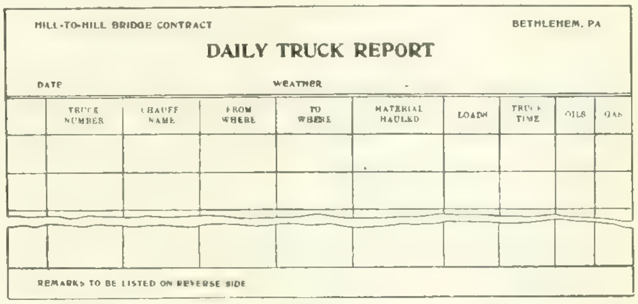


FIG. 2—FORMS USED ON MISCELLANEOUS HAULAGE

No check was kept on individual truck consumption of oil and gas. Total bills for these items were pro-rated monthly among all trucks continuously operating.

noting the number of trips made from the loading point to the dump. The cards were used as follows:

At each loading point and at the dump were checkers with punches that identified them with particular places. The driver of each truck was given one of these cards as he left the garage in the morning. When he arrived at the loading point the man there with the punch punched opposite "Load Punch" on the card and then the hour and minute of the driver's arrival. As the driver left with his load the man at the loading point punched out the first figure in the horizontal line of figures indicating that the driver had left with his first load. When the driver arrived at the dump the man there left his distinctive punch in the space opposite "Dump Punch" and then also punched the hour and minute of the driver's arrival at the dump. This process was repeated with each trip.

At the end of the day it was possible to check the activities of each driver by looking over his time card. The number of trips made was therefore indicated both on the hour and minute circles and in the horizontal and vertical columns. If the drivers card showed much fewer trips than the average for all trucks both he and the manager of the truck department were called on the carpet.

Besides the trucks on regular run several were used from time to time for miscellaneous jobs. To record the movements of such trucks another report was made out by the driver. That type of report is reproduced in Fig. 2.

In actual excavation a small steam shovel was used first before any sheeting was placed. After having dug down about 10 or 15 ft. bracing and sheeting was placed and the rest of the excavation was done by clamshell, handling the material direct from pier to trucks without any intermediate dumping board. All the material was taken to one dump. Excavated material is to be used in backfilling; and it is probable that considerable borrow will be used in addition.

The bridge is being built by the Pennsylvania Public

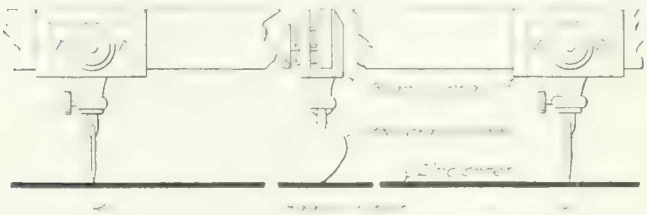
Service Commission, of which Dr. Frank Herbert Snow is chief engineer, under the local supervision of the Bethlehem Bridge Commission. Clarence W. Hudson, New York, designed and is supervising the erection of the bridge. Rodgers and Hagerty are the contractors, with W. Caccia in charge for the firm as resident engineer, and George Angel as general superintendent. H. J. Finebaum is the representative of Mr. Hudson on the job, though Mr. Hudson is in frequent contact with the work himself.

Making Curve Templets

By Emile Low

U. S. Assistant Engineer, Buffalo, New York

REFERRING to the article "Making Curve Templets of Pressboard," *Engineering News-Record*, Aug. 24, p. 306, I have for many years used curves made of oil board, such as used in letter copy books. These I cut by means of a beam compass, usually to a scale



BEAM COMPASS FOR CUTTING CURVE TEMPLETS

of 200 ft. to the inch for even degrees and five- to ten-minute intervals. To cut the curves it is also necessary to have an old-fashioned steel eraser blade. A drawing table is the best surface to cut the curves on, having a piece of zinc where the curves lie. Cutting them with a sharp blade is much better than scribing from a metal set and trimming with shears. When well done the edges are not rough, but absolutely smooth.

Cable Guard Rail on Pennsylvania State Highways

WITH large wooden posts painted white above a black base, cable guard rail as illustrated gives excellent visibility on Pennsylvania highways. A ¾-in.

FIG. 1. WIRE CABLE GUARD RAIL PENNSYLVANIA

FROM JOB AND OFFICE

Hints That Cut Costs and Time

standard galvanized wire cable is used, threaded through intermediate posts and fastened to the end posts by eye-bolts provided with washers, nuts and long threaded shanks. The cable is strung with a block and tackle and tightened by means of the eye bolts. The end posts, as shown, are anchored against the pull of the cables by means of a ground anchor and a 12-wire

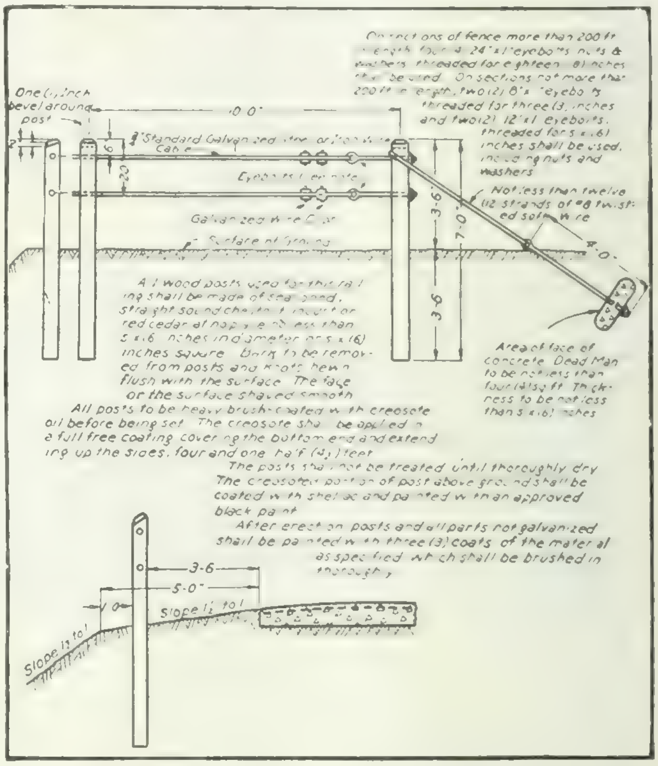


FIG. 2. WHITE PAINTED POSTS GIVE VISIBILITY

twisted cable looped around the post. The drawing gives all essential details of the structure and the view shows how clearly the railing stands out to the eye of the passing driver.

Old Band Saw Makes Expansion Joint Holder

An expansion joint holder made from and old band saw by slotting the saw and bolting it to a 2 by 4-in. piece of lumber was used by the Grays Harbor Construction Co., of Hoquiam, Wash., in a concrete street-paving job, according to the *Concrete Highway Magazine*. The saw was attached to the 2 by 4 which extended over the entire length of the saw and beyond it over the side forms. At the top of the joint holder and placed about 3 ft. apart were fingers made of short flat iron bars so fastened that they could be turned up and out of the way while the elastite was being placed against the joint board. They were turned down over the elastite to hold it in place. The device was held in place by means of round iron bars so bent that one end hooked over the 2 by 4 and the other end, sharpened to a point, was driven into the side forms. Iron pins driven into the subgrade helped to hold the device firmly in place.

FROM JOB AND OFFICE

For Contractor and Average Engineer

Two Curve Problems Solved

BY GEORGE F. SYME

North Carolina Highway Commission, Raleigh, N. C.

THE two problems presented below have recently been submitted to me for solutions. The first deals with the replacement of a tangent connecting two curves in the same direction with a third curve, the second deals with the widening of a pavement on the inside of compound curves.

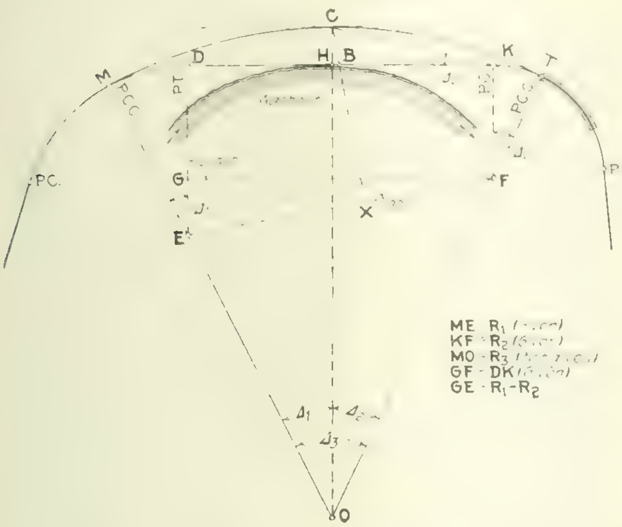


FIG. 1. PROBLEM IN RAILWAY LOCATION

Given: Two curves (Fig. 1) in the same direction, connected by a tangent DK of known length.

Required: To replace the tangent with a third curve which shall begin at some point M, on the first curve and fall tangent to the second curve at a *fixed point*, T.

Solution: Draw the curve MCT. Join centers E and F, draw FG perpendicular to ED, bisect tangent DK at B, draw BX perpendicular to EF, produce BX to cut large curve at C, and join C and O. A tangent through C will be parallel to DK, and CO, DE, and KF are then parallel. Draw chord TKC, then $\angle TFK$, $(= TOC = \Delta_2)$, is known, because point T is fixed.

(1) Solve right triangle EGF for side EF and for $\angle$s EFG and GEF. Then $\angle HCB = \angle EFG$ and $\angle CBH = \angle GEF$.

(2) In triangle KBC, $\angle CKB = \frac{1}{2}\Delta_2$ and $\angle CBK = 180° - \angle GEF$. Then $\angle KCB = 180° - (\angle CBK + \frac{1}{2}\Delta_2)$, and $BK = \frac{1}{2}DK$, which is known.

Then $KC = BK \dfrac{\text{Sin } CBK}{\text{Sin } KCB}$.

Chord $TK = 2R_2 \text{ Sin } \frac{1}{2}\Delta_2$, and chord $TC = TK + KC$.

Then $OT = R_3 = \dfrac{TC}{2 \text{ Sin } \frac{1}{2}\Delta_3}$

Now in triangle OEF, side $EF = \sqrt{EG^2 + GF^2}$, $OE = R_3 - R_1$, and $OF = R_3 - R_2$.

Now knowing the three sides of triangle OEF we have, where $S = \frac{1}{2}$ the sum of the three sides,

$\text{Sin } \frac{1}{2}\Delta_3 = \sqrt{\dfrac{(S - OF)(S - OE)}{OF \times OE}}$, from which we find Δ_3.

And $\Delta_1 = \Delta_3 - \Delta_2 =$ the angle required to back through on the first curve, to locate the point M. The large curve will fall tangent to the second curve at T.

The problem in widening pavements on the inside of compound curves, by connecting the two inside arcs with a third circular curve is as follows:

Given: A two-centered compound curve, Fig. 2 (with complete curve data), on the center line of a pavement W feet wide.

Required: That the pavement be widened on the inside of the curve by means of given transition spirals and circular arcs.

Solution: Select the proper spiral for each end of the curve, and note that there results an offset, BC, on the inner edge of the widened pavement. To eliminate this a third curve, PSL, is desired.

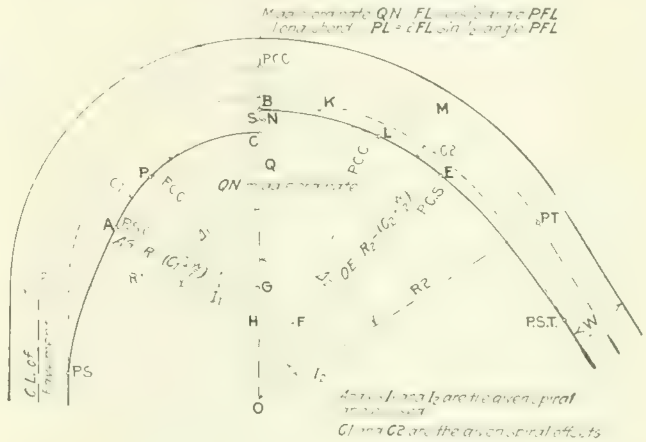


FIG. 2. WIDENING PAVEMENT ON COMPOUND CURVE

Draw the above figure, making BM perpendicular to OB at B. Note that line PCK, through point C, cuts BM at K. Assume an angle as CGP, which locates P.

Then $\angle BCK = \dfrac{180° - \angle CGP}{2}$, and $BK = BC$ tan $\angle BCK$, where BC is the difference between the given radial offsets C_1 and C_2.

Tan $\frac{1}{2}\angle BOL = \dfrac{BK}{OB}$, hence $\angle BOL$, which locates the point L.

Now $\angle PFL = \angle sBOL + CGP$, = the central angle of the required curve.

In triangle GFO, we have $OG = OB - (GC + BC)$, and $GF = \dfrac{OG \text{ Sin } BOL}{\text{Sin } (180° - \angle PFL)}$, then the radius of the required curve $PSL = FP =$ the given radius $GP + GF$.

The long chord PL may be easily computed and used as a check on the field work, and ordinates to any desired point on the curve PSL may also be computed.

The above problem may also be solved by assuming a radius FP, greater than GP but less than OB. In this case we solve the triangle GFO, in which all sides are known, for OF and FG are radial differences and $OG = OB - (GC + BC)$, as before.

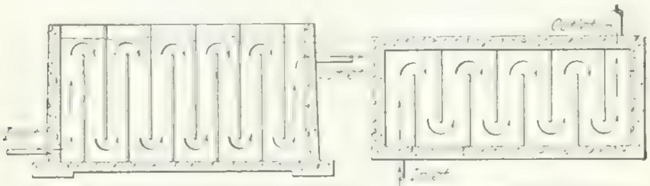
In practice it is sometimes advisable to make two or more solutions of the problem based upon different assumptions, and to select that curve which best fits local conditions.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Computing Loss of Head Through Baffles in Mixing Chambers

Sir—Will some of your readers kindly give the proper method of computing the loss of head through over and under baffles and through horizontal baffles in mixing chambers, as shown by the accompanying illustrations, giving the formula used for computing this loss. P. B. S.



Section showing Over and Under Baffles | Plan showing Return Baffles

Considering Foreign Woods to Resist Borers

Sir—I have been much interested in reading in *Engineering News-Record* of Oct. 12, pp. 619 and 626, an article on the service obtained from greenheart on the Panama Canal and also Mr. Kooy's communication. The Marine Piling Investigations Committee of the National Research Council are in no way overlooking the possibility of using foreign timbers. We have collected considerable data through various sources, most of it from the Forest Products Laboratories, at Madison, Wisconsin. We have a service record or a record of tests for greenheart as follows:

In the British Isles we have record of eighteen different ports in which greenheart was used. In several Scotch ports this timber is reported to have been heavily attacked in from eleven to fifteen years—in one case it was destroyed in four years. In England the results are somewhat varied. Slight attack is reported on ten years service and in two cases, complete destruction in twenty-five to thirty years, while at other points perfectly sound timber is reported which has been in service as high as fifty years.

Reports from Holland, Belgium and France show service ranging from three to twenty-nine years. In no case is the attack reported as more than slight. One installation in the Mediterranean was reported as destroyed in twenty years. In South Africa very heavy attack in eight years is reported. In three out of four cases in Java and India the timber was destroyed in from ten to twenty years, while in the fourth case, heavy attack was reported in ten years. Trinidad reports complete destruction in fifteen years and Georgetown, British Guiana, in twenty to twenty-five years.

The Forest Service placed a test piece at Pensacola, Florida, which was very heavily attacked in seven years. In this case, the attack of the teredo type of borer was apparently light and the heavy damage was done by martesia.

Definite conclusions cannot be drawn from these records, but there is some reason to think that in northern harbors, at least, greenheart may be expected to give fairly long service.

The records of service of jarrah mentioned by Mr. Kooy are not so good. There are only four reports from England; three of them show timber in good condition after sixteen to twenty years service and one of them shows heavy attack after twenty-four years service. South and East Africa report twelve cases, only one of which shows the timber in good condition after twenty years' service and most of them show it destroyed under twelve years. One test shows it destroyed in six months. Reports received from Arabia, India and Ceylon all show timber heavily attacked or destroyed in from fifteen months to six years, Japan shows destruction in two and a half years. The Australian ports which have used this timber to a considerable extent show quite variable records. Some of them show long service, but from other information it appears probable that the borers were not very active at these points. In one New South Wales harbor total destruction is shown in six and one-half years, while in one case in Victoria seven years service was obtained with only slight attack.

Information has been collected by the committee covering a number of other foreign timbers, and arrangements are being made to test some of them in American harbors. It is entirely possible, as Mr. Kooy suggests, that some of these timbers may be found of value for port work in the United States. They will, however, undoubtedly, prove to be expensive.

WILLIAM G. ATWOOD,
Director National Research Council.

New York, Oct. 17.

Testing Hollow Building Tile

Sir—In your issue of Sept. 7, p. 396, William B. Newhall, consulting engineer for the Northwestern Clay Products Co., discusses some very important points to be observed in testing hollow tile, in particular the method of applying the load and the rigidity of the bedment of plaster. Undoubtedly the methods considered by Mr. Newhall are efficient. They will give good test results at little if any additional expense. However, it is not always expedient to add portland cement to the bedment plaster in the case of a busy laboratory on account of the time required for setting.

I should be glad to put in evidence my own views at this time as to how we can most efficiently proceed with this rather new and valuable structural material. One point refers to the structural design of tile, the others to the methods of tests. The writer arrives at his conclusions in connection with a long experience in testing tile and other material at the U. S. Bureau of Standards, together with experience since then with raw clays.

1. A beam or diaphragm such as the web of a tile is weakest at the ends or points of juncture with the other material, there being no transverse forces intermediate. The theory of secondary stresses well known to engineers shows that a free beam without transverse loads has its internal stress couple a maximum (or a minimum) at the ends or juncture points. Now it will be clear there is scarcely any filleting given by the manufacturers at the re-entrant angles. A ¼- or ½-in. radius fillet could be easily supplied in the dies at little expense. They should be supplied for the same reason a pattern-maker supplies them in a pattern for a casting. There is sometimes a shrinkage crack coincident with the re-entrant angle, an additional weakness. Stress theoretically tends to largeness at this point even when the cells are vertical in the testing machine. Moreover, the tiles frequently fail just at these points. The weakness is developed *a fortiori* when the tile is bedded with the cells running horizontal. If the web were bellied very slightly in addition to the larger filleting of the re-entrant angles, some additional strength might be added, but this point is not as important as the filleting. This filleting is important for the same reason as gusseting a garment or supplying a frame with cross-braces at the corners. Practically, the tendency to infinity of stress is eliminated by this means. It presents no practical difficulty to the manufacturer and will greatly enhance the value of his product as regards strength.

2. In making compression tests the applied stress should be a uniform compression without bending couples or platen frictions introduced by the testing machines as the result of any eccentricity. Mr. Newhall proposes an improvement on the older form of a hemispherical block. While, however, his method tends to eliminate eccentricity, it does not prevent rotation of the surface plate which may be brought into play as a result of inherent heterogeneity in the material, unequal compression of the bedment of plaster, or

imperfect ends. It would seem that the desideratum to be attained is some sort of a hydraulic bearing which would insure the application of a uniform compression stress to specimens, eliminating eccentricity of loading, rotation and bending, and the necessity of a bedment mortar. It is true that thousands of concrete cylinders are tested by the older hemispherical block method. This, however, is only another instance of the persistency of what might be designated the law of the survival of the unfittest. If uniform compressions were applied to concrete cylinders undoubtedly the relatively wide bands of data now characterizing the various stress relations found in connection with different methods of proportioning concrete would be narrowed, with much smaller deviations from the mean curve. The same observation would hold in the case of tiles or other compression pieces.

The hydraulic bearing is not wholly untried. Gardner S. Williams and C. J. Tilden used one form in beam tests at the University of Michigan—a box or chamber with an inner rubber casing holding water which was subjected to compression. The chamber was open on the side next the upper flange of the beam where loads were applied. Egress and rupture of the casing or inner tube was prevented by a sort of corseting of small steel slats resting in juxtaposition on the flange of the beam, this also eliminating flexural effects and variability of pressure. Dean Marston has applied a simple hydraulic bearing to testing drain tile, using merely a short length of fire hose with sealed ends, partially filled with water. This readily adapts itself under pressure to the rough surface of the tile. Perhaps the best form of bearing for compression pieces would be a development of a type once used by Mont Schuyler and discussed by him in a paper before the A.S.T.M. in 1913. He secured a uniform or hydrostatic pressure simply by the use of an inner chamber in the bearing head, this being separated from the faces of the specimen by a flexible diaphragm having practically the same diameter as the former. With this type when perfected a true hydrostatic pressure can be secured without bedment of plaster or cement.

3. Mr. Newhall states in his third point: "Only those tests that make the vertical webs fail in diagonal shear can be said to have properly developed the strength of the tile." This, of course, is the common view as regards compression failures. The writer, however, is of the opinion that this is only to be regarded as an inference. Brick piers have vertical planes of failure, the diagonal planes being confined to the ends as the result of local effects due to the bracing of the pier structures by lateral platen frictions. The writer is under the impression that the change from flatwise to edgewise tests of brick in compression as proposed by the A.S.T.M. specifications (C21—20) was made solely for the purpose of eliminating platen frictional bracing of the brick. Some authorities are in favor of a test on end. Mont Schuyler's tests on concrete under uniform compression show that the cylinder breaks into three pieces separated by vertical planes 120 deg. apart. I have found likewise that this is the common type of failure with rock for road material tests with the Page impact machine. I have found moreover that in the case of fairly uniform compression stress amorphous materials such as clays break up into septaria or honeycomb structures, the prisms' planes being still 120 deg. apart as in the case of Mont Schuyler, his case apparently being particular as a result perhaps of relatively small cylinders being used. I believe that the behaviors cited are akin to crystallization. The behaviors in natural clays might in fact easily pass for shrinkage failures in drying out—they are so similar, were they not obtained by direct compression through many tests. Physicists with whom I have discussed these phenomena think the analogies are favorably supported by the test results. I will proceed to discuss the phenomena as they appear in the case of tile tests.

4. A test should be arranged to develop the intrinsic strength, i.e., the maximum possible strength of the material, whether this be in the form of a hollow tile, a concrete cylinder, brick, or steel column. A rigorous test of his material is due the manufacturer.

If it is desired to obtain the maximum possible strength of hollow building tile, then in addition to the use of a hydraulic bearing of the Schuyler type it might be well to consider omitting a bedment plaster altogether where great refinement is desired and, instead, grinding the ends of the tile square with the axis on a surface grinder. This would be necessary for tile but not concrete. A Dorry type of grinder—a steel disk revolving horizontally at a moderate number of revolutions to which sand is fed—will suffice for surfacing the ends, the weights of the tiles placed on the disk maintaining sufficient pressure for expeditious surfacing. When the tiles thus surfaced are tested even with a hemispherical block method of applying the load the compressive strength developed is much larger than in the case of plaster bedments. From memory, values of 12,000 to 14,000 lb. per square inch were found. The failures in this case were not of diagonal shear type. There were no initial reports or partial failures. Instead the tiles failed like the one hoss shay, with a single final collapse, elastic limit and ultimate being identical. The pieces broke at the re-entrant angles into a series of webs and side strips. This type of failure for openwork structures would seem to be strictly comparable to the net work of prisms occurring in the case of brick piers, Schuyler's cylinders or rock tested in the Page impact machine. If the re-entrant angles were filleted as has been suggested and it were possible to adopt some efficient hydrostatic bearing block for the standard compression test, it is not improbable that still higher results might be obtained than were reported.

It is of course a question whether the points mentioned are worthy of consideration to the exclusion of others commonly designated as "practical." I am under the conviction that the intrinsic strength of a tile is above the apparent strength developed by ordinary test methods. Accordingly in formulating a standard test every effort should be given to rigor of performance to insure that the data obtained denote the real strengths attainable and are not in effect mere apparent values conditioned by the contingencies of observation and not truly representative of the quality of the material. The paper by Mr. Newhall emphasizes some of the important factors to be considered. I am in hearty agreement with the plea of his last paragraph.

J. H. Griffith,
Department of Civil Engineering,
Iowa State College.
Ames, Iowa.
Sept. 20.

Wyoming Rock Prices

Sir—In *Engineering News-Record*, Aug. 10, p. 232, is an article on "The Southeast Corner of Wyoming," by W. W. DeBerard, in which the Wind River Road is mentioned. He makes the following statement: "On the 13½ miles in the contract recently let to the Utah Construction Co., 11½ miles must be carved out of the solid rock, making 94 per cent of the excavation rock (284,000 cu.yd.). Incidentally, this road will be the main route to Yellowstone Park. Contractors will be interested to know that the solid rock excavation went at 68½c. per cubic yard, a decidedly low figure under the circumstances." This is an error and should be corrected. As a matter of fact on section B, a solid rock job, the Utah Construction Co. bid $1.50 per cubic yard, on section C, a mixed earth, loose rock and solid rock job which was unclassified their bid was 70c. per cubic yard.

E. F. Stevens,
Stevens Bros.,
Contractors.
St. Paul, Minn., Sept. 2.

[C. C. Warrington, deputy state highway engineer, writes that the $1.50 price for section B is correct but that the contractor is being paid 68½c. for section C, as given in the article and 18c. for section D, earth excavation largely.

The work on this project was divided into three sections in order to conform to the various classes of excavation and bids were requested for unclassified excavation on each section. The rock on section B consists of diorites and granites in solid ledges. The rock on section C are the sedimentary lime and sand stones in ledges and in slides. Editor]

NEWS OF THE WEEK

New York, October 19, 1922

Group Meetings to Feature Highway Program

No General Sessions at State Highway Officials Convention While Subcommittees Are in Session

Principal emphasis will be placed on group meetings at the eighth annual meeting of the American Association of State Highway Officials, which will be held at the Baltimore Hotel at Kansas City, Mo., Dec. 4, 5, 6 and 7. No general sessions will be held during the time that the group or subcommittee meetings are in progress. These subcommittee discussions will cover plans and surveys, design, specifications, traffic control and safety, bridges and structures. The subcommittee discussions are scheduled to take place during the afternoon of Dec. 4. Regular meetings also are scheduled for the full committees on administration, construction, motor-truck regulation, maintenance, standards, tests and investigations and publications.

Detailed Program

At the opening session, in addition to the address of welcome and the annual address of President C. M. Babcock, of Minnesota, there will be a formal paper on "Troublesome Problems Encountered in the Administration of a State Highway Department," by A. R. Hirst, the state highway engineer of Wisconsin.

W. S. Keller, of Alabama, will preside at the general session on Dec. 5. Addresses will be given by A. B. Fletcher, state highway engineer of California, on "Financing Construction and Maintenance on a State Highway System," and by Clifford Older, chief highway engineer of the Illinois Department of Public Works, on "The Service Test of the Bates Road—A Step Toward the Rational Design of Roadway Surfaces." T. E. Stanton, the assistant state highway engineer for California, will present tentative conclusions on the design of pavement sections derived from studies of the effect of traffic on the Pittsburg, California, test road. An evening session will be held on Dec. 5 to consider matters pertaining to bridge design. The principal paper will be presented by L. N. Edwards, bridge engineer, Maine State Highway Commission. C. N. Connor, the assistant engineer of the North Carolina commission, and C. B. McCullough, bridge engineer for the Oregon commission, are scheduled to present remarks on the subject.

At the morning session on Dec. 6, Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, will discuss the functioning of the federal-aid policy. Rollen J. Windrow, the consulting engineer to the Missouri highway commissioner, will present the handling of federal aid from the state point of view.

There will be an afternoon session on Dec. 6 at which John H. Mullen, deputy commissioner of highways for Minnesota, will present a paper on "A Construction Division—Its Financing, Organization and Operation." G. C. Dillman, Deputy Commissioner of the Michigan State Highway Department, will address the same session on "The Field Control of State Highway Maintenance Work."

Officers will be elected and committee reports received at a morning session on Dec. 7.

Philadelphia Awards Contract for 280-Ton Incinerator

A contract for a 280-ton incinerator for mixed garbage and rubbish, to be located in the northeast section of Philadelphia has been awarded to the C. O. Bartlett & Snow Co., Cleveland, Ohio, in accordance with its recent bid of $145,200 for four furnaces in one plant, including all auxiliaries. Three other bids, all informal in some respects, were received. *Engineering News-Record* is officially informed that the plant proposed by C. O. Bartlett & Snow Co., met every requirement of the specifications, and that the company was able to show a plant of approximately the same capacity in successful operation on this continent for five years, practically of the same design and construction as called for in the city specifications. The furnace selected is of the Sterling type, with four grates to each furnace. No effort will be made to produce steam as a byproduct of the destructor. Frank H. Caven is director of public works of Philadelphia; Fred C. Dunlap is chief of the Bureau of Highways, and John H. Neeson is deputy chief in charge of street cleaning.

Road Builders' Convention Session to Be Separate From Exhibits

Radical changes have been made in the program for the thirteenth American Good Roads Congress and Fourteenth National Good Roads Show to be held in Chicago, Jan. 15-19, 1923. Instead of holding sessions at the Chicago Coliseum, where the show will be housed, they will be held at the Congress Hotel. It is believed that this will insure a better attendance as noises heretofore so disturbing to the speakers and convention delegates will be eliminated.

Another feature of the program of the American Road Builders' Association is the fact that controversial subjects will not be avoided this year as heretofore, and, according to C. M. Upham, chairman of the general arrangements committee, the program will consist of controversial subjects of vital interest to the whole roadbuilding industry.

The exhibits committee has employed a professional director of exhibits and the publicity committee, an experienced publicity man.

New York Engineers Discuss Structural Safety

Diverse Opinion Expressed as to Responsibility; Resolution to Study Subject Further Passed

Methods of bringing about greater assurance of structural safety in buildings of public assembly were discussed at a meeting of the New York Section of the American Society of Civil Engineers on Oct. 18. Divergent opinions were expressed, but the meeting finally voted in favor of further study of the subject by a committee.

James B. French, consulting engineer, introduced the subject with a sketch of existing conditions as revealed in the failure of the American Theater in Brooklyn and the Knickerbocker Theater in Washington, last December and January, and presented a resolution originally introduced last spring before the structural sub-section of the New York Section. This resolution (*Engineering News-Record* of August 31, 1922, p. 351) proposed legislation to require that before any building of public assembly be opened its safety to be certified to by a competent structural engineed. Mr. French made a strong argument in favor of this resolution, taking the position that no other method will suffice to eliminate the risks arising from incompetent design or bad construction or erection.

Other Opinions

Rudolph P. Miller, consulting engineer and former superintendent of buildings at Manhattan Borough, spoke in favor of governmental control of the responsible heads of building operations. Such regulation was proposed by him some years ago, and has been introduced as a bill before the last two legislatures of New York State. It failed in both sessions, however, although a bill to license brokers was passed without difficulty; he referred to the difference as illustrating the ease with which legislation involving money matters goes through, as contrasted with safety legislation. L. F. Pilcher, state architect, attributed the failure of this bill to inadequate presentation of the arguments in its favor to the proper parties, and asserted broadly that any bill that is properly presented is sure to obtain the necessary support for passage. However, he charged broadly that it is impossible to card-catalog or to mechanize honesty or responsibility, and presented the view that the personal care and responsibility of either architect or engineer or both in combination is fundamental to the success of any construction operation. Experiences of New York state in constructing institutional buildings illustrated this argument. Mr. Pilcher's main emphasis was on harmonious cooperation of engineer and architect, with either the architect or the engineer responsible, depending on circumstances.

Daniel T. Webster, manager of Marc Eidlitz Sons, contractors, upheld the

view that the engineer is necessary to a large construction job, and that his responsibility and supervision should attend upon the job throughout, until its completion, at which time he is capable then of certifying the safety and adequacy of the construction. Sound practice in this respect should be enforced by the society, and the society should also set up a sub-committee to deal with problems arising in construction relations and gradually build up a code of practice. Lewis D. Rights, contracting engineer of the Shoemaker-Satterthwait Bridge Co., reviewed the change in commercial conditions in the structural field, from design by fabricating companies to design principally by independent engineers, and pointed out that the manufacturers desire generally to eliminate engineering service from their work and confine themselves to construction. He opposed the French resolution, however, on the ground that the responsibility for the structural safety of a building should rest upon the owner, not upon the engineer. He moved that the resolution be referred to a sub-committee of three for report. This proposal was adopted by the meeting. Another suggestion made in the course of the discussion, to the effect that the owner of any building under construction should be required to give bond for its safety, so that bonding interests would undertake the determination of safety, was not acted upon.

At the same meeting an interesting sketch of the Alsatian Rhine navigation canal project was presented by M. Antoine, an engineer of the French Government. This project, which has been in existence in some form for twenty years or more, has recently acquired definitive status by an international agreement of the states bordering on the Rhine. In connection with the navigation improvements which this canal will bring about, nearly half a million horsepower will be developed.

Motion pictures illustrating the Catskill aqueduct were shown as an introduction to the meeting. The section has adopted the plan of opening each meeting with motion pictures, to bring about an early gathering and thereby make is possible to terminate the meetings earlier in the evening.

Roads Bureau College Planned

The establishment in Washington of a Bureau of Roads College, somewhat along the lines of the Army War College, is regarded by Thomas H. MacDonald, Chief of the Bureau of Public Roads, as a desirable step to keep practising highway engineers abreast with progress in the art. The college would be planned so as not to conflict with established educational institutions. It would not be a post-graduate school. The idea is to provide short courses largely for the benefit of experienced engineers. There is ample opportunity, Mr. MacDonald thinks, for more work on the scientific side of road building. The study of the physics of road building materials is not keeping pace with the science of their application. For that reason Mr. MacDonald attaches importance to the arrangements already made for a series of lectures by Dr. W. A. Patrick of Johns Hopkins University on the physical chemistry of the colloids. These lectures will constitute a part of a series arranged by the Secretary of Agriculture.

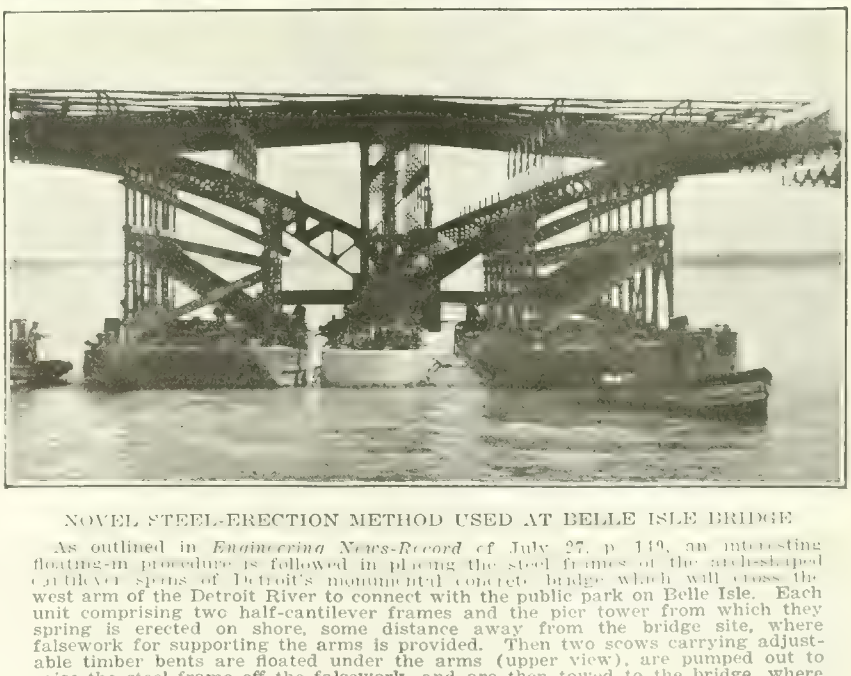
New Canadian National Board Appoints Executives

The first meeting of the new Canadian National Ry. board of directors was held Oct. 10, when Major Graham Bell, Deputy Minister of Railways, was appointed vice-president. S. J. Hungerford, who has been vice-president and operating general manager of the Canadian National lines (not including the Grand Trunk) was formally appointed vice-president and general manager of these lines. Both these appointments are temporary, pending the coming of Sir Henry Thornton from England.

W. D. Robb, vice-president and general manager of the Grand Trunk, has appointed D. E. Galloway as assistant vice-president of the Grand Trunk System; C. G. Bowker, operating manager on lines east of the Detroit and St. Clair Rivers; and C. Manning assistant manager on the same lines. Mr. Galloway was appointed assistant to the president in 1911 and occupied that position for several years.

Would Consolidate Colleges in Canadian Maritime Provinces

A proposal has been made to consolidate all the colleges in the three Canadian maritime provinces in one federated university. This would include the engineering schools conducted by the colleges. At present, the following maritime province educational institutions have engineering schools or departments: Dalhousie University, Halifax; University of New Brunswick, Fredericton; St. Francis Xavier University, Antigonia; Mount Allison University, Sackville; St. Dunstan's University, Charlottetown; Nova Scotia Technical College, Halifax; Acadia University, Wolfville; and King's College, Windsor. The proposal for one big engineering school has been received with favor by many of the graduate engineers of the maritime provinces although there has been exhibited a difference of opinion over the advisability of discontinuing such long established engineering schools as that of the University of New Brunswick.



NOVEL STEEL-ERECTION METHOD USED AT BELLE ISLE BRIDGE

As outlined in *Engineering News-Record* of July 27, p. 149, an interesting floating-in procedure is followed in placing the steel frames of the arch-shaped cantilever spans of Detroit's monumental concrete bridge which will cross the west arm of the Detroit River to connect with the public park on Belle Isle. Each unit comprising two half-cantilever frames and the pier tower from which they spring is erected on shore, some distance away from the bridge site, where falsework for supporting the arms is provided. Then two scows carrying adjustable timber bents are floated under the arms (upper view), are pumped out to raise the steel frame off the falsework, and are then towed to the bridge, where the steelwork is easily lowered to its seat on the pier by flooding the scows. In the lower view the frame is seen approximately over the pier, being pulled to correct position by mooring lines. The work is being done by the Wisconsin Bridge & Iron Co. under the direction of Esselstyn-Murphy, engineers.

Warren Bros. Co. Wins Paving Patent Suit

A decision in favor of Warren Bros. Co., of Boston, in its suit against Oscar Huber, contractor, involving 75,000 sq.yd. of paving in the State of Oregon laid prior to May 5, 1920, under the Warren company's then-existing bitulithic patents, was handed down Oct. 12 by Judge Bean of the United States District Court at Portland, Ore. The decision reaffirms other court decisions establishing the validity of the Warren company's basic patent No. 727,505 and establishes 25c. a square yard as a reasonable royalty.

This case involves work done several years ago before the Warren patent No. 727,505 had expired on May 5, 1920. The decision has nothing to do with the Wallace patents under which the Warren company is now operating and on which the Warren company recently lost a suit brought against Thompson Bros., in which the County of Fresno, Calif., was a co-defendant.

Of the Oregon case the court says: "The defense made in this case of anticipation by prior uses, prior patents and literature and double patenting is the same as those involved in prior litigation, either in fact or in kind. The evidence here does not show anything substantially new in respect thereto or any reason why the conclusion of such court should not be followed. . . .

"The defense of non-infringement is not made out. The pavements laid by the defendant under this contract with the State Highway Commission and involved in this suit are in all particulars the same as that previously laid by him and the Highway Commission upon which royalties were paid, and in my opinion are clearly infringements of plaintiff's patent. There is no dispute as to the yardage, 74,541.8 yd., and the evidence shows beyond question that 25c. a yard is a reasonable royalty."

Great Notch Tunnel Bids Opened

Several interesting features are noted in the comparison of bids for the construction of Contract 3 of the Great Notch tunnel and approaches for the North Jersey District Water Supply Commission. Five bids were submitted, the totals being as follows: Heyman & Goodman Co., Jersey City, N. J., \$918,297; T. A. Gillespie Co., New York City, \$978,543; Mason & Hanger Co., New York City, \$1,158,441; Patrick McGovern, Inc., New York City, \$1,208,285.25; and the Frederick Snare Corp., New York City, \$1,386,025. Three lump sum bids were also submitted.

Rather an unexplainable situation is evident for removal of top soil, earth excavation in open cut, rock excavation in open cut, and refill and embankment. For these four items the low bidder bid \$79,400 as against \$417,510, the high bid for the four quantities. For earth excavation in tunnel the unit bids ranged from \$9 to \$29.50; for excavation of trap rock in tunnel, from \$15.50 to \$29.50; for excavation of sandstone in the tunnel, from \$15.50 to \$29.50, and for the enlargement of the tunnel in rock, from \$11.35 to \$28. Unit bids on concrete masonry in the tunnel were \$9 for the low bid and \$17.30 per cubic yard, the high bid. Cement prices ranged from \$2.60 to \$4.50 per barrel, with no two bids identical.

Model Bill Covering Day Labor Work Is Aim of A.G.C.

A model bill requiring that an accurate account be kept of construction work done by day labor and that this record be open to the public is to be drawn by The Associated General Contractors of America and a campaign for its adoption in each state, with such variants as may be necessary, will be started. The model bill will be framed along the general lines of the law in effect in Minnesota.

The provisions which it is desired to include in such bills are: the publication of the estimated cost of the work; receipt of bids; publication of final cost if finally executed by a public body by means of day labor; and accounting of cost, including expense of equipment, depreciation, repairs, engineering and other services and similar legitimate charges. The Minnesota law does not include receipt of bids.

It is the belief of the contractors' organization that a comparison of the cost of executing work through a public body with that of letting by contract will show that the former method is much more expensive.

The California legislature last year passed a bill of this character but it was vetoed by the governor. The bill, even more inclusive, will be introduced again at the next session of the California legislature.

Yakima-Portland Railroad With Branch Lines Is Proposed

In the filing of articles of incorporation for the Yakima Southern Ry. Co. at Olympia, Wash., a project involving the construction of 154 miles of railway from the Yakima district in eastern Washington to Portland, Ore. was announced. E. E. Lytle heads the company, which plans for its first unit the construction of an 86-mile railway, costing \$5,000,000, to be built from Underwood up the White Salmon River and across the Cascade Mountains to Yakima. The work involves a one-mile tunnel. The road will have a maximum of 1.5 per cent grade. Additional lines projected are an extension from Yakima to Beverly, 38 miles, and another 35 miles between Ellensburg and Wenatchee. Another line, 35 miles long, from North Prosser to Paterson, is also projected. Traffic across the Columbia River into Portland will be handled by huge barges, equipped to convey the fruit shipments from the rich Yakima and Wenatchee districts.

Colonel Kelly Inspects Kettle Falls Power Site

Col. William Kelly, Corps of Engineers, U. S. Army, and chief engineer of the Federal Power Commission, recently inspected the Kettle Falls power site on the Columbia River in company with Col. Edward Schulz, district engineer for the Power Commission. They were accompanied on the tour of inspection by R. L. Hearn, hydraulic engineer for the Washington Water Power Co., the organization which recently was given a preliminary permit to develop the Kettle Falls property. Col. Kelly is on an inspection tour of proposed power developments on the Pacific Coast as shown by applications on file with the commission at Washington.

A.A.E. Provides for Membership in Chapter-at-Large

As a result of chapter referendum just completed on amendments to its by-laws, the dues of each member of the American Association of Engineers will become payable on April 1 of each year instead of on the anniversary of his being made a member; and the fiscal year of the association is changed from Jan. 1 to July 1. While the collection of dues on the anniversary of a membership date avoided any peak load, the confusion on the part of chapters and members outweighed this advantage in the judgment of the members as expressed in the referendum.

The amendment extending to any member the privilege of affiliating with the chapter-at-large was carried also by 2 to 1, and is of much greater significance than either of the other amendments carried. In effect, it permits any member to belong to the national association only. Heretofore all members were required to belong to a local chapter, with the result that those who moved about considerably or who were interested in the major national problems alone felt under restraint and became dissatisfied. The amendment as adopted reads:

> Article V, Section 5: There shall be a chapter-at-large with which any member may choose to affiliate and to which may be assigned by the board of directors foreign members who cannot properly be assigned to chapters. National officers shall be ex-officio officers of the chapter-at-large.

The proposed amendment providing for a nominating committee of three to be appointed by the board of directors to place in nomination two candidates for president, and first and second vice-presidents, with the privilege retained by the members of nominating by petition as at present, was lost.

Employees Liability Law Covers Typhoid in Michigan

An employee who contracts and suffers from typhoid fever due to polluted water furnished by an employer is entitled to compensation according to a recent decision of the Michigan Department of Labor and Industry. The commission noted that the sickness was an "accident" within the meaning of the law. While a number of similar cases have been before the commission the application for compensation, according to Ray Derham, deputy commissioner, has been denied because it has been impossible for the injured employee to establish the fact that he contracted the disease during the course of his employment. The Michigan Supreme Court has never yet passed on this specific question although it has decided on cases of influenza, anthrax and blood poisoning. In Dunwood vs. Royal Indemnity Co., 218 Michigan 358, the Supreme Court discussed this class of case at length. In that case a doctor was held to have suffered an accident when an influenza patient coughed in his face and the doctor contracted the disease as a result.

A number of years ago the Supreme Court of Wisconsin decided that the contraction of typhoid fever was an accident.

Work Resumed on Sacramento Filter Conduits by Day Labor

After considerable delay work has been resumed on the intake conduits from the river to the pumping station of the Sacramento water-filtration plant. The work is now being done by day labor. A review of the original contract, the controversy with the contractor, and the final settlement appeared in *Engineering News-Record*, Jan. 13, 1921, p. 77, and April 27, 1922, p. 711. The delay has been due (1) to a lawsuit involving the validity of the new city charter and, (2) when the charter was held valid and the contract readvertised, to a lack of formal bids on Sept, 7 and to the bids received on Sept. 19 being considered too high—three bids ranging from $158,777 to $187,490 compared with the engineer's estimate of $130,000.

On Sept. 25 the city council rejected all bids and authorized the city engineer to proceed with the work on a day labor basis. This is being done under Albert Givan, city engineer, George Calder, resident engineer, filtration division, and G. M. Mott, Jr., superintendent of construction.

As originally planned, the intake consisted of twin concrete pipes of 5-ft. inside diameter, 1,000 ft. long, to be placed with the invert 35 ft. below the present ground surface or about 15 ft. below the level of the water table. This depth proved a serious obstacle to the contractor and disagreement arose after delay and alleged excessive costs in unwatering the deep trench for the pipes and in driving the tunnel under compressed air, a method substituted for the open caisson work in the hope of improving progress and costs.

The plan of locating the conduits at so low a level has been abandoned; the bids referred to above were on a modified scheme which will use the original low intake and delivery terminals as already constructed but will span the distance between by a siphon, thus avoiding deep excavation. As now being constructed, the invert of the intake conduits will be only about 16 ft. below the present ground surface.

Flinn Elected as Director of Engineering Foundation

Election of Alfred D. Flinn as director of the Engineering Foundation has been announced by the chairman of the foundation. This is a new post, created by the governing board to meet the expanding needs of the foundation in its work of industrial research. This board is composed of representatives of the four founder societies of civil, mining, mechanical and electrical engineers.

Mr. Flinn will retire as chairman of the engineering division of the National Research Council, a position which he has held since October, 1921, but will continue as secretary of the United Engineering Society in order that the foundation may continue intimate relations with the Founder Societies. Mr. Flinn has been secretary of this Society and of the Foundation since January, 1918.

The Engineering Foundation Board adopted the report of the executive committee, which recommended a continuance of intimate relations with the National Research Council, including financial support.

The Engineer in Public Life

CHARLES T. MALE

This year another engineer joined the ranks of New York State's legislators. Charles T. Male, civil engineer of Niskayuna, N. Y., was named member of the New York Assembly from the First District, Schenectady County. Born March 8, 1889, he was graduated from Union College, Schenectady, in 1913 and received a master's degree in civil engineering the following year. He began his engineering work as secretary to Charles J. Bennett, state highway commissioner of Connecticut, in 1913, and up to the time the United States entered the war his professional activities included a period of teaching at Union College, service on the Panama Canal as sanitary inspector and topographic draftsman, and a period with the New York State Department of Health as sanitary inspector on special investigations in Long Island. From 1916 to 1917 he was engaged in building construction for the American Locomotive Co.

Entering the army in May, 1917, he served with rank of second lieutenant and first lieutenant, Engineers, and later as captain, Sanitary Corps. He spent seventeen months in France with the A. E. F. in charge of investigations of water supply for troops. On his return to the United States he resumed his connections with the American Locomotive Co., but left that organization in 1919 to become instructor in engineering mathematics at Union College, later rejoining the State Department of Health as assistant sanitary engineer. For a short time in 1921 he filled an unexpired term, by appointment, as town superintendent of highways at Niskayuna.

Assemblyman Male believes that the engineer, by virtue of his training for the utilization of natural resources, should help in the solution of the problems of the state. He has no sympathy with the belief that a professional man should keep out of politics.

Landis Award Committee Places 20,000 Workmen

The employment bureau of the citizens' committee to enforce the Landis Award in Chicago had placed, up to Sept. 7, more than 20,000 mechanics and laborers in the thirteen "outlaw" trades where the unions refused to accept the scale of wages and working conditions laid down by Judge Landis. Of this total 8,046 were carpenters; 2,947, laborers; 2,778, painters; 1,920, sheet metal workers; 1,247, plumbers, and 725 lathers Since the construction boom started the service bureau has averaged more than 100 placements per day.

Newark Retains Staniford in Bridge Case

The city of Newark, N. J., has retained C. W. Staniford, consulting engineer, of New York City, and former chief engineer of the Department of Docks of that city, to report on the proposed bridge of the Central Railroad of New Jersey across lower Newark Bay. Mr. Staniford has been instructed to make a survey of Port Newark and submit recommendations as to the practicability of re-routing traffic now on the Newark Bay bridge over the Newark branch bridge above Port Newark or through a new tunnel to be built under the bay.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City, Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17 and 18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

Personal Notes

CHARLES F. WOOD, for the past four years designing engineer and assistant to the construction engineer on the Braden Copper Co.'s extension of plant in Chile to 10,000-ton daily capacity, has become associated with the Frederick Snare Corp. as construction engineer in charge of all port and terminal developments for the Ferrocarriles del Norte de Cuba at Puerto Tarafa, Cuba. Puerto Tarafa is at present the main sugar port of Cuba, exporting 700,000 tons of sugar annually.

LEWIS I. BIRDSALL, superintendent of filtration, water-works department, Minneapolis, Minn., has resigned to accept a position as water expert in the sales department of the General Chemical Co. at Chicago. Mr. Birdsall has been in the former position since the plant was started in January, 1913, and is well known in the water-works field, having written many articles on the operation of water-purification plants. He has been president of the Engineers' Club of Minneapolis and chairman of the Minnesota Section of the American Water-Works Association. ARTHUR F. MELLEN, assistant superintendent of filtration during the past four years, has succeeded Mr. Birdsall. Mr. Mellen is secretary of the Engineers' Club of Minneapolis,

and of the Minnesota Section of the American Water Works Association.

GERALD J. WAGNER, formerly director of public service of Grand Rapids, Mich., has been engaged by that city as consulting engineer in public utility matters.

WILLIAM E. WOOD, president of the W. E. Wood Co., Detroit, Mich., general contractors, has been nominated for president of the Associated General Contractors of America for the 1923 term.

VERNON R. COVELL has been appointed county engineer of Allegheny County, Pa., to succeed J. G. Chalfant who died recently. Mr. Covell has been deputy county engineer of Allegheny County for the past fifteen years.

L. P. O. EXLEY, office engineer for the Gulf, Mobile & Northern R.R. Co. and the Meridian & Memphis Ry. Co., has been promoted to assistant chief engineer, with headquarters at Mobile, Ala.

M. L. WORRELL, formerly of Meridian, Miss., has been appointed engineer and manager of the Vicksburg, Miss., water-works. He replaces J. A. STEELE, JR., former manager, who has resigned on account of ill health. Mr. Worrell is a former captain in the Construction Division of the Army. He was field engineer of several southern water plants from 1892 to 1907; superintendent of public works, Rome, Ga., 1908-10; and engineer and manager, water-works, Meridian, Miss., 1911-1917. He has been in the practice of public utilities engineering at Meridian and Lafayette, La., since his discharge from the Army.

SPOONER and MERRILL, consulting engineers of Grand Rapids, Mich., announce the opening of an office in the Harris Trust Building, Chicago, in charge of George Henry Knutson, formerly with the Harris Trust and Savings Bank. Mr. Knutson accepts the position as a resident partner.

CLARENCE R. MOORE, EDWARD W. SANFORD, EDWARD R. FOSTER, and HARRY W. FARRAND have been appointed by Director Caven, of the Philadelphia Department of Works, assistant engineers in the department.

PAUL STARRETT, formerly president of the George A. Fuller Co., and W. A. STARRETT, formerly a vice-president of the same company, have formed a partnership under the firm name of STARRETT BROS., INC., builders, with offices at 101 Park Ave., New York City. Both men are well known in the construction field. For thirteen years William A. Starrett was a member of the firm of Thompson, Starrett & Co., during five years of which time he had charge of all construction work, then becoming executive vice-president of the firm. He later became senior member of the firm of Starrett & Van Vleck, architects, New York City, still later becoming associated with the George A. Fuller Co. in an executive capacity.

EARL BRACKEN, formerly an office engineer with the Kittitas Reclamation District, Ellensburg, Wash., has become connected with Powell & Jacobs, consulting engineers of Hamilton, Mont., as office engineer.

EARL J. WHEELER, until recently in private engineering practice, is now associated with M. Tschrigi & Sons, of Cedar Rapids, Iowa, sanitary and municipal consulting engineers. Mr. Wheeler is in charge of paving and sewerage work.

STEWART BLACKMAN, formerly an assistant engineer in the Massachusetts Highway Commission, has become associated with the Kansas City Power & Light Co. as engineer and draftsman.

PAUL BAYLISS, a valuation engineer with the American Appraisal Co., has been appointed an assistant engineer with the Central Illinois Public Service Co. He is stationed at Galatia, Illinois.

J. MCLANE TATE, until recently a project engineer with the New Mexico State Highway Commission, is now connected with the Wilkie Woodard Co., of Los Angeles, Calif., civil and landscape engineers. Mr. Tate's position is that of assistant engineer.

F. M. TOWNSEND, until recently employed in the engineering department of the M., K. & T. R.R., is now with the Hudson River Connecting R.R. and stationed at Selkirk, Albany County, N. Y. His position is that of junior engineer.

HARRY D. ELLIOTT, formerly with S. S. Boggs, county engineer of Warsaw County, Ind., is now one of the testing engineers with the Illinois State Highway Commission.

C. K. REDFIELD is now a designing engineer for the Truscon Steel Co. and is stationed in the Detroit office. Mr. Redfield was formerly bridge engineer for the Oakland County Road Commission and located at Pontiac, Mich.

L. H. USILTON, formerly a superintendent of construction for the Turner Construction Co., New York City, is now connected in the same capacity with the Barney-Ahlers Co., New York City, industrial building contractors.

M. RADUS has severed his connection with the Submarine Boat Corp., with which concern he was employed as field engineer, to become associated with the New Jersey State Highway Department. His position is that of assistant civil engineer, and he is stationed at Washington, N. J.

H. M. NEIGHBOUR, until recently resident engineer on concrete paving, El Paso Co., Tex., has now become field man on concrete bridge work for the Maricopa (Ariz.) County Highway Commission. He is stationed at Phoenix.

L. L. SHIREY, formerly an assistant engineer with the C., C., C. & St. L. Railway Co., has been made a designing engineer with the same road. He is stationed in Cincinnati.

C. D. BOWSER, formerly employed by the Mount Vernon Bridge Co., of Mount Vernon, Ohio, has been elected an instructor in structural engineering at the University of Michigan.

J. E. BUTLER, building inspector of Richmond, Va., has tendered his resignation. It became effective Oct. 1. However, reconsideration of his decision to resign has been sought by builders, contractors, and other interested business men in Richmond through the circulation of a petition. As yet no successor has been named.

OBITUARY

HENRY P. BORDEN, a former member of the Board of Engineers of the Quebec Bridge, at one time consulting engineer to the Department of Railways and Canals of the Canadian government, and more recently in private consulting practice in Ottawa, died in that city Oct. 19. Mr. Borden was born in Port la Tour, N. S., and was graduated from McGill University, Montreal. He began his professional career as an assistant engineer in the bridge department of the Canadian Pacific Ry. at Montreal. He then became assistant chief engineer in the structural department of the Montreal works of the American Locomotive Co. Later he was made structural engineer for the Canadian Pacific. In 1908 he became assistant engineer, Board of Engineers of the Quebec Bridge, being appointed a member of the board early in 1916 upon the death of C. C. Schneider, a position which he held until the work was finished. From 1919 until 1921 he was engaged by the dominion government in a consulting capacity. He was a member of the Engineering Institute of Canada and of the American Society of Civil Engineers.

CHARLES P. LOVELAND, a civil engineer of Montreal and a native of Bangor, Me., died in Montreal Oct. 19, aged 51 years. Mr. Loveland had gone to Canada in 1907 in connection with municipal water-works contracts. Later he became identified with the Leahy Construction Co., and still later with the J. W. Harris Manufacturing Co.

R. C. P. COGGESHALL, for the past 50 years connected with the water-works of New Bedford, Mass., and for more than 25 years of that time its superintendent, died in that city Oct. 20 after an illness of many months. Mr. Coggeshall was widely known in the water-works field having been one of the first secretaries, presidents and editors of the New England Water Works Association. He was also active in the American Water Works Association. An extended biography will appear in a later issue.

JOHN N. COLE, state commissioner of public works of Massachusetts, died Oct. 18 in Boston. Mr. Cole had been prominent in public affairs in Massachusetts for twenty years or more. He entered newspaper work when a young man, becoming publisher of the paper first employing him. He successively occupied the positions of representative from Andover to the state legislature, speaker of the Massachusetts House, chairman of the Commission on Waterways and Public Lands, and Commissioner of Public Works. Into the last commission was merged the Waterways and the Highways Commission. Mr. Cole had always been a hard worker in any public position he occupied and during the last two years had made a particular fight to secure increases in motor-vehicle fees in Massachusetts in order to have more money with which to build roads.

From the Manufacturer's Point of View

Water-works Men Give Views on Buying Pipe in Winter

Discussion Starts on Proposal of Manufacturers To Spread Purchases Over Entire Year

At *Engineering News-Record's* request a number of water-works engineers and water department officials have expressed their opinions regarding the desirability of buying cast-iron pipe during winter and increasing the amount of construction in cold weather, as suggested by the manufacturers in last week's issue. The discussion follows:

FRANK A. BARBOUR
Barbour & Dixon, Civil and Sanitary Engineers, Boston

In reference to spreading the purchase of cast-iron pipe throughout the year, there can be no question as to the desirability of such action from the standpoint of economy in manufacture.

Just how far the reduction in cost of the pipe would, in New England, be offset by increased cost of handling and laying is a question. In cross-country lines, where the work is large enough to justify modern trenching equipment, your statement that the cost of excavation will not be much increased may be true, but on the average job in New England winter work does not pay. Snows interfere and the efficiency of labor falls with low temperatures.

Of this fact we had a clear case last year in pipe-line work in western Massachusetts extending from Oct. 15 to Dec. 15. At the latter date the ground was frozen to a depth of 1 ft. and during the last month the men were more busy fighting the cold than in doing effective work. After Nov. 15 on the average pipe-line job in New England field costs markedly increase and, in my judgment, any experienced contractor —aside from the greater difficulty of handling frozen ground—will allow for decreased efficiency of labor under winter conditions.

In many cases it is entirely feasible to string the pipe along the line and lay the following spring, but this is not generally true in streets, particularly in the case of large pipe. Whether it is economically advisable to purchase in the winter months, place in storage yards and rehandle in the spring depends, of course, on the differential between prices at the demand peaks and under winter conditions. In any case storage in the air does not improve pipe coatings—particularly the coatings of the quality now frequently furnished.

In general, if the problem is viewed on the simple basis of final cost, there is much to be said for the present New England practice of taking delivery of the pipe only during the season of favorable weather. If final cost is made only a relative factor and the value to local labor of spreading the working period over a longer time is introduced, it is not unlikely that more winter work can be wisely undertaken in New England than has been the case in the past. It will, in my judgment, involve greater expenditure by the particular department adopting such practice, but it may re-act to the general good.

CARLETON E. DAVIS
Chief, Bureau of Water, Philadelphia

The arguments in favor of spreading purchases of pipe through the entire year are sound. Pipe users and pipe makers should co-operate to make the practice effective.

As an incentive, the foundries, following the practice which coal-mining companies apply to summer purchases, might offer a discount for winter orders. When pipe prices are stabilized such discounts might be tangible and sufficiently evident to form a real inducement to the purchasers.

There will always be an element of human nature working towards seasonal, rather than steady, buying. Once a large project, for the authorization of which considerable effort has been made, is finally financed, a strong demand for its immediate consummation arises, and quick results are required. Stock purchases of pipe for routine extensions are not subject to the same urge for action. Such buying could wisely be concentrated in the winter.

The buyer and the seller are both interested in uniformity of output and towards that end I suggest consideration of a discount for winter work.

Discussion will continue next week.

Highway Industries Exhibitors to Discuss Road Show Plans

The first meeting of directors of the Highway Industries Exhibitors Association will be held in Chicago, Oct. 27, to complete details of incorporating the association and to discuss the allotment of space to exhibitors at the Good Roads Show to be held at the Coliseum, Chicago, beginning Jan. 15.

The association has received from the Secretary of the State of Illinois a charter of incorporation. At the forthcoming directors' meeting by-laws will be adopted, officers elected, and an executive committee appointed.

Metal Lath Varieties to Be Reduced

Following the practice of a number of other producers of structural materials, the manufacturers of metal lath are co-operating with the Department of Commerce in an effort to cut the excess varieties out of a long list of products. A preliminary meeting was held in Washington Oct. 2 and a formal meeting has been arranged for Dec. 12, at which representatives of the metal lath industry, architects, plasterers, lathers, contractors, and dealers will be invited to a joint conference. W. B. Turner, of the General Fireproofing Co., Youngstown, Ohio, is chairman of the Industry Committee on this matter, and Wharton Clay, commissioner of the Associated Metal Lath Manufacturers, is secretary.

Federation to Report on 12-Hr. Shift in Industry

Will Answer Vital Questions Regarding Work Conditions and Their Effect on Production

Some weeks will expire before the Federated American Engineering Society report on the twelve-hour shift in American industry is available. The manuscript, however, is in the printer's hands. The report attempts to answer the following questions:

What is the extent of continuous work in American industry; what the the alternatives to the twelve-hour shift; are there technical difficulties in changing from two-shift operation; how does the change from two to three-shift operation affect the number of shift workers; what are the factors to be considered in changing from two- to three-shift operation; what is the effect of eight-hour as compared with twelve-hour shift operation, on the quantity and quality of production, absenteeism, labor turnover and industrial accidents; how do wage rates on eight-hour shift operation compare with wage rates on twelve-hour shift operations; what is the general opinion of managers of three-shift plants regarding three-shift as compared with two-shift operation; do employees make good use of the increased hours of leisure; and to what extent have plants reverted to two-shift operations?

Will Deliver Construction Plant Catalogs in Russia

An offer to deliver catalogs of American manufacturers of construction plant and materials to the leading engineering society in Moscow, Russia, has been received by *Engineering News-Record* from Marcus S. Hill, who is planning to sail for Russia early in November, as a representative of three firms selling surplus army clothing, meat packers' supplies, and plows.

"After an absence of three years," Mr. Hill writes, "I will return to Russia on business and will be happy to take with me any literature pertaining to technical or engineering subjects which readers of your journal feel inclined to contribute. Catalogs (in duplicate only) covering equipment used in excavation, building construction, and every phase of general construction will, I know, be keenly appreciated, as well as catalogs describing plant employed on municipal work, power plants and irrigation.

"Business," Mr. Hill adds, "may or may not come from the sending of these catalogs—that is not the main object just now—but I am confident that the men reading the literature for which I am asking will never forget the kindly feeling shown by the firms which respond to this request and will remember the senders when opportunity offers in the form of possible business. All the literature received will be handed to engineering societies in Moscow."

Manufacturers who wish to avail themselves of Mr. Hill's offer may send their catalogs and other literature (in duplicate only) to Marcus S. Hill, care of the Editor, *Engineering News-Record*, 10th Ave. at 36th St., New York, N. Y.

Business Notes

J. S. Mundy Hoisting Engine Co., Newark, N. J., has under way an expansion of its plant in the form of a 40 x 96-ft. corrugated steel building for the storage of boilers and stock parts for its hoisting engines. It will be equipped with a monorail and 5-ton electric hoist. The new structure will relieve the congestion in its main shop due to the recent installation of new machine-tool equipment, including six new boring mills, several milling machines, new cylinder planers, and drill presses. Since Jan. 1 production at the Mundy plant has increased 100 per cent and plans are now under way to double existing manufacturing facilities by constructing, this spring, a new building prolonging the existing main shop and installing additional equipment.

F. L. Paddock, former manager of the Chicago office of the Hydraulic Steel Co., has become secretary-treasurer of the Racer, Gale, Paddock Co., Lantana, Fla., a real estate development organization.

Equipment and Materials

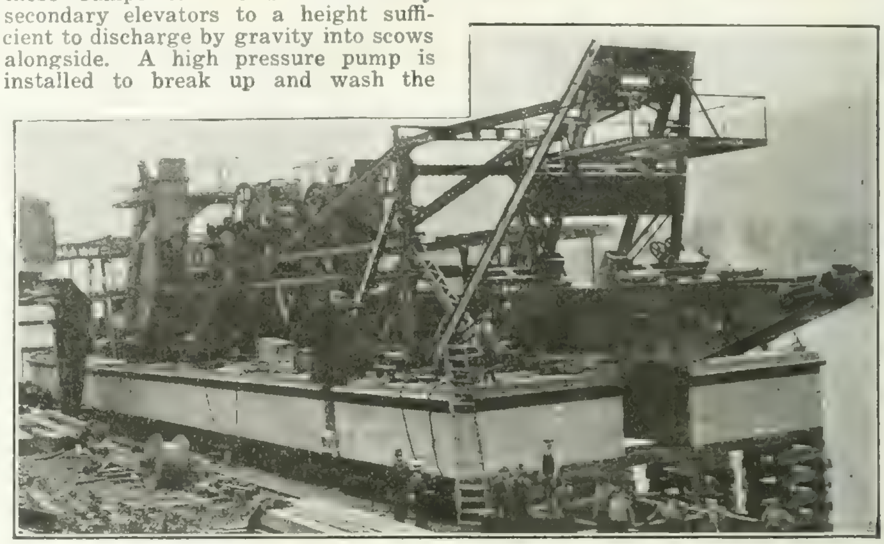
Big Sand Dredge Has Diesel-Electric Power Equipment

Special design features, chief among which is the use of Diesel-electric power equipment for driving an endless chain of heavy excavating buckets, each of 8 cu.ft. capacity, have been incorporated in the large floating elevator dredge for reclaiming river sand and gravel which the Bucyrus Co., South Milwaukee, Wis., constructed recently for the Iron City Sand Co., of Pittsburgh. The dredge, fully equipped, weighs 900 tons and its manufacturers give its capacity as 150,000 cu.yd. per month. It will dig 50 ft. below the water surface.

Material, as excavated, is delivered to barges alongside and by means of screens is separated into sand and three grades of gravel. Any or all of the various sizes of gravel may be saved or rejected as desired. The oversize stones—everything in excess of 2¾ in.—are rejected by the screen and returned to the river. Stones over 8 in. in diameter are rejected by a set of grizzley bars before reaching the screen.

The digging end of the dredge consists of an endless chain of close-connected 8-cu.ft. buckets mounted on a structural steel digging ladder 95 ft. long, suspended concentrically with the upper tumbler and inclined at an angle of 45 deg. for a maximum digging depth. Each bucket weighs approximately 1,500 lb. and consists of a nickel-chrome steel casting, forming a link and bowl, with manganese steel lip for the cutting edge. The complete weight of the ladder with its chain of buckets and tumblers is approximately 225,000 lb.

Excavated material is delivered through a hopper into a revolving screen 7 ft. in diameter by 32 ft. long. The sand screen is about 8 ft. 6 in. in diameter by 16 ft. long and surrounds the revolving screen at its upper end. The sand and various grades of gravel are conducted by chutes to sumps in either side of the hull immediately abreast of the revolving screen. From these sumps it will be carried by secondary elevators to a height sufficient to discharge by gravity into scows alongside. A high pressure pump is installed to break up and wash the material which is delivered to the screen.



Power for operating the dredge is supplied by a 300-hp. Diesel type, four-cylinder, two-cycle, solid injection oil engine manufactured by the Worthington Pump & Machinery Corp. This engine operates at a speed of 277 r.p.m. and is direct-connected to a 270-kva. Westinghouse, 3-phase, 60-cycle, 440-volt generator.

The bucket line is driven from a 125-hp. motor which is also used for raising the spuds and hoisting the ladder. The revolving screen is driven through a series of gear reductions and a friction drive roller from a 50-hp. motor. The secondary elevators are driven through suitable gear reductions from 15-hp. motors mounted overhead near the elevator tumblers.

The dredge is held to its work by four, steel-armored wood spuds which are about 65 ft. long and mounted in casings at either side of the dredge near the bow and stern. The principal movements of the dredge will be controlled by a single operator located in an overhead pilot house or lever room, so that he can at all times command a good view of the bucket line.

The hull is of steel construction throughout, having a length of 160 ft., a width of 40 ft. and a depth of 7 ft.

The Diesel electric power equipment was chosen primarily because of the trouble encountered in various rivers with impure boiler feed water. The plant, the Bucyrus Co. claims, will be more economical in operation than a steam dredge.

Shovel Company Seeks Records of Operating Costs

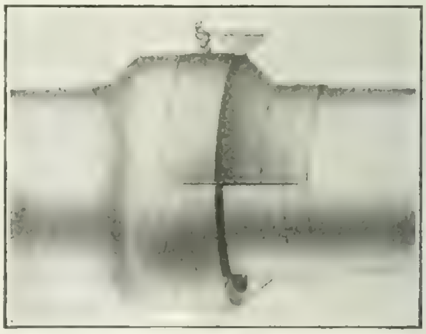
The Erie Steam Shovel Co., Erie, Pa., announces a prize competition to secure data on the output and cost of operation of its revolving steam shovels. The contest is now open and will continue until Dec. 31. Conditions are outlined as follows:

"Records may be sent in by steam-shovel owners, managers or any employee in direct contact with steam shovel work. In every case, however, the record must be accompanied by a written statement from the owner of the machine to the effect that the figures submitted are correct to the best of his knowledge. The record should include approximate number of days the machine has worked, yardage moved, class of materials, and all upkeep costs exclusive of cable, dipper teeth and grate bars."

Further information regarding the contest may be secured from the Erie Steam Shovel Co., Erie, Pa. The judges of the contest will be Arthur S. Bent of Bent Bros., contractors, Los Angeles; Halbert P. Gillette, editor *Engineering and Contracting*, Chicago; and A. C. Vicary, vice-president, Erie Steam Shovel Co.

Waxed Paper Gasket for Poured Sewer Pipe Joints

For pouring bituminous or grout joints in vitrified tile sewer pipe the G-K Sales Agency, Macungie, Pa., has developed a special gasket of thin waxed paper, in two sections, shaped to conform to the bell and spigot of the pipe. As shown in the accompanying illustration, the gasket is fastened on



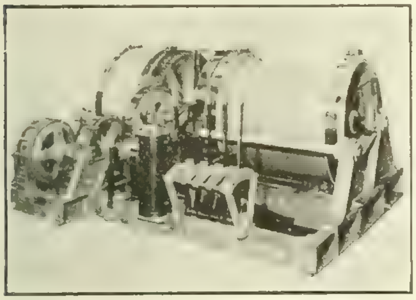
the pipe with cord. It has sufficient strength to sustain the weight of the compound or grout and is not affected by the heat of the jointing material.

The gasket was designed in an effort to secure a more practical runner than the asbestos jointer ordinarily used. With the latter, backfilling of the trench must be delayed until the joint compound has set, entailing loss of time and labor in removing the runner. With

the waxed paper gasket the pipe layer or inspector can pass his hand around the joint and determine, by the radiation of heat, whether the whole joint is filled. The gasket, it is claimed, is so inexpensive that contractors find it economical to leave it on the joint and backfill as soon as pouring is completed.

American Hoisting Engines for Service in Japan

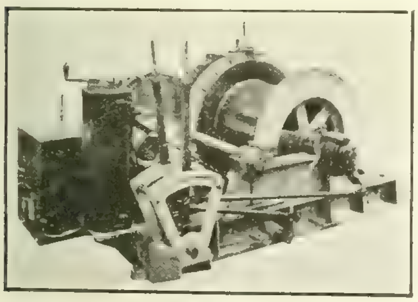
For use on construction projects in Japan the J. S. Mundy Hoisting Engine Co., Newark, N. J., has recently shipped six hoists embodying special features of design. Two of the units are intended for cableway service and hydro-electric developments for which the firm of Thebo, Starr & Anderton, San Francisco, are consulting engineers. Illustrated is a 75-hp., two-speed unit with a



TWO-SPEED, 75-HP. CABLEWAY HOIST

capacity of 50,000 lb. The drum is 53 in. in diameter and 42 in. long, and will serve a cableway span of 1,250 ft. Vertical hoisting speeds of 25 and 100 ft. per minute and horizontal traveling speeds of 500 ft. per minute are provided for. This hoist is equipped with double brakes, allowing the handling of heavy loads on long lifts.

The other hoist is a single-speed, 140-hp. unit, capable of raising loads of 5,000 lb. at 200 ft. per minute. The



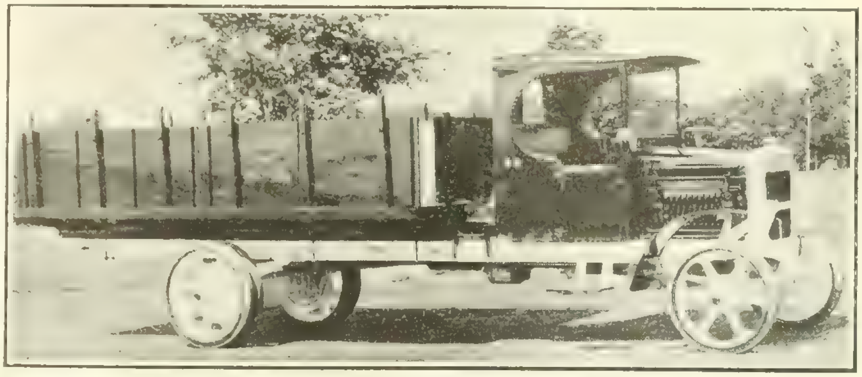
80-HP. HOIST FOR OVERHEAD TRAMWAY

maximum horizontal traveling speed is 1,000 ft. per minute.

The four hoists for overhead tramway service, previously referred to, are of 67, 80, 100, and 300 hp. respectively. A feature of their design is the use of cast steel drums to provide extra strength and solenoid brakes for safety.

New Model of Heavy Duty Truck

A new model of its 3½-ton motor truck for general heavy duty is announced by the Atterbury Motor Car Co., Buffalo, N. Y. The chassis weight is 7,500 lb., body weight allowance 2,500 lb., and among its features are the latest type of Continental motors (four cylinders, 32.4 hp.), amidship transmission, left-hand drive and com-



plete electric lighting equipment. The truck has four speeds forward and one reverse. The frame is of hydraulic pressed steel, bolted throughout, no rivets being used.

The standard wheelbase is 14 ft. 6 in., although a special short wheelbase of 12 ft. 6 in. and a special long wheelbase of 16 ft. 6 in. are provided. The short-wheelbase truck is designed especially for contractors' use with a 10-ft. dump body. For this truck claims of operating flexibility are made due to its short turning radius. The photograph shows a 16½-ft. wheelbase model for the Bureau of Water, Buffalo, N. Y.

Publications from the Construction Industry

Asphalt Pavement—BARBER ASPHALT Co., Philadelphia, in an illustrated booklet entitled "The Last Analysis," presents service records of pavements in which Trinidad Lake asphalt has been employed. The first sheet asphalt pavements constructed in this country about 48 years ago, it is stated, were built for the most part of Trinidad asphalt, in Newark, N. J., Washington, D. C., and New York City. Yardages of asphalt pavement in a number of cities and their ages are listed.

Compressed Air Tools—INGERSOLL-RAND Co., New York, has just issued a 32-p. booklet entitled "Trench, Tunnel and Pipe Work by Compressed Air" in which many uses of air tools by contractors and public utilities are described and illustrated. Many of these uses have only been developed recently in connection with the portable wagon-mounted air compressors. Among the subjects covered are pneumatic clay diggers for both trench and tunnel work, paving breakers for cutting pavement, Jackhamer rock drills in trench work, pneumatic calking of lead wool and cast lead, pneumatic backfill ramming and service pipe installation. In each case the use of the air tool is compared to the hand method to show the actual saving.

Anti-Slip Tile—AMERICAN ABRASIVE METALS' Co., New York, sales representatives for the Carborundum Co., Niagara Falls, N. Y., features anti-slip tile for stair treads, elevator landings, ramps, and general floor surfaces in a 22-p. illustrated booklet. The tile are made of one of the modern artificial abrasives, a product of the electric furnace, crushed and mixed with clays and other ceramic materials and finally molded into various sizes and shapes. The tile are then vitrified in high temperature kilns. The tile cannot wear smooth and have a high resistance to wear, according to the claims of their manufacturer. The booklet illustrates the use of the anti-slip tile on stairways, floors, ramps and swimming pools. A specification guide for the placing of the tile also is included.

Treated Ties and Timber—CENTURY WOOD PRESERVING Co., Pittsburgh, has issued Bulletin 24 dealing with treated ties and timbers for industrial plants. It comprises 24 pp., illustrated, covering the destructive influence of moisture on timber and methods of preventing it. Three processes used in timber treatment—surface application of preservative, open-tank treatment, and treatment in closed cylinders under pressure—are described. Suggestions also are offered on best methods of seasoning timber before treatment. Several methods of handling ties and timbers rapidly and at low cost are indicated and the concluding portions of the text deal with posts, poles, piling, and wood-block floors and pavements. Tables are given showing size and contents of cross-ties, preservative required and cubical contents of round poles and piling.

Auto Truck Snow Plow—BAKER MANUFACTURING Co., Springfield, Ill., describes in a 12-p. illustrated booklet its detachable snow plow for motor trucks. It is made in two sizes, an 8-ft. and a 10-ft. blade, the larger size generally being used on trucks of over 3½ tons capacity. The device is attached to the truck through clamps gripping the axle just between the spring shackle bolts. The blade proper, 6 in. high, is hinged to a mold-board 16 in. high and is held in position by compression springs on the back of the blade. This hinged construction is a special feature of the device for it allows the blade to be tripped in the event of its striking an obstruction. In this event the 6-in. height of the blade swings back, allowing a minimum amount of snow to be passed over without removal. Furthermore, the fact that the blade is divided into two sections longitudinally still further reduces the area through which snow may be lost when the blade is tripped. A lifting device enables the blade to be raised or lowered and it is also possible to adjust the blade to any angle desired The company also manufactures a V-shape, two-way plow for trucks.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Business Inflation and the Present Outlook

Review of a Monthly Survey Made by the National City Bank of New York

In its monthly survey of business conditions, the National City Bank of New York describes the conditions that bring about business inflation, and surveys the present situation from that angle. After pointing out the tendency of business to run in cycles, with greater confidence and activity in some years than in others, the discussion points out that development on the up trend reaches a point beyond which it is not called to pass by the demands of legitimate, wholesome expansion.

"When confidence has been completely regained and belief in a lengthy period of prosperity is established, the sanguine, speculative spirit develops. It is stimulated by the deficit in many kinds of goods and constructional work that accumulated during the depression. Consumption having been below normal for a time, the demand now rises above normal and stimulates the industries to the limit of their capacity. It does not stop there but tries to drive them beyond their capacity. Various phenomena develop now; dealers double their orders expecting them to be scaled down, or duplicate them with different producers. Manufacturers build and equip new factories to enable them to take care of the business that seems to be in sight and raise wages to attract labor from competitors or from other industries; advancing costs make it necessary to use more bank credit.

"By this time the situation is becoming abnormal. The demand for nearly everything is above the supply and above the normal or average demand, to which in the long run prices are surely adjusted. It is stimulated by speculative anticipation and by competitive buying, supported by cradit.

"The banks respond to the appeal of their customers who say that they want credit for legitimate needs in production and trade, but if production already has reached the capacity of the industry, additional credit simply finances competition for labor and material and drives wages and prices higher and higher. This is inflation: The use of credit as purchasing power in excess of productive capacity."

The discussion points out that although prices have recently shown a slight recovery after the considerable fall from war-time levels, the gain cannot be called secondary inflation; but looks like the recovery that always comes when old stocks are exhausted and industry gets fairly under way again. "Although the war time was anything but a period of depression, it continues, some of the effects were similar to those resulting from a period of depression. Industry in some lines fell behind the normal growth of the country, creating a deficit of supply or accumulation of demand. This is true in house building, in the construction of railway equipment. and in some other lines, and a revival has occurred in those lines. It is due to imperative needs rather than to a belief that the bottom has been finally reached in construction costs, although the feeling doubtless prevails that prices are not likely to go lower until the existing shortage is in large part made up. The advance in wages is due in part to the revival of industry, but in large part to the immigration act."

It is pointed out also that abnormal conditions in some of the industries are influencing prices, as for example, the effect of the coal strike upon iron and steel, which in turn has affected all industrial costs. It is contended that buyers are not contributing to inflation but are buying cautiously for immediate needs only. The increase in the demand for credit has been chiefly to carry stocks and other securities; and the rise in these indicates that capital is accumulating and that there is faith in the country's stability and progress. Although financial conditions are favorable for the encouragement of a period of inflation, it is believed that those who are counting upon one do so in the belief that the American people with their optimistic mentality cannot let pass an opportunity of the sort. To offset this, however, it is believed that the lessons of the last few years have been too deeply engraven upon the minds of American business men and that they will be reluctant to borrow and spend recklessly in expectation of an imminent boom.

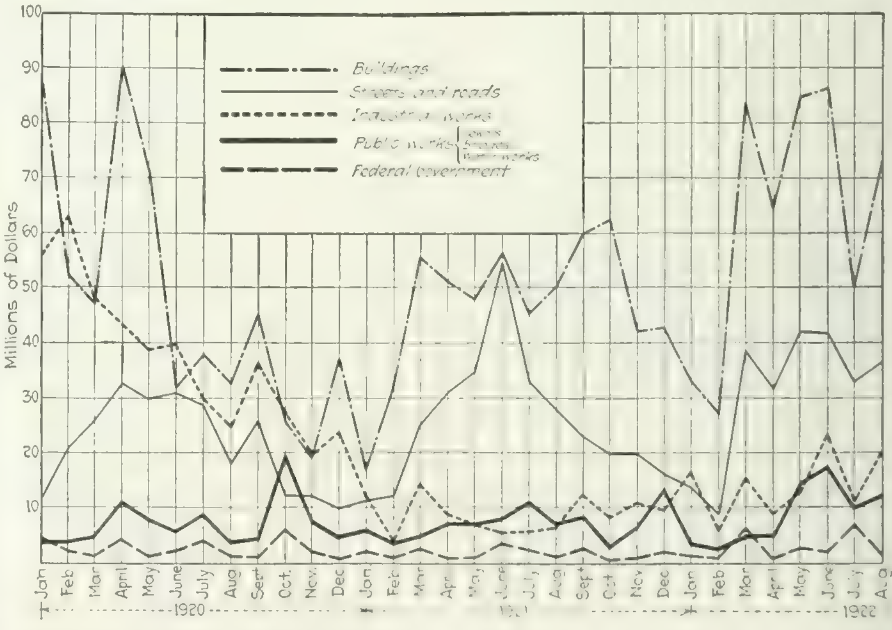
The Construction Industry Since January 1920

The accompanying chart sums up, graphically, the volume of construction contracts let during the period between January, 1920, and the present. The five principal classes of construction reported by *Engineering News-Record* have been segregated to show the effect of changing business conditions in each of the fields.

Most noticeable at first glance is the slump after the summer of 1920 and the present upward trend. Picking out the individual curves we find that buildings—mainly commercial and public buildings costing more than $150,000—fell off sharply during the summer of 1920, dropping from $90,000,000 in April to less than $20,000,000 during the following January. A large share of this drop was due to the inflated cost of building which made new construction almost prohibitive. With the falling off in costs and an increasingly urgent demand as a result of the long cessation from building during the war, this class of construction held fairly uniform during 1921 at better than 50 per cent of the 1920 peak. A fair volume of contracts was let during the last winter and this season has seen a consistently high voume of contracts awarded.

The volume of industrial construction reflects very accurately the trend of business in general. From the peak of 1920 it declines with exceptional uniformity to the low point of 1921. Today it is on a slight upgrade—very slight, indeed—but none the less accurately portraying a corresponding situation in general business.

Streets and roads show the seasonal troughs and crests but reflect the impetus that has been given to highway building by the Federal-Aid legislation. Money was not so plentiful in 1920 and the volume of contracts awarded was somewhat restricted in consequence, but in 1921 the highway construction program fairly attained its stride.



Construction Equipment Exports

For the month of July, 1922, the Department of Commerce has issued figures on exports of construction equipment from the United States. During that month 152 concrete mixers, valued at $93,702, were shipped. Of that number, 104, valued at $61,435, went to Japan; 7, valued at $8,475, went to Quebec and Ontario, Canada; 7 were sent to British India and 4 to Mexico.

Federal-Aid Roads Have Record Year

More Than 10,000 Miles of Highways Completed During Year Ending June 30—Labor Costs Higher

More than 10,000 miles of Federal-aid highways were completed during the fiscal year ending June 30, according to a compilation by the Bureau of Public Roads. The Bureau also reports that the present calendar year has exceeded all previous records for road construction, incomplete data leading the Bureau to estimate that during 1922 the sum of $742,000,000 will have been spent on Federal-aid highways, State roads and projects constructed by other agencies.

On July 1, 1921, the Bureau's figures showed the total mileage of completed Federal-aid highways at 7,500, with an additional 18,000 miles in various stages of construction. On June 30 last, the completed Federal-aid mileage had more than doubled, the total being 17,700 miles, with 14,500 miles under construction, estimated by the Bureau to be 56 per cent completed, on the average.

Texas led the states in total mileage of Federal-aid highways completed in the fiscal year ended June 30, with 933 miles. Arkansas, Georgia, Iowa, Minnesota and North Carolina each reported more than 500 miles of Federal-aid roads completed within the year, the Bureau's announcement states, while Montana and Wisconsin each completed more than 400 miles.

The statement shows that since 1916 more than 30 miles of bridges have been built on Federal-aid projects. One of these, from Mandan to Bismarck, N. D., is 3½ miles long and cost $1,428,000, of which the Federal government contributed half.

Wage schedules, applying on thirty-nine different kinds of labor used in Federal-aid road work in August, show slight advances over those in effect during June. Common labor, for instance, in road paving operations, advanced 1c. per hr. in the East and West South-Central Sections as well as in the West North-Central Division; the same grade of labor rose 3c. in the East North-Central, 4c. in the Mountain Division and 5c. per hr. in both the New England and Middle Atlantic States. The South Atlantic Group quoted 39c. in August as against 20c. per hr. during June. In the Pacific Division, however, the rate remained unchanged, at 50c. per hr.

Fewer Bad-Order Cars Than at This Time Last Year

Freight loadings for the week ending Oct. 7 totaled 968,169 cars, a decrease of 20,212 from the week preceding but an increase of 68,488 over the corresponding period in 1921. A considerable part of the reduction in total cars loaded, however, is undoubtedly due to the heavier loading of each individual car. This has resulted in a decrease in the number of cars required for the same tonnage, thereby increasing the available supply. The American Railway Association further reports shortages of 71,063 box, 40,499 coal and 141,252 general freight cars for the week ended Oct. 7.

Bad-order cars, however, are at present about 20 per cent under the number on hand at this time last year.

The railways of the country reported 44,703 serviceable locomotives on hand Oct. 1, as against 19,727 in need of repairs. This represents an increase of 538 over the number serviceable on Sept. 15, due to the installation of new locomotives as well as the greater number being repaired and turned out by the shops.

Propose that Congress End Issue of Tax-Free Securities

Proposals to end the issuance of non-taxable securities will be urged upon Congress at its short session, according to reports current in Washington. The question of tax-free bonds is said to be tied up closely not only with the tax problem but also with the general industrial prosperity.

Diversion of capital from private industry to the shelter of tax-free bonds of cities and other sub-divisions of states is declared to have reached such a point that public debts are being run up beyond reasonable needs while business in general is forced to pay unreasonable interest charges to raise the capital for much-needed development.

Plans now under discussion contemplate a resolution proposing a constitutional amendment to outlaw tax-exempt securities. Support is expected from President Harding, Secretary Mellon and other treasury officials. In other quarters it is held that no constitutional amendment is necessary or desirable, and that if the federal government will desist from issuing tax-exempt bonds the way will be open for the states

AUGUST FEDERAL AID LABOR REPORT—AVERAGE HOURLY PAY BY GEOGRAPHIC DIVISIONS

Kind of Labor	New England			Middle Atlantic			East North Central			West North Central			South Atlantic			East South Central			West South Central			Mountain			Pacific		
	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural
Foremen																											
Miscellaneous			1.00		.55						.50														.56	.55	...
Superintendents	1.10	1.10	.93	1.12	1.18	1.05	.76	.95	.98	.88	1.05	88	74	.83	1.00	.86	.56	.55	.92	.88	1 18	1 00	1.02	.98	1.14	1.15	1.00
Foremen	.67	.70	.77	.68	.67	.67	.70	.67	.67	.65	.70	.62	.48	51	57	58	.56	.55	.50	.59	.64	.71	.70	75	81	.85	.81
Subforemen	.66	.55	.68	.56	.58	.55	.47	.54	.56	.48	.54	.57	.37	.41	42	.57	.45	.42	.43	.47	.48	59	.63	.59	.67	.67	.73
Operators																											
Miscellaneous	....	....	..		.50		.50	.54		.61	.43	.55	1.00	.62	.40		.41	31	....	.43	.50	.63	.67	61	.62	.61	62
Auto drivers	....		.45	.53	.44	33		.48		.50	.35	.43	.28	.25			.38			.52			.40	.50	.56	.60	.56
Truck drivers	.52	.51	.46	.45	.44	.43	36	.41	.36	.38	.38	.38	.27	35	35	30	35	32		.34	27	55	.53	.45	.65	.66	.63
Roller engineers	.66	.64	.50	.55	.62		.55	.48		.41	.54	.70	.45	.49		.51	.44		1 00			.54	.65		.74	.75	...
Machine drillers	.58	.60	....	.51	.48						.40	70	.35	.39		.60	.33		.50	.35	....	.54	.75		.62	.62	
Mixer operators		70	...		.66	51		55	59	.37	.60	.38	.60	53	.41	.43	47	32		.59	.32		63	62		.97	.73
Steam shovel operators	1 01	.94		.90	.96	.65	88			.72	.50		.81	72		.76	.63		1 12	.65		84	60	.78		1.10	
Tractor operators	47	43		.49	.47		.55	48		.58	.56		.32	.39		.36	.37	45	.60	.43			67	.75	.76	.71	.75
Jackhammers	.50	.50		.49	.54	...				.53	.40			.32		.27	.29	.45				.57			.67	.59	
Crane operators	1.16	.92			.75	.75		72	.73	.62	66		...	.77	....		.49	.60		.66	.58	.62	64			1.10	
Enginemen	.64	.57	.47	.51	.50	.55	.55	.44		.50	49	49	.44	.30	.48	.46	.40	.38		.42	.53	60	66		69	.75	
Skilled labor																											
Miscellaneous	...	.60	.60	.56	.45	.50	.68	.40		.54	.50	.44	1.10	.32	.34	.45		.36			75	50	.53	.50	.60	.64	.62
Blacksmiths	.51	.55	.59	.50	.55	.57	.45	.68	.40	.56	.66		.33	.50	.50	.43		.50	44	41	.40	62	55	.58	.66	.71	.72
Bridgemen	....	...	.85			.81				.60		.49	..		.82			.51			.41		.50	.42			.62
Carpenters	.57	.60	.68	55	.53	.53		60	.52		.60	.64	.60	48	.45	69		.48		.75	.51	65	60	.67	.80	.75	.77
Bridge carpenters	....	...	.82		.67	.67			.48	...	.50	.51		.40	.48	.75		.50			.55		49	67	.70	.	.63
Drillers	.56	.50	..	.48	.52		.50		...	.51	.48		35	.26		.26	.35			.20		48			.53		
Firemen	.67	.60	...	.48	.47	.40	.47	.38	.40	.45	.37	.45	.31	.38	28	.40	.35	.26		.27	27	.50	.52		.74	.66	
Finishers	....	....	....	....	.53	.45	.	.46	....		.46	.70	.45	.51	..		.30	.30		.45	.38		.53	70		.54	
Concrete finishers	....	.53	.50	....	.50	.50	. .	.51	.59	.	.53		.40	.33	.32	.35	.46	.31		.43	.34		.55	.53			.68
Masons	....	...	.82	.42	..	..	.		..					1.00	.54	.	..	.61			.22			.71		...	.52
Mechanics	.52	.62	....	....	.56	.51	...	.71	.60	.34	.47		75	.51	.60	.71	.52	.52		.44	....	.83		.75	65	.40	
Powdermen	.45	....	....	.50	.53		..		.	.53	.41		.43	.30		.60	.26	....	.30	.35		61			.62	.61	
Commissary labor																											
Miscellaneous	.	...	...	.	.50					.50				.30						.35		.56	.55	.60	.59	.59	50
Cooks	.53	.45	...	.50	.50		.54	.46	.60	.43	.49	.33	.30	36		.21	.22	.22	.24	.25	43	.47	.43	.34	.55	.53	54
Assistant cooks	.37		.	.	.40		.45	.45		.28	.38	.30	.20	.27		14	14	.12		.17	.35	.37	.31	.37		.30	
Cooks' help	.30	.30	.	..		.30	.38			.28	.27	.32		.20		.15	.14	.15	20	.12	.20	.39		.26	.36		
Flunkeys	.10			.35	.30					.29	.27			.17		.15	.15	.13	.19	.14	.17	.34	.30	.30	.31	.35	
Waiters	.	...			..	.			...	...	...		35		.	.14	.12	.12	.10	.10	.10		.	....	.49	.40	..
Common labor																											
Miscellaneous	..	...																						...	.43	.40	...
Common labor	.40	.43	.42	.36	.38	.38	.34	.33	.35	.31	.33	.32	.31	39	.50	.22	.21	.23	.25	.25	.25	.40	.39	.37	.50	.50	.51
Teamsters	.39	.40	.34	.43	.48	.46	.34	.38	.32	.28	.29	.30	.50	.57	..	.24	.17	.23	.23	.25	.24	.40	.39	....	.50	.44	..
Teams																											
Teams	.68	.72	.60	.68	.70	.67	.31	.40	.47	.25	.27	.26	.20	.21	.19	.42	.46	.46	.37	.37	.35	.36	31	.62	.38	.36	
Team incl. teamsters	.72	.76	.77	.69	.70	.68	.63	.63	.63	.59	.64	.59	.20	24		.47	48	49	.48	48	46	.73	.47	.61	.62	.80	
3 Horse teams	1 02	60	...									62												...	..	.	..

Note—Rates in dollars and fractions of dollars.

and municipalities to follow suit. It it held that one reason for the spread of the tax-free bond is the competition of the federal securities of that description.

Final Cement Figures Slightly Higher Than Estimated Total

Final figures on the output of portland cement during 1921, compiled by the United States Geological Survey from reports of all producers, show that production was a little less than 99 per cent of that in 1920, the record year. Statistics for the year 1921, up to the present time, were based mainly on reports of producers but in part on estimates. These estimates, however, were found to be only about 0.6 per cent lower than the final production figures.

Department of Commerce statistics show exports of hydraulic cement from the United States in 1921, at 1,181,014 bbl., valued at $4,276,986, or $3.62 per bbl., as compared with 2,985,807 bbl., valued at $10,045,369, or $3.36 per bbl., in 1920. The exports went principally to the West Indies, South America, Mexico and Central America. Imports in 1921 were 122,322 bbl., valued at $388,842 or $3.18 per bbl. as compared with 524,604 bbl., valued at $1,254,729 or $2.39 per bbl., in 1920.

Total production for the entire country during 1921, reached 98,842,049 bbl., 81.5 per cent of which were burned with coal as fuel; 10.2 per cent using crude oil; 5.6 per cent with both coal and crude oil and 2.7 using oil, coal and gas.

Pennsylvania held the lead, during 1921, with a total output of 27,628,598 bbl., from twenty-two mills.

Bids Wanted on Big Filtration Job

Proposals will be opened, on Dec. 1, 1922, for a 10,500,000 gal. filtration plant; a 10,500,800 gal. concrete reservoir; c. i. pipe and castings, at the office of M. Rivera Ferrer, Commissioner of Public Works, San Juan, Porto Rico.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of October 5; the next, on November 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.14	$3.95	$4.20	$2.90	$3.15	+$3.85	$3.25	+$3.80	$3.75
Structural rivets, 100 lb.	3.85	4.60	6.00	3.35	4.00	4.80	4.50	5.00	6.50
Reinforcing bars, ¾ in. up, 100 lb.	3.04	3.85	4.00	2.80	3.05	3.85	3.00	+3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	+54%	61.15%	45%	59½%	58.9–5%	+41%	47.9%	45%	30.00
Cast-iron pipe, 6 in. and over, ton	55.30	51.00	51.50	48.70	55.50	63.00	51.00	54.00	55.00
Concreting Material:									
Cement without bags, bbl.	2.60	2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd.	1.75	2.00	2.25	2.00	1.75	1.75	2.25	1.00	1.50
Sand, cu.yd.	1.00	1.35	2.25	2.00	1.00	0.75	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	1.65	1.60	2.25	3.50	2.25	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59.00	42.00	40.00	51.00	41.00	39.75	35.00	24.50	50.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	25.00	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.14½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	—16.90@18.55	12.00	10.90	11.00	18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	.09	.065	....	.11	.08@.16
Hollow partition tile 4x12x12, per block	.1230	.0776	.115	.0808	....	.065	.108	.11	...
Linseed oil, raw, 5 bbl. lots, gal.	.93	.97	1.13	—.94	+1.00	1.08	1.04	.86	1.06
Common Labor:									
Common labor, union, hour	.60	.35	......	......	......	.50@.55	.56¼	.50@.60	...
Common labor, non-union, hour	.44@.60	.30	.25	.72½	.35@.50	.35@.50	.47½@.50	....	.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars, tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180 lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180 lb. net.

Dallas quotes lime per 180 lb. bbl. Steel, cement, cast iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5¾ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180 lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180 lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement prices in Canadian funds (the Canadian dollar stands at par.) Bag charge is 80c. per bbl. Discount of 10c. per bbl for payment within 20 days from date of shipment. Steel pipe per 100 ft. net: 2½-in., $30; 6-in., $110.

Changes Since Last Week

Steel structurals up 5c. per 100 lb. in Denver and Seattle warehouses despite the general downward trend of mill quotations. A slightly easier fuel situation reflected in lower pig-iron prices. Structural shapes and reinforcing bars, however, are quoted at an average price of $2 per 100 lb., Pittsburgh, with small tonnages as high as $2.10@$2.15.

Discounts reduced two points on both black and galvanized wrought-steel pipe, on new Pittsburgh basing card of Oct. 19. Rise immediately reflected in lowering of warehouse discounts in New York and Denver.

Downward tendency seen in prices of kiln products, consequent to improvement in coal situation and seasonal falling off in demand. Common brick quoted at $14@$15.50 as against $15@$16 per M. alongside dock, New York. Kelly Is. lime, $1.55 as compared with $1.70 and Sheboygan, $1.45, down from $1.55 per bbl. (180-lb. net) f.o.b., Minneapolis.

Linseed oil declined 3c. in Chicago, during week and rose 2c. per gal. in Minneapolis; prices stable elsewhere.

Lumber prices unchanged despite hampering by car shortages, of logging and lumber mill operations. Situation becoming serious in the Northwest and unless soon relieved, will result in the closing down of many logging camps.

Pine lumber shipments from mill to New York City, however, now accomplished in five and six weeks as against seven to nine weeks, one month ago.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN Editor

Volume 89 NEW YORK, NOVEMBER 2, 1922 Number 18

"The Living Wage"

WHEN it refuses to base a wage award on the theory of "the living wage" and labels that doctrine "a bit of mellifluous phraseology" the Railroad Labor Board speaks for the general public. It is time for someone to voice the impatience that has been aroused by the mischievous agitation of this appealing but impractical theory. Every decent American will sympathize with every effort to raise the standard of living for common labor, but nothing of the sort ever can be accomplished through a disregard of industrial stability, upon which depends the prosperity of all—including common labor. Arbitrarily to fix wages on the basis of estimated needs without regard to available earnings and competitive conditions would simply invite industrial chaos with consequent disaster to us all. However worthy our aspirations may be, no social good ever can result from our running amuck in the economic community.

William D. Uhler—Organizer

IN CREATING an organization excelled nowhere in America for state highway construction and maintenance, Col. William D. Uhler, whose death is announced in this issue, performed a task which ranks above his accomplishments in building great mileages of road—and he was equalled by few as a roadbuilder. Colonel Uhler conceived state road building and maintenance to be a great business continuing from year to year and requiring an organization for its direction comparable in ability and permanence with the organizations directing a great railway system or a great business corporation. In building up such an organization for Pennsylvania he went further, perhaps, than any other state highway engineer. To it as a model came highway officials from all the nations and none went away without example and inspiration which he could in some respect put to work in bettering his own organization practice.

Highway Contract Practices

HIGHWAY officials and contractors for road construction acting through their national associations have exhibited a disappointing inability to co-operate. Late in 1919 when the joint committee to consider contract practices was created by the Associated General Contractors and the American Association of State Highway Officials every indication was had that the action had the warm approval of the membership bodies of both associations. There is no reason to believe that this sentiment has altered, yet for almost three years the committee has failed to function in any constructive manner. No reports, beyond a perfunctory statement once a year of "progress," have been made. It seems high time to ask the reason for this failure. An answer is needed, particularly because rumors persist that intolerance within the committee is chiefly responsible. As the subjects for consideration have been formulated by contractors, as outlined in this issue, they are certainly not impossible of discussion in good temper. The committee will have another opportunity previous to the convention of the American Association of State Highway Officials in December to arrive at conclusions which will serve at least as a basis for discussion. It will, in fact, be disappointing if there is not a much more definite accomplishment to be reported.

Original Bridge Thought

THAT new things can be found even in so settled a practice as bridge engineering is demonstrated by the Oregon City arch across the Willamette River. As an article in this journal some months ago showed, the main span of this bridge is unique—a half-through arch of box girder section heavily coated with gunite. In this issue Mr. McCullough, the engineer in charge of the bridge, describes the novel scheme of erection wherein the old towers of suspension bridge to be replaced were used to carry the backstays for the cantilevered ribs of the arch and the old midspan roadway to support the crown sections of the new arch rib. It is not necessary to claim in either design or erection any epoch making advances to note that the care and study devoted both to the selection of type and the method of erection, with the novelty and utility of the final results, are testimony that bridge engineering need not be the cut and dried thing some of our British contemporaries fear it is becoming across the ocean.

A Doubtful Experiment

BEFORE this reaches most of our readers the voters of the state of California will have decided whether they are to enter into the most stupendous adventure in state ownership ever attempted in this country. Of late the proposition that the state control the water power within its boundaries has been advanced in a number of different ways and in many parts of the country but beyond a supervision of franchises and rates the idea has never been legalized. The constitutional amendment now before the California voters, however, goes further than any proposal heretofore made; it is in effect the complete ownership by the state of all water rights and power and, by extension at least, the entering of the state into many cognate businesses, such as the designing and building of all sorts of power plants, the sale of light and power and even the production of the machinery and material necessary to all of this. Economic and political history is against the desirability of such a move. In our early days of railroading it was attempted in many of the states, with such conspicuous lack of success that in most of the states where it was tried constitutional provisions were made against the state using its credit for anything but strictly governmental purposes. The advocates of the amendment would probably admit that California cannot profitably go into the railroad business but they would claim that the time and conditions

make water power a different kind of business for which the state is eminently suited. The facts and the prospects seem against such a view but in California it may prevail. If it does the citizens there will have the rather doubtful pleasure of serving as the testing ground of the most advanced experiment in state socialism these states have yet tried.

What of the New York Terminal Report?

IN JUNE, 1921, the National Association of Owners of Railroad Securities organized a Board of Economics and Engineering to investigate certain phases of the railroad situation. One of these had to do with the subject of joint terminals, and for immediate study the board selected New York and Chicago. In March of this year the association published the board's report on the Chicago problem together with its plan for unified control and operation of the terminals in that city. This report and plan were abstracted in *Engineering News-Record* of July 13. The board completed its work several months ago, but the association has not yet made public its findings with respect to the New York terminals. Although this investigation has been the enterprise of a private association, its subject is of great public interest, and we hope that the association will follow the same course with the New York report that it did with the one having to do with Chicago. The five engineers of whom the board was composed are eminently qualified to shed light on this complex subject, which means so much to the population and the industries, not only of New York, but also of those communities which depend upon it as their port of entry. The controversy that has raged concerning it has been materially complicated by local political considerations and it would be well worth while to have before us a technical and economic study conducted by competent engineers under the auspices of an organization with no political axes to grind.

How High Is a Dam?

VAINGLORIOUSNESS should not be charged against engineers, contractors, or owners who claim to have built or to own the highest dam, the tallest building, the largest elevated water tank or the biggest hydro-electric plant ever erected. The most that can be asked of such persons is that they make reasonably sure of their superlatives by a survey of possible rivals, with particular regard to exact basis of comparison. Confining the further discussion to dams, in view of Edward Wegmann's letter on another page on the highest dam in the world, it is pertinent to ask, "how high is a dam?"

Dimensions, capacities, weights, and the like may be compared in a variety of ways, depending upon the nature and object of the comparisons—whether a mere matter of bigness; or of difficulty in construction; or of the fundamental basis of structural design; or of function—to name only four bases of comparison.

Bigness has the broadest popular appeal and is perhaps oftenest used by engineers and certainly by contractors. Dam heights may very properly be compared from the lowest depths to which any part of the excavation and subsequent structure penetrates to the greatest height to which any part of the dam extends, provided the limitations are made clear. If one wishes to restrict at all, parapets may, as such more clearly extraneous objects as flagpoles must, be excluded; but why should not the 3-ft. parapet of the Arrowrock dam with its length of 1,100 ft., be included in the overall height of that towering structure, thus making it 351.5 ft. from the lowest point in the foundation to its highest masonry work?

Difficulty of Construction legitimately calls for overall heights, both for the reason just indicated and because the deeper and the higher a dam goes the greater the difficulty and the unit cost. This is true even though in each mere volumes may be rapidly diminished. If it be argued that a mere pocket, perhaps only a few square yards or feet in area, may add materially to the height of dam but be of little real consequence in material, labor, difficulty or cost, it may be answered that in some cases the contrary is true, but that no limiting line can be drawn and that all true comparison is lost if deep penetration is added to the total height in some cases and omitted in others.

Fundamental Basis of Design is vitally affected by not only the overall heights of dams, but also by other factors well known to the dam engineer. These call for several different standards of height comparison, some of which involve the height of the dam in its relation to elements of possible destruction, as crushing weights on the one hand and on the other weight as a resistance to overturning or sliding, and depth of the water behind the dam in terms of pressure tending to cause sliding, overturning, vertical rupture or lifting. Although water depths and pressures are not strictly different ways of expressing dam heights yet some of these possible bases of comparing heights of the dam structure follow the need for considering water depths in dam design. The extent to which the various governing elements in design vary with different materials of construction (masonry alone having been in mind thus far) and types of sections need only be mentioned here, except to note such special factors in the design of earth dams as the vertical distance between water surface and the intersection of the lower slope with the lowest point of the natural bed of the stream in relation to saturation effects.

Functionally, dam heights are mainly concerned with the head they afford for water power since the volume of water stored depends also upon average depths and total flooded areas of reservoirs. It is common to report maximum water depth against the dam but as regards both power head and available storage the real factor is the distance from water surface to power penstock or water-supply conduit.

Summing up, there are numerous perfectly legitimate bases for comparing heights of dams, according to the main object of the comparison. In some cases it may be desirable to use more than one basis. The most common and natural desire is to compare structural bigness, or total height. For this purpose it is hard to answer the argument for using the distance between the extreme points of depth and of height, the latter perhaps more generally, but not of necessity always, stopping at the crest of the dam or at the crest of the wing wall in the case of overflow dams. The point always to be observed is that in any given set of comparisons the same method should always be used and that basis should be clearly defined.

So much for "How high is a dam?" As to which is the highest dam in the world, the question asked by Mr. Wegmann, if answered from the most common standard of bigness or gross height, is that the Arrowrock Dam still overtops all others.

Three Score Years and Ten

SEVENTY years ago the fifth of November, twelve men met in the office of the Croton Aqueduct Department in New York City "for the purpose of making arrangements for the organization, in the city of New York, of a society of civil engineers and architects." Alfred W. Craven, uncle of the present distinguished engineer of that name, presided. In that meeting was born the American Society of Civil Engineers, now the oldest American national engineering society and, except for the Boston Society of Civil Engineers, the oldest of all our engineering societies. So, on this anniversary, marking the scriptural allotment of life to the individual, it is appropriate that we pause long enough to look back over the road the society has traversed.

In 1852 American engineering was young. Railroad practice was in its infancy, the structural engineer still looked to the forest for his materials, the sanitary engineer had scarce come into being, and the builder of water-works never had heard of principles and processes that today are commonplaces to the engineering undergraduate. In its technical aspect, our profession was restricted in scope and of meager substance. But in their conception of the professional spirit and in their understanding as to the needs of the infant profession, the twelve founders were splendidly endowed. With sure discernment of what is fundamental and enduring, they announced the first purpose of the new society to be "the professional improvement of its members." Then followed "the encouragement of social intercourse among men of practical science, the advancement of engineering in its several branches, and of architecture, and the establishment of a central point of reference and union for its members." Today, after the lapse of a lifetime, the constitution of the society still sets forth its objects in language almost identical with that of the founders.

In its pursuit of these ends the American Society of Civil Engineers became the major influence making for the unity and the advancement of American civil engineering and for the development of a professional consciousness in its practitioners.

It has contributed to the advancement of engineering science by providing a forum in which have been discussed the problems that have confronted the civil engineers of America during seventy years. Its special committees have reported to the profession on technical questions of far-reaching importance. It has forwarded engineering research and has contributed to the establishment of engineering standards. It has stimulated technical discussion by providing medals and prizes to encourage participation by all who might contribute helpfully, and it has honored appropriately those who have attained eminence in the profession. Its papers and *Transactions* comprise a technical treasury of unparalleled worth, valued wherever English-speaking engineers may be found. They are a veritable chronicle of the golden age of engineering.

The society has established and maintained the "central point of reference and union" that for seventy years has been a professional home for its members, however far afield they may have been scattered by the exigencies of their calling. For thirty-six years it occupied its own house, and since 1917 it has been part proprietor of the Engineering Societies Building, the engineering capitol of the nation. Of its library, containing in 1916 more than 89,000 documents, 67,000 were not duplicated in the collections of the other Founder Societies and were incorporated in the joint library of the United Engineering Society. Today, in co-operation with other national engineering associations, the society contributes toward the maintenance of a "central point of reference and union," for the profession in all of its branches.

It has "encouraged intercourse among men of practical science," not in America alone, but throughout the world. It has taken an active part in three international engineering congresses that have been held in the United States, and in addition to these, has held four of its conventions outside our national boundaries; two in Canada, one in England, and one in Mexico.

Of recent years the society has directed increasing attention to the encouragement of intercourse between its members dispersed throughout the country and between those members and the society headquarters. It has inaugurated the holding of general technical meetings at various points and has encouraged and fostered the development of local sections. While all that might be done to help the local sections has not yet been achieved, the deficiency has been chargeable to inadequate resources rather than to any lack of sympathy with their needs. Even in the beginning, the founders understood how necessary it always would be to keep alive in each member, the conviction that the society is *his* society, and thereby to avert the blight of sectionalism with its complementary fear of over centralization. The local sections have been evolved to meet this need, and until their success has been assured the society continues to count their welfare as among its chief concerns.

But foremost among the services the American Society of Civil Engineers has rendered to the profession is the "professional improvement of its members," for therein lies the distinctive characteristic of a profession. Ambition for self-improvement is the mark of the professional spirit; and this applies with equal force to the manual craftsman and to the intellectual worker. High or low, wherever we may find him, the man of professional instincts is building something of himself into his work out of sheer love for it and because of an instinctive urge to be of service to his fellows. In maintaining high standards of membership and in upholding faithfully these professional ideals, the society has rendered its greatest service, not only to the profession but also to the community of which it is a part. For the community has learned that the name and the influence of the American Society of Civil Engineers never is found in support of any project not in keeping with those ends.

Such is the record of three score years and ten. And *Engineering News-Record* offers to the American Society of Civil Engineers its warmest congratulations on the fullness of its years, the excellence of its craftsmanship and the worth of its ideals. But most of all, we congratulate it on the opportunity that lies before it to serve the profession with equal fidelity in the solution of the problems that now beset it. May those who guide its destinies for the next seventy years be endowed with a measure of the same vision and the same wisdom, and above all be governed by the same high purposes as were those responsible for its present estate.

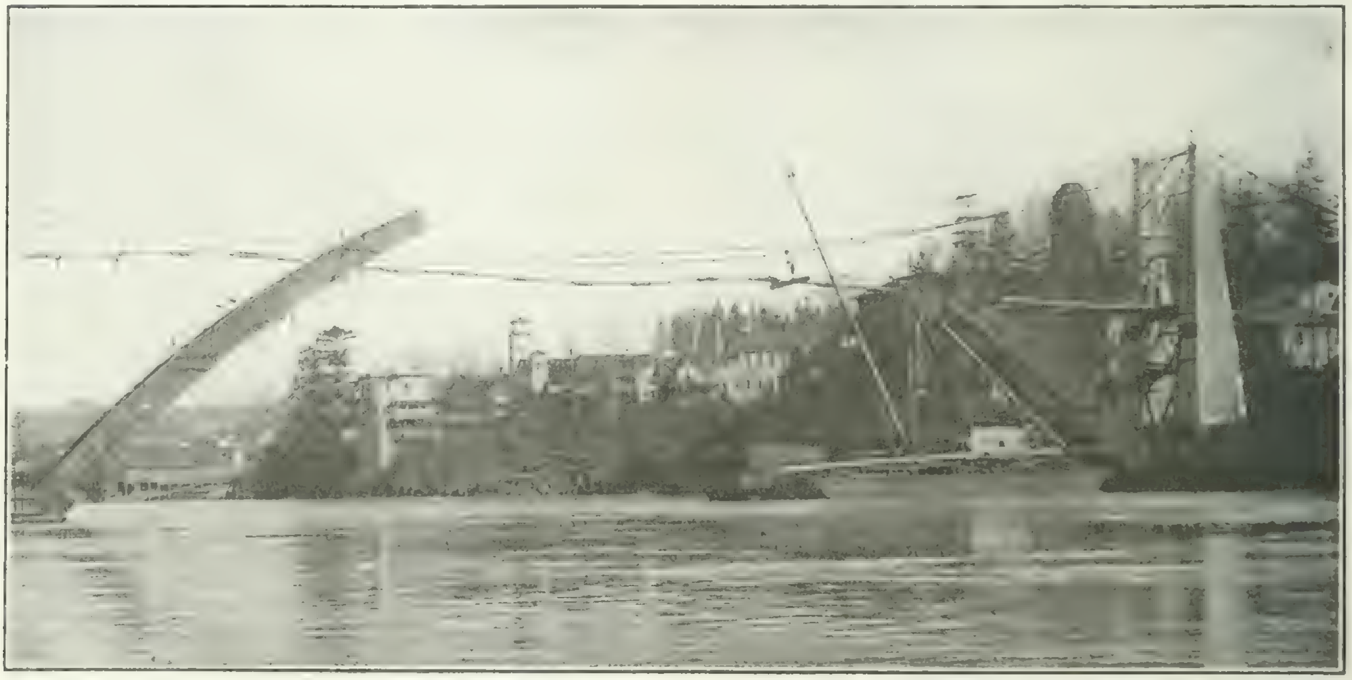
Old Suspension Bridge Used in Erecting New Arch

Main 350-ft. Ribs of New Highway Bridge at Oregon City, Ore., Swung Into Place by Means of Cables of Bridge Being Replaced—Other Erection Methods Studied

By C. B. McCullough
Bridge Engineer, Oregon State Highway Dept., Salem, Ore.

IN THE erection of the 350-ft. steel arch bridge across the Willamette River at Oregon City, Ore., several different schemes for placing the large arch ribs were studied and the one selected seems to be unique in bridge erection, namely utilizing the old suspension bridge at the site to carry the sections of the ribs until the arch was closed. The adopted method and the alternate schemes are the subject of this article, together with some notes on the foundations.

The Oregon City bridge, as described in *Engineering News-Record*, June 8, 1922, p. 942, has as a main span a steel arch 360 ft. between pier centers and 350 ft. between skewbacks, with a 5 per cent grade roadway halfway up the arch so that it is suspended at the center and supported by posts at the ends of the arch. The ribs are 22 ft. center to center and are each of box-girder section, which at the springing line is filled with concrete and which is covered with concrete applied by cement gun. Erected as a three-hinged arch, the hinges are replaced after erection by through splices.



GENERAL VIEW OF OREGON CITY ARCH UNDER ERECTION

Rib sections are held in place by stays from towers of old suspension bridge being replaced. Old footway used for temporary construction crossing. The main channel of the Willamette River at the site of this crossing is 100 ft. deep

The main channel of the Willamette River at the site of this crossing is nearly 100 ft. deep which fact precluded the consideration of false work in the channel, thus rendering it necessary to adopt some other method of erection. The several different schemes considered in this connection are shown in one of the drawings and may be described as follows:

Alternate Methods—Scheme A—Falsework on floating barges and a battery of hydraulic jacks for elevation adjustment. Since a program of this kind could only be employed during the summer season (owing to the severity of fall flood water conditions), this scheme could not fit in with the program of operations demanded by the time limit on the job. This scheme was never seriously considered by any of the contractors bidding upon the work.

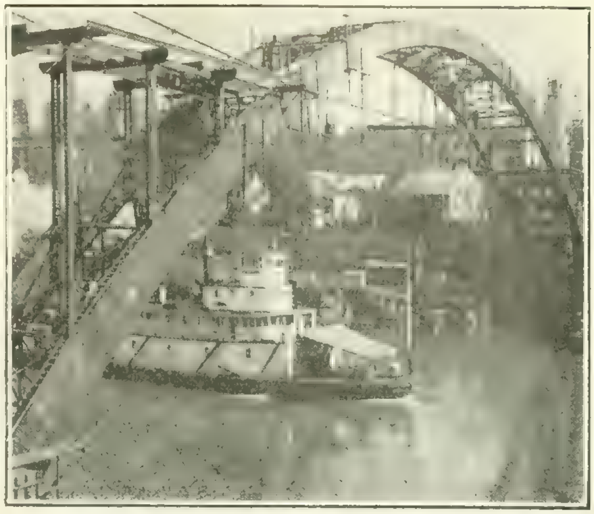
Scheme B—This schedule contemplated the erection of section 1 of the rib, the construction of the abutments or piers and the subsequent erection of sections 2, 3, 4 and 5 from a derrick placed on top of the piers. The floor stringers in this case were to be employed as a temporary anchorage and the balance of the work (sections 6, 7, 8 and 9) placed with the derrick moved out to the end of the temporary cantilever.

Schemes C and D—Both of these schedules contemplated the erection of one-half of the arch rib in one operation. Scheme C contemplated first the placing of the lower section (section 1), next the erection of the piers and a timber erection tower surmounting the same. One-half of the balance of each rib was to be riveted up next and floated to the site in "position No. 1," raised by jacks to "position No. 2" and connected at the lower erection pins. Each rib was then to be raised to a position sufficiently above the true position to allow the other half span to clear when raised; and subsequently, the two sections were to be lowered simultaneously and pinned at the center. Scheme D was somewhat similar except for the fact that lifting was to be done from a

vertical tower on a large barge at the center, thus dispensing with a shore line for lifting. In this scheme, the entire half span including lateral bracing was to be lifted at one operation.

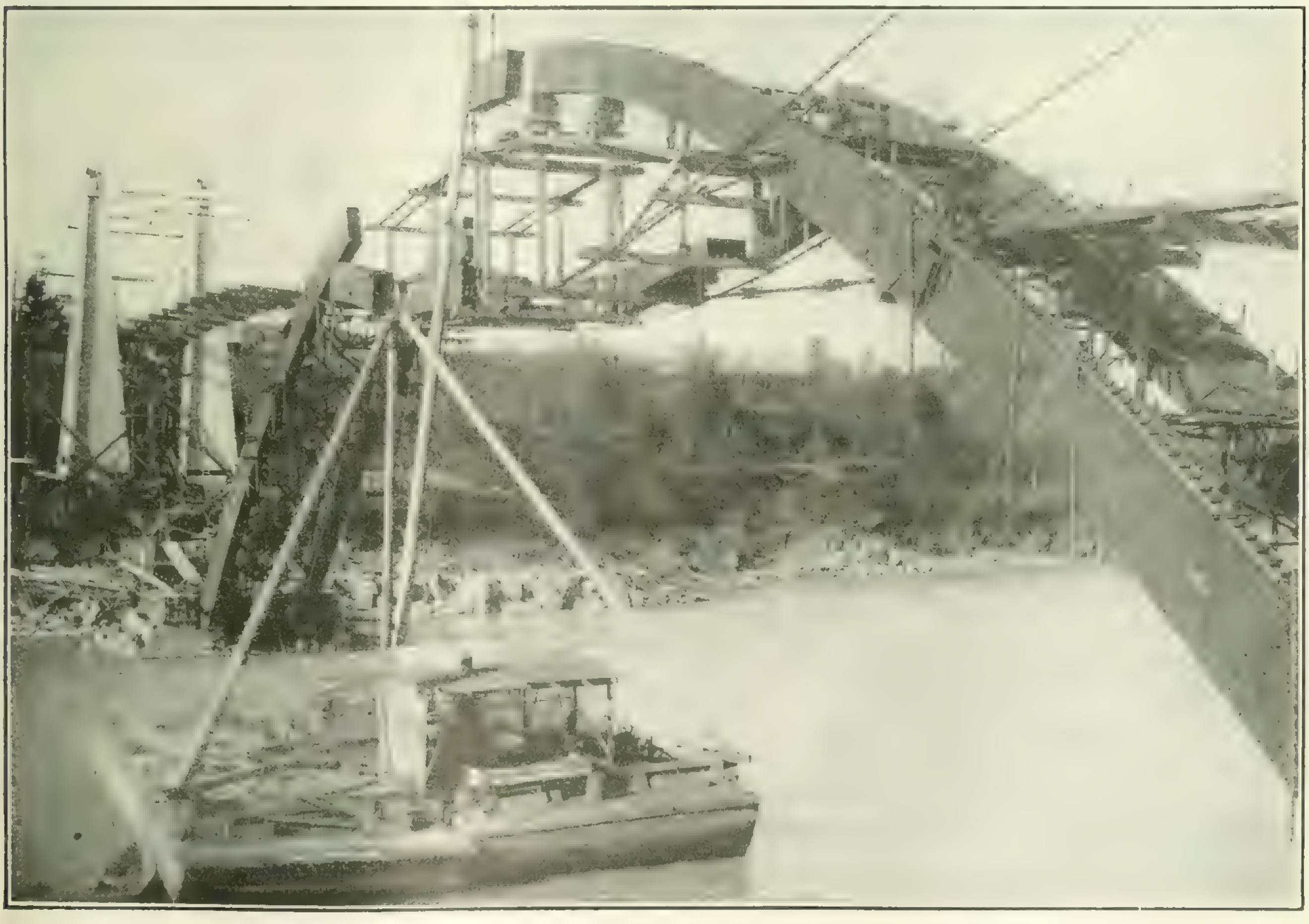
Method Adopted—Utilizing the cables of the old suspension span. The erection schedules described hereinabove were worked out in the office of the State Highway Department, and submitted to the erectors upon request before bids were taken. The successful bidder, however, proposed a fifth scheme which was finally approved and adopted for the work. This erection schedule was worked out by the firm of Gerrick and Gerrick, of Seattle, Wash., who were sub-contractors for the erection and is largely the work of A. Münster, of Seattle, who was retained by the above firm as consulting engineer. This scheme utilized the main cables and towers of the old suspension span (which was to be replaced by the present structure) for the support of rib sections.

Rib sections No. 1 at either end were first placed on the skewback support by means of a barge derrick. These sections were rested on a temporary erection hinge and held to position by means of a radial cable passing upward over the old suspension bridge towers and back to an anchorage on the approach. Sections 2, 3, 4, 5 and 6 were successively placed, each rib section being held by radial cables passing over the towers and down to the anchorage. One of the photographs shows six rib sections on the left held in this manner and the fifth section on the right being lifted from the scow for placement.



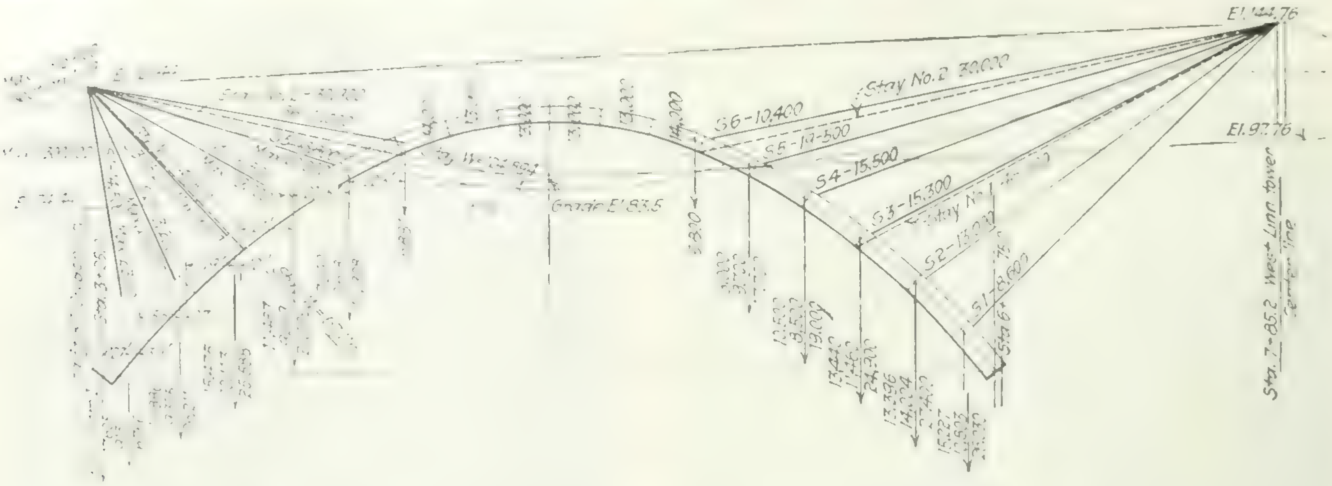
OREGON CITY ARCH RIB SWUNG INTO PLACE

There is also shown herewith a graphic analysis of cable stresses which is self-explanatory. Although each radial cable was amply capable of sustaining the maximum stress induced therein by virtue of the rib loads, it was considered the part of prudence to require the use of auxiliary *stay* cables to insure against overstress in any one of the radial cables due to a breakage or any undue deflection in any of the others. The graphic analysis indicates the scheme first outlined and contemplates the use of *two* stay cables for each cantilever; one at the



PUTTING CROWN SECTIONS OF RIB IN PLACE ON OREGON CITY ARCH

Old cables being used to carry rib sections prior to swinging in place. Haunch sections stayed back to suspension bridge tower. Crown section built up on falsework on cables

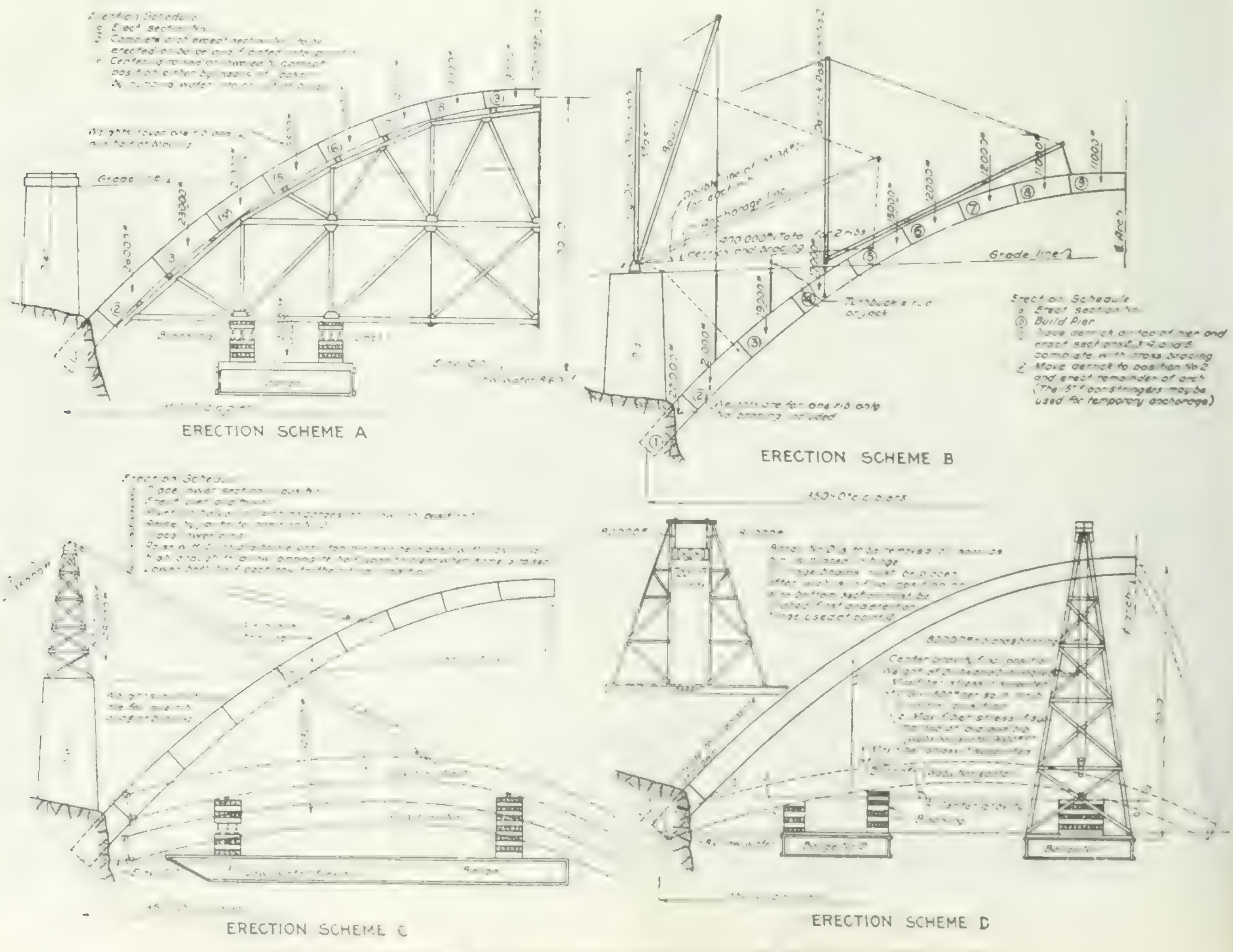


GRAPHIC REPRESENTATION OF THE CABLE STRESSES IN ERECTING THE ARCH

extreme end of section 3 and one at the extreme end of section 6. These stay cables were designed to carry the entire six rib sections independently of cables, S1 to S6 inclusive. The two stays shown were afterwards discarded in favor of one heavy stay cable at the end of section 4.

The central portions of the rib span (sections 7, 8 and 9) were placed on timber bents carried directly on the main cables of the old suspension span. One of the views shows the construction of these bents, the last section being placed at the time of the taking of this photograph. There is also a view of the completely swung rib with the central falsework removed from the main cable and a portion of the column and floor steel in place.

Tests of material cut from the main cable made in the laboratory at the time of erection disclosed an ultimate strength of 157,000 lb. per square inch. This, with an area of 13.85 sq.in., gave a breaking load of 2,174,450 lb.; while the maximum erection load under



ALTERNATE METHODS STUDIED FOR ERECTION OF OREGON CITY ARCH

the worst condition amounted to 351,000 lb., thus giving an ample factor of safety. The radial cables were 1-in. plow steel having a breaking load of 38 tons. The stay cables were of 2-in. plow steel having a breaking strength of 140 tons.

In order to eliminate the difficulty of blocking the center sections to correct elevation, which would be caused by the varying deflection in the main cable, the six center sections were first loaded onto a platform between the bents and supported by the main cables causing the cable to take its final (or nearly final) position before the bent blocking was placed.

After the rib was swung, a portion of the remaining dead-load was added to the structure acting as a three-hinged arch. Subsequently, the ribs were fixed at crown and at skewback thereafter acting under live-load and the balance of the dead-load as fixed arch ribs.

Foundation Work—Some of the details of the construction of the main piers are worth describing. These foundations were on solid basaltic rock, one abutment being entirely in the dry and the other in about 8 ft. of comparatively still water. No problem out of the ordinary was presented by either foundation, the wet abutment being concreted in the dry through the unwatering of a double wall puddle cofferdam of ordinary type. Core drillings were taken for a distance of from 25 to 35 ft. below the surface to disclose the presence of any seams or pockets in the foundation material. The drillings, however, indicated nothing of this kind, yielding a very uniform and continuous core. Tested in the laboratory, these core specimens gave the following results:—

Maximum compressive strength —
15,300 lb. per sq.in. = 1,101.6 tons per sq.ft.
Minimum compressive strength —
11,050 lb. per sq.in. = 795.6 tons per sq.ft.
Average of maximum and minimum strength —
13,175 lb. per sq.in. = 948.6 tons per sq.ft.

In view of the fact that the resultant base pressure on the abutment, even under the worst possible live-load condition, falls within the middle third of the base and that the maximum extreme toe pressure amounts to but 4.9 tons per square foot, this type of foundation leaves little to be desired. The base rock was lightly shot and about 2 ft. of material removed in order to roughen the surface and remove any shattered or slightly seamed surface material and concrete placed thereon in the dry.

Personnel—Contract for this structure was awarded in June, 1921, to A. Guthrie & Co., Inc., of St. Paul and Portland, and construction work begun during the following July. The schedule of erection herein outlined operated with the utmost satisfaction to all parties concerned and from start to finish the program was carried through without a hitch. Credit for the admirable solution of the many erection problems encountered is due to the excellent engineering staff maintained by the contractors' and sub-contractors' organizations, to A. Münster, their consulting engineer, and to R. A. Furrow and C. P. Richards, who were in charge of the construction work for the Oregon State Highway Department, by whom the bridge is being built.

VIEW OF BRIDGE IN LATER STAGES OF COMPLETION

Canadian Canal Traffic Shows Increasing Tonnage

The July summary of Canadian canal statistics issued by the Dominion Bureau of Statistics, shows increased traffic in nearly every case. Total traffic through the Canadian and American locks at Sault Ste. Marie increased more than 26 per cent, over July, 1921, and also over June, 1922. The large increases were in wheat and iron ore; the latter totalling 8,942,659 tons, compared with 4,356,760 tons in July, 1921; 9,235,086 tons in July, 1920, and 8,912,609 tons in July, 1919. Wheat shipments for the month were 17,777,377 bushels as against 7,838,878 in July, 1921; 7,838,470 in July, 1920, and 7,100,008 in July, 1919. Coal shipments continued light.

Welland canal traffic showed a slight decrease from July, 1921, mainly in soft coal shipments and in American corn. Wheat shipments increased 191,291 tons or 6,376,000 bushels, while barley, iron and steel and pulpwood also showed increases.

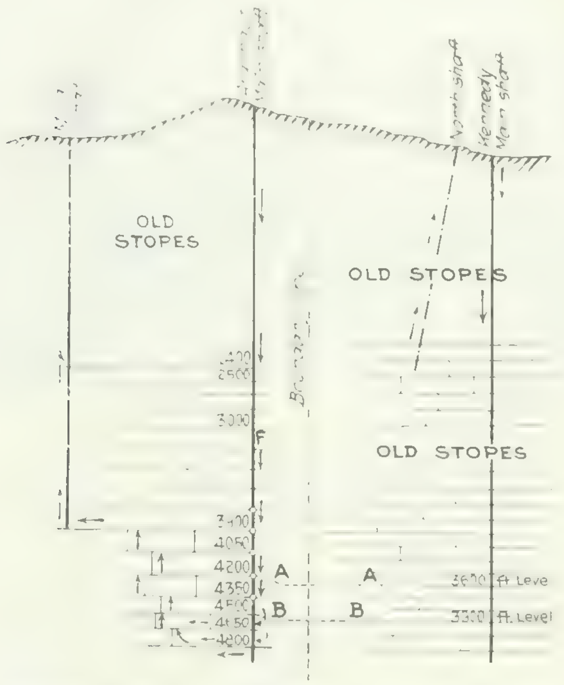
On the St. Lawrence canal passenger traffic increased more than 44 per cent over that of July, 1921. Freight traffic also increase 23,256 tons or 4 per cent despite large decreases in coal and in corn and oats. Wheat, iron and steel, pulpwood, lumber and timber all showed substantial increases.

The Argonaut Mine Disaster

A Review of the Conditions and Events that Led to the Death of Forty-seven Men, Trapped by Fire in Main Shaft

SO WIDESPREAD an interest was aroused by the three weeks' struggle to reach the forty-seven miners imprisoned in the Argonaut mine in California and so fragmentary have been the accounts available in the lay press that *Engineering News-Record* has prepared the following brief story of the accident, drawing freely upon the more detailed accounts published in *Engineering & Mining Journal-Press* of Sept. 23, Sept. 30, Oct. 7, and Oct. 14.

The Argonaut mine is situated a mile north of Jackson in Amador County, Calif., about ninety miles northeast of San Francisco, and taps the Mother Lode, a gold-bearing formation that runs along the western slope



SECTION OF ARGONAUT AND KENNEDY MINES

These are the principal workings only projected on a vertical plane. The fire started at point F. The arrows indicate the ventilation and the small circles at the intersections of main shaft and levels indicate doors to stop draft. A-A and B-B indicate the lines of approach for the rescue parties from the Kennedy mine.

of the foothills of the Sierra Nevada. Its workings extend to a depth of 4,275 ft., while those of the Kennedy mine, which adjoins it, are carried to a depth of 4,150 ft., part of this difference being due to the fact that the rim of the Argonaut shaft is 112 ft. higher than that of the Kennedy owing to the contour of the ground. The main shafts of the two mines are 1,100 ft. apart.

The accompanying diagram, which shows the workings of the two mines projected on a vertical plane, will make clear the lay of the land. The main shaft of the Argonaut mine is sunk on an angle, which makes it about 4,885 ft. long. The Kennedy shaft is vertical. Each mine has a secondary shaft, that of the Argonaut being designated the Muldoon shaft. This is 450 ft. south of the main shaft and has a hoist that can be operated to a depth of 800 ft. only. Below that, the shaft as far as the 3,900 ft. level is but a system of linked raises equipped with ladders. The bottom level, 900 ft. deeper, is similarly reached by means of the raises that connect the successive levels on the south side of the main shaft. The main shaft is used for hoisting and pumping and by means of it the miners go to and return from their work.

Ventilation of the mine is effected by a fan at the Muldoon shaft, which draws the air down through the main shaft, through the workings and out through the Muldoon shaft. This matter of ventilation should be noted carefully as it had a considerable bearing on the accident and has given rise to controversy over the responsibility for the fatalities.

In order further to direct the fresh air into the bottom workings, the upper levels, where they connect with the shaft, are closed by doors. The location of these doors is shown by the small open circles at the junctions of shaft and levels. The ventilating system of the Kennedy mine forms a separate unit, as the workings of the two mines do not connect, although some leakage of air from the Kennedy is said to exist at the 4,200-ft. level of the Argonaut.

To understand more fully the conditions surrounding the accident, it is necessary to know that the managements of the Argonaut and Kennedy properties have not been good neighbors. If they had been on friendly terms it is probable that communication between the workings of the two mines would have been maintained with a joint system of ventilation that might have gone far toward averting the serious consequences of the disaster. The latest controversy between them grew out of a fire in the Argonaut workings in March, 1919, which spread into the Kennedy mine through ventilation connections existing at that time. After it had made considerable headway northward into the Kennedy workings it was decided to stop pumping and to allow both mines to drown. That was in March, 1920, since which time they remained under water until April, 1921, when they were unwatered and reopened. Some of the upper workings of the two mines connect or used to do so, but the deep levels do not.

So much for the setting. Shortly before midnight of Sunday, Aug. 27, the timbering of the main shaft of the Argonaut was found to be afire near the point marked *F* on the diagram. Communication with those below by means of telephone and electric-bell line is supposed to have been broken by the fire soon after it started, so no signal was given to the miners working at the bottom, chiefly between the 4,800-ft. and the 4,650-ft. level. At first it was thought that the fire could be extinguished before the men would be in serious peril, and by the time their plight was appreciated it was too late. But this was not known until the end.

On Monday and Tuesday efforts were made to extinguish the fire by the use of water from above, but this proved futile. On Thursday it was decided to prevent it from spreading upward by building a bulkhead across the shaft at the 2,400-ft. level, for by that time it had reached nearly to the 2,500-ft. level. Owing to the fact that the Muldoon shaft was charged with smoke and fumes carried from the fire down the main shaft and thence through the mine, none of the imprisoned men were able to escape by that route, and nothing was known concerning their fate.

Controversy has arisen as to whether the ventilating

fan should not have been stopped at once, thereby permitting the heated air rising in the main shaft to reverse the direction of the ventilation. This would have drawn fresh air through the Muldoon shaft which would have remained fresh while it circulated through the workings and up to the level of the fire in the main shaft. It is contended that any opposing momentum left from the artificial ventilation after the fan had been stopped could have been checked promptly by closing temporarily the top of the Muldoon shaft. It would not have been necessary to reverse the fan. It is said that if this had been done the men might have climbed out of the mine through the raises and the Muldoon shaft, even though this involved a climb from the 4,800-ft. level and could probably have been acomplished by an athletic man in not less than five hours. At least, it is said, they could have reached the bottom of the Muldoon at the 3,900-ft. level and there awaited help.

As against this, however, some experts contend that it was right not to stop the fan. They insist that it is a first principle at the time of such a disaster not to reverse the ventilation, because any such change is confusing to the imprisoned men, who plan for safety on the assurance that the ventilation will remain as they know it. Others argue that the ventilating doors on the upper levels were not entirely effective, that some leaked or were open, and that therefore there was a short-circuiting of the air current so that the smoke and gas were not led immediately to the bottom workings, even with the fan in operation. This, however, is denied; and the argument is offered that even if it were true, the effect would be simply to deaden the air of the lower workings and to send the smoke from the main shaft into the Muldoon connections above the 3,900-ft. level, thereby again preventing escape through the Muldoon shaft.

On the night of Monday, Aug. 28, it was decided to attempt a rescue by establishing communication through the Kennedy mine. Early Tuesday morning the work was started. The fire of 1919 had burned the timbers in those workings nearest to the Argonaut and the admission of water in 1920 caused the ground to cave, filling the levels with mud and broken rock. An effort was made to reach the imprisoned men along two lines of approach; one on the 3,600-ft. level and the other on the 3,900-ft. level of the Kennedy. The lower of these was clear for the greater distance, but to connect it with the Argonaut workings required its being advanced 140 ft. through virgin rock. Altogether 475 ft. of rock and waste would have to be penetrated. By the 3,600-ft. level the total distance would be 530 ft. but the conditions appeared to be more favorable than on the 3,900. The 3,600-ft. drift would have to be extended in two places through virgin ground for a total distance of 130 ft. and would enter the Argonaut at a point 60 ft. below the 4,200-ft. level of that mine. Thus the task consisted partly of digging new drifts through debris and partly of blasting a way through rock.

It was thought that some of the men would have taken refuge at the north end of the 4,200-ft. level, because that drift is behind the shaft and nearest to the Kennedy workings, from which it was believed there was a leakage of air. The place would, therefore, be outside the line of the draft that was carrying the smoke and gases from the shaft into the workings below and to the southward. Others thought that the men would have made an attempt to escape through the Muldoon shaft and that they would be at the south end of the mine. In order to hasten the rescue it was arranged to work in 6-hr. shifts with gangs of 20 men at each heading, two men working at the face for 20 min. before being relieved by another pair. With good luck, an advance of 40 ft. could be made along a choked drift, and 16 ft. could be driven in live rock in 24 hr. Despite the litigation between the two companies their staffs co-operated loyally.

Connection was eventually made at 4:55 a.m., Sept. 18, between the 3,600-ft. level of the Kennedy mine and the 4,200-ft. level of the Argonaut, after slightly more than 21 days of work. On the 3,900-ft. level, 86 ft. of rock remained to be penetrated. When the men were reached it was found that they had taken refuge in a drift on the 4,350-ft. level, where they had made a vain stand against the fumes. A note, burned by acetylene flame on the mine timbers, indicated that they had perished within four or five hours after midnight on Aug. 27, after having built two bulkheads, using their clothes to make them tight. They had started a third when the gas evidently overcame them.

The coroner's jury has advised that "more precautions be taken to prevent fires" and that the two mines "be compelled to keep and maintain an opening with proper doors at one of the lower levels." The governor of California has appointed an investigating committee consisting of A. B. C. Dohrmann, president of the State Industrial Welfare Commission, William J. Loring, mining engineer and president of the American Mining Congress, and John C. Williams, miner and vice-president of the Grass Valley Miners Union.

To Eliminate Grade Crossings Under Federal-Aid Road Act

Washington Correspondence

As a result of the grade-crossing provision of the Federal Highway Act a great increase in the number of grade-crossing eliminations will take place from this time forward. In considering which crossings are to be improved, Thomas H. MacDonald, chief, U. S. Bureau of Roads, points out that consideration must be given to the following points:

Character of railroad (main line or branch); number of tracks; number of trains per day; approximate speed of trains at crossing; sight distance from each direction of approach; angle of crossing; method of financing (is railroad compelled by law to pay a part of the cost of elimination?); physical conditions as they favor elimination of crossing by under-pass, over-pass or relocation.

Intersections have been classified as follows: Class 1, grade crossings possible to eliminate by relocation: Class 2, crossing of a primary highway and a trunk-line railroad having two or more main tracks; Class 3, grade crossings of a single track trunk-line railroad and a primary road, or of any trunk-line and a secondary highway of the 7-per cent federal and road system; Class 4, grade crossing of spur and switch-lines, logging roads or branch lines on which train service is limited.

Original Investment as a Basis of Value in Rate Making

Effect of Changing Price Level on "Present Fair Value" — Regulation that Will Keep Investors Interested and Insure Supply of Required Capital

By Edward Flad
Former Member, Public Service Commission of Missouri
St. Louis, Mo.

The Missouri Public Service Commission, ever since it was established by statute in 1913, has been composed of four lawyers and one engineer. From April, 1917, to October, 1921, I was a member of the commission. Being an engineer by education and experience, with only a layman's knowledge of the law, I approached the problems that came before the commission from a viewpoint somewhat different from that of the lawyer members. In reaching a decision upon any question at issue, a lawyer, when acting in a judicial position and unhampered by the interests of a client, by force of training, will be guided by precedent. He holds that when the court shall have spoken, the law must be considered enrolled. His first quest is to determine what the courts have held in other similar cases, and having interpreted the previous decisions of the courts, he follows his interpretation ruthlessly and decides the question at issue with but little regard to what might appear to him to be fair and reasonable or for the general public good, were he not bound by his interpretation of court decisions. On the other hand, not being versed in the law and being untrammeled by knowledge of court decisions, my first endeavor was to determine what appeared to be fair under all the evidence and circumstances in each case, with due regard for the golden rule and the general welfare of the community; and having reached a conclusion, my next problem was to find competent authority for an interpretation of court decisions, even if a trifle strained, that would permit of the desired solution. And I may state in passing that, as a general rule, it was possible to find good legal support for the interpretation required.

Interpreting Law to Meet Modern Needs—The decisions of our courts bearing upon the right of the state to regulate and tax and even interfere with what we formerly conceived to be the inalienable rights of the individual, fully demonstrate that constitutional requirements, statutes and court decisions, may generally be interpreted to meet the changing and increasingly complex conditions and requirements of the community.

I was the more encouraged in my plan of procedure as above outlined by the early discovery that the four lawyers of the commission frequently disagreed among themselves in the interpretation of court decisions, as applied to particular cases under consideration. In at least one important case, two of the lawyer members held that the commission had jurisdiction and the other two held to the contrary, each side ably supporting its views by reference to court decisions. As it devolved upon me to cast the deciding vote, I felt at liberty to accept the interpretation that to me appeared best to protect the general public interest. The commission assumed jurisdiction by a vote of three to two and was upheld in that course by the Supreme Court of the State of Missouri.

And thus I find justification for approaching the question of rate base, or the value of a particular utility for rate making purposes, by first endeavoring to determine the solution that will best serve the ultimate interest of the general public and then adopting same if previous decisions of the courts can be construed to so permit.

Rate Regulation—The right to regulate utilities and fix the maximum rates is based upon the police power of the state, which may not be abridged, if it be not exercised in an arbitrary or oppressive manner. Under regulation, the state decides upon the nature of the service to be rendered, the net return that the owner may properly be allowed on his investment, the amount of bonds and stocks that he may issue and the manner in which he shall keep his accounts. It is akin to condemning the owner's property for public use, except that under regulation, he must continue to operate, to furnish funds for extension and betterments and to assume numerous responsibilities and hazards of loss.

The fifth and fourteenth amendments to the Constitution of the United States, sometimes referred to as the "just compensation" and "due process" amendments, will protect the owner against confiscation; but though the regulation fall short of confiscation, it may still be drastic enough to react against the general public good.

In order to accomplish its purpose, which is to secure continued and adequate service at the lowest rate possible, regulation must be such as will satisfy the average investor in public utility securities, for the relation between the investor and the public is a continuing one; extensions and betterments must be provided and new utilities established and unless the investor is satisfied with the regulation provided by the state he will refuse to invest and the utilities will fail to function properly.

The Investor's Viewpoint—Before laying down a general policy for determining the rate base we may therefore properly ask, "What will the investor in utility securities demand?" He will demand that so long as the funds that he provides are used in the service of the public, they shall be accorded a return that appears fair at the time he invests, with due regard to the risk involved. If it is generally understood that the regulatory body will normally protect the honest prudent investment, the investor will be satisfied. Under former competitive conditions, the investor assumed risks of loss even though the utility displayed all reasonable care and prudence in the management of its affairs, and the assumption of these risks justified an expectancy of abnormal gains. Under proper regulation however, competition is eliminated except where gross negligence or imprudent acts justify its invocation, and under normal conditions, the investment is protected.

Some will argue that the courts have held that the "present fair value" is the proper value to assume for rate-making purposes, that the reproduction cost new

as of the date of inquiry, should be the controlling factor in determining present fair value and that "original cost" is no measure of the "present fair value."

We may agree that "present fair value" must be the controlling factor, and still differ as to the definition of "present fair value" or the manner in which it shall be determined. Value in exchange depends upon net earnings, which, in turn, depend upon the rates allowed; and the rates are to be determined by the value, and so we circle around, lost in a labyrinth of definitions and interpretations of court decisions.

Valuation at Reproduction Cost—How would a valuation of the basis of reproduction cost as of the date of the investigation affect the security holder? Let us assume a utility organized with an investment of $100,000, sufficient to provide the plant and property, stores and supplies and working capital. One hundred thousand dollars is placed in the service of the public and the individuals furnishing the funds receive in lieu thereof, $50,000 in bonds, $30,000 in preferred and $20,000 in common stock. The rate of return for each class of securities must bear a proper relation to the risk involved. Five per cent for the bonds, 7 per cent for the preferred stock and 10 per cent for the common stock would probably be considered sufficient under normal conditions, such as existed prior to the recent world war. The total annual interest and dividend charges for our $100,000 corporation, would therefore be $6,600 or 6.6 per cent on the investment. During the recent period of inflation many of the utilities have demanded a valuation as of the date of the investigation. In a number of instances which came before the Missouri commission such a valuation, if granted, would have been double the actual investment. With our $100,000 utility as above assumed, if constructed before the war, the fixing of a rate base during recent peak prices would have resulted in a valution of $200,000. If a 7 per cent return were allowed, there would have been $14,000 per annum available for interest and dividend charges. The holders of the bonds and preferred stock would have continued to receive 5 per cent and 7 per cent respectively, receiving no direct benefit from the inflated valuation, but the holders of the common stock would have earned annually 47 per cent on their investment.

The application of the same formula, during normal times, to a utility whose investment had been made during a period of inflation, would reduce the earnings below what would be necessary for proper functioning, and inevitably result either in receivership or cessation of service.

Though each may appear fair in the light of all of the facts in that particular case, it seems entirely unnecessary and unreasonable to accept an interpretation of court decisions that will lead to the adoption of a policy for valuation of our utilities calculated to give a temporary advantage to the holders of the equity, but manifestly unfair and entirely contrary to the ultimate interest of both the investor in utility securities and the consuming public.

Valuation on Investment Basis—By establishing a rate base on the investment theory the investor is reasonably sure of a return which, at the time he invests, seems fair to him, considering the risk involved, i.e., whether he purchased bonds, preferred or common stock. Under such procedure it would be incumbent upon the commission to take into account, in fixing the rate of return, either increases or decreases in prevailing interest rates at any time, in so far as they affected refunding propositions, or the sale of additional securities required to finance additions and betterments.

I maintain that the average investor in utility securities will be satisfied with a valuation on the basis of original investment, independent of accrued value due to inflation of the currency or growth of the community, provided he is insured, as far as may be, against loss due to a deflation of the currency or ruinous competition and has reasonable assurance that his honest, prudent investment will be protected. More than this is not necessary because it is not required by the purchasers of securities and would, therefore, place an unnecessary burden upon the consumer, and less than this will fail to secure the funds required for construction, additions and betterments.

The majority of our present utilities were organized before the days of regulation. Our larger utilities represent combinations of many smaller corporations and in most cases past accounting methods will not furnish correct information as to actual investment in the plant used and useful at the time of the investigation. Where the actual investment may not be ascertained, an estimate of the cost of construction, as of the date of construction is more illuminating, can be made with greater accuracy, and properly has more bearing upon the question of "rate ease" than an estimate of the cost of construction as of the date of the investigation. It is, of course, conceded that all relevant evidence, such as the degree of prudence exercised in the investment, the depreciated condition of the plant, early losses, excessive past earnings, cost of consolidation, extraordinary efficiency in operation or construction, etc., must be given proper consideration in a final determination of the rate base.

Supporting Legal Authority—Having reached the conclusion that the rate base should represent the honest, prudent investment, with such qualifications as may be indicated by all relevant facts, because that policy will satisfy the average investor, encourage the investment in utility securities, allow utilities to function properly, secure the lowest possible rates for service and do justice to both the utilities and the consuming public, I am pleased to note that competent legal authority can be found to construe the decisions of our courts so as to permit of its legal adoption.

It would be pretentious for me, a layman in legal matters, to construe the decisions of our courts. For the benefit of those who may desire to delve into individual controversies, and generalize from the decisions reached, I submit herewith references to various cases which have been cited, some for and others against the adoption of the policy herein advocated. The oft-quoted case of Smythe vs. Ames (169 U. S., 466-1898) has been cited as justifying a valuation based upon "investment" as well as one based upon "reproduction cost new."

Other cases cited are as follows: For a value based on "Investment"; (1) Ames vs. Union Pacific Ry. Co., 64 Fed. 165, decided Nov. 12, 1894, Justice Brewer; (2) Brymer vs. Butler Water Co., 179 Pa. 231, 36 Atl. 249, decided Jan. 4, 1897; (3) Coal & Coke Ry. Co. vs. Conley, 67 W. Va. 129, 67 S.E. 613, decided March 8, 1910, Supreme Court of Appeals of West Virginia; (4) City of Appleton vs. Appleton Water Co., 5 W. R.

C. R., 215, decided May 14, 1910, Wisconsin Railroad Commission; (5) Mahew vs. Kings County Light Co., 2 P. S. C., 1st D. N. Y., decided Oct. 20, 1911, New York Public Service Commission for First District; (6) Petition of Grafton County Electric Light and Power Co., 28 A. T. & T. Co. Com. L. 533, Feb. 3, 1914, New Hampshire Public Service Commission.

For a value based on "Reproduction Cost as of the Date of Investigation": (1) Case of St. Joseph Ry., Light, Heat & Power Co., Van Valkenburg, J., District Court of the U. S. (268 Feb. 278), decided Nov. 10, 1920; (2) P. U. C. of Ill. ex rel City of Springfield vs. The Springfield Gas & Electric Co., (Docket No. 13,048 Illinois Supreme Court); (3) San Diego Land & Town Co. vs. Jasper, (189 U. S., 439-1902); (4) Stanislaws vs. San Joaquin Co., (192 U. S., 201, 1904); (5) City of Knoxville vs. Knoxville Water Co., (219 U. S. 1-1909); (6) Wilcox vs. Consolidated Gas Co., (212 U. S. 19-1909); (7) Louisville & Nashville R.R. Co. vs. Railroad Commissioners, (196 Fed. p. 800); (8) Consolidated Gas Co. vs. Newton, U. S. Dist. Court, S. Dist. of N. Y., (267 Fed. 231-1920); (9) Denver vs. Denver Union Water Co., (1918 C. P. U. R. 640); (10) East Chicago vs. East Chicago and I. H. W. Co., Indiana Commission (P. U. R. 1920 p. 192); (11) San Diego Land & Town Co. vs. National City, 174 U.S. 739, 757.

Effect of a Low Dam at Harrisburg on Flood Stages and Discharge

By S. N. Whitman
Of Gannett, Seelye & Fleming, Inc., Engineers, Harrisburg, Pa.

DISCHARGE records, before and after construction, show that a 4½-ft. dam across the Susquehanna River at Harrisburg, Pa., has no effect on the discharge and corresponding gage height when the mean depth is 300 per cent of the dam height. The Harrisburg studies were made by the writer in connection with a report which he prepared on a similar improvement at Elmira, N. Y., on the Chemung River. At Elmira, however, the total amount of slackwater required can only be produced with a movable dam in order not to cause flood damage greater than that which would be experienced without the dam.

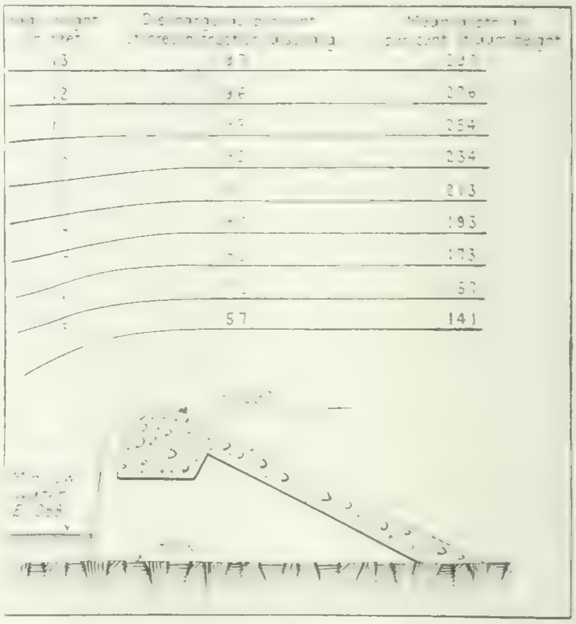
The Susquehanna River at Harrisburg is almost three fourths of a mile wide and is confined between banks averaging 25 ft. in height above low water. The channel is crossed by several bridges and is dotted with islands forming an irregular chain in mid-stream. At low river stages large areas of the channel were exposed where stagnant water was formed which subsequently became very foul smelling and bred many mosquitoes. The currents were swift and the channel shallow, making it almost impossible for canoeing or other recreations.

James H. Fuertes, consulting engineer, New York City, designed a low type of reinforced-concrete dam approximately 0.6 mile long and averaging 4½ ft. in height. It does not extend quite to the river banks at full height, small openings being provided so that the minimum discharge will just flow over the entire crest. Construction began in 1913 and was practically completed in one year except that several small openings were not closed until 1916. The dam provides slackwater which is now very popular for recreation purposes. With the additional improvements made to the river front and sewer system, the river front has been transformed into one of the most beautiful parts of the city.

The data here used for comparative purposes were kindly furnished by the Pennsylvania Water Supply Commission and the city engineer of Harrisburg, Pa.

The Weather Bureau gaging station records for the Susquehanna River discharge at Harrisburg are available since January, 1891. The construction of the sanitary dam was closely followed to note the backwater effects at the gage, which is located 4,200 ft. up stream. These records are invaluable in the study of the obstruction effects of the dam. The rating curve used until Dec. 31, 1913, was used for the pre-construction discharges and the one effective since Aug. 30, 1916, for the post-construction discharges.

The accompanying diagram shows the mean depth at the dam expressed in percentage of the dam height and



EFFECT OF DAM ON PRE-CONSTRUCTION DISCHARGE

the present discharge expressed as a percentage of the pre-construction discharge for the various Weather Bureau gage readings.

This curve shows that for a gage height of 13 ft. the obstruction effects are negligible. The variation listed is within 3 per cent of the pre-construction discharge and can therefore be considered as within the normal discharge variation limits of the mean rating curve.

The control at Harrisburg has not changed and when the flood stage has reached an elevation where all obstruction effects are lost it is probably true that the present rating curve gives more nearly correct values for all the higher stage records and that a comparison beyond this height becomes a mere mathematical expression.

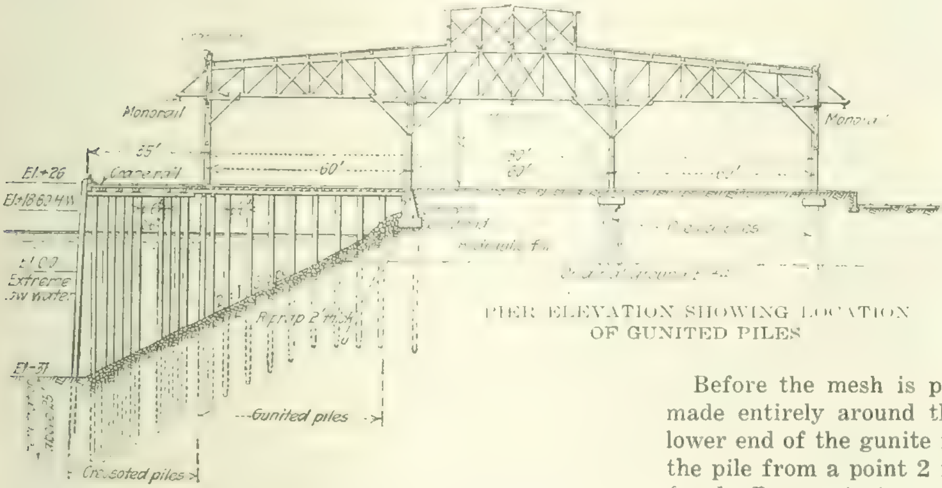
Very little information has been collected on the discharge of submerged weirs. The coefficients obtained to date are usually for discharges under exceedingly low heads and the velocities of approach and retreat have not been given due consideration. Each installation is affected by many local and construction conditions and the information here listed is valuable for comparative or checking purposes for improvements of a similar nature.

Gunite Applied to Fir Piles For Tacoma Pier

No Cracks If Two Applications Used—Piles Vertical When Coated, Delivered by Raft—Coating Costs $1.20 Per Foot

IN CONSTRUCTING a new pier for the Port of Tacoma, creosoted wooden piles were satisfactory for fender lines and under the open portions of the structure, but in order to avoid the probability of having to disturb the shed and goods stored therein, it was decided to use under the superstructure some form of support that would not require renewal in a few years. Accordingly decision was made to use fir piles coated with gunite. Adding the cost of treatment at $1.20 per linear foot to the original cost of the piles, the total cost was approximately twice as much as creosoted piles and about half the estimated cost of the ordinary reinforced-concrete piling.

Foundations for that portion of the pier to be occupied by the superstructure called for 1,450 piles. The actual footage of piling to be gunited is 54,131 lin. ft. About 1,400 piles had been gunited by the tenth of September and about 800 had been jetted down in place, apparently with complete success. In getting the piles down only the weight of the hammer is ordinarily used and heavy blows are never struck.



PIER ELEVATION SHOWING LOCATION OF GUNITED PILES

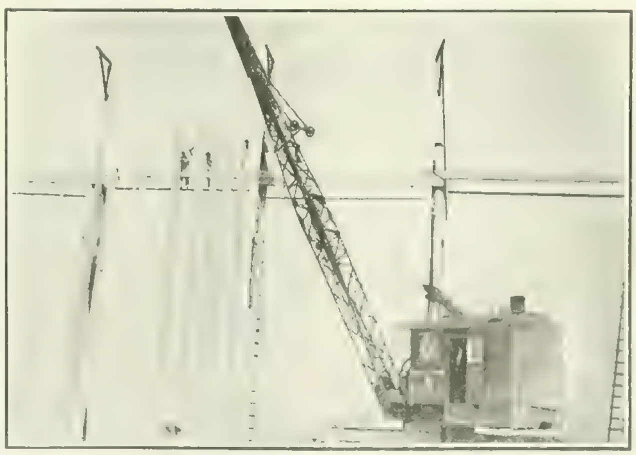
The piles, stripped of all bark, arrive at the site in rafts from which they are lifted by a locomotive crane and delivered to the yard where the mesh reinforcing is attached. From this point a locomotive crane conveys them, one at a time, to the shooting rack, about 1,100 ft. long, erected along the edge of a fill near the new dock. This fill is retained by a bulkhead along the water's edge consisting of two rows of piles and planking projecting 10 to 12 ft. above low water level. The rack consists chiefly of a third row of piles, spaced about 25 ft. apart fastened at the bottom to the piles that retain the fill and extending 40 to 50 ft. above the level of the fill. Stringers or tie-timbers run along the tops of the piles in the rack and serve as supports for the upper end of the piles to be coated.

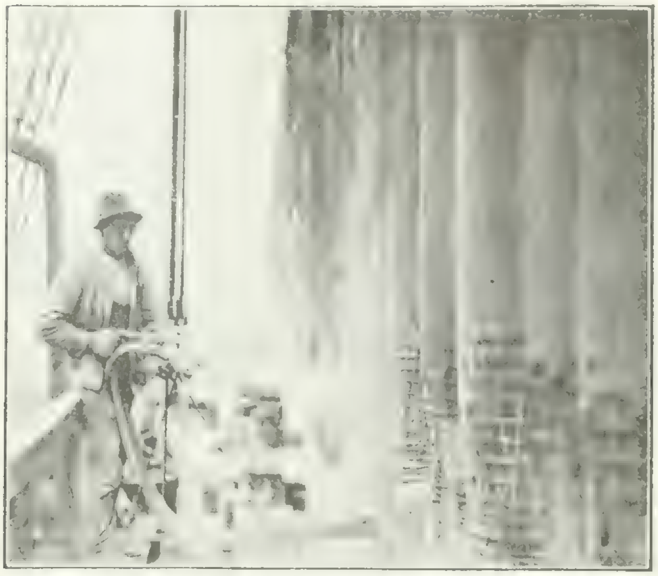
Another run of timbers at water level serves as a base or support on which the bottoms of the piles to be coated may rest. The rack thus provided will accommodate 542 piles at a time and is divided into bays, 18 to 28 ft. long, according to the distance between the supporting piles. Some of the bays have the stringer at the top higher than others, thus providing for various lengths of piles to be coated. The rack is paralleled for its full length by a track on which the locomotive crane operates.


FASTENING MESH REINFORCING ON THE PILES

The reinforcing consists of electrically welded wire mesh, 2 in. square, made of No. 12 galvanized wire. This comes in 5-ft. widths and for each pile a length is cut from the roll equal to the length of that portion of the pile to be coated. Specifications require the reinforcing to have a minimum lap of 4 in. when fastened to the pile. Metal chairs, or spacers, are used to hold the mesh in place at the desired distance of ¾ in. from the surface of the pile. The spacers are put on in rings 2 ft. apart, eight to the ring, and fastened to the pile with 16-penny wire nails.

Before the mesh is put on, a saw cut 2 in. deep, is made entirely around the pile at the point where the lower end of the gunite is to terminate. The surface of the pile from a point 2 ft. above this cut is then chamfered off so as to taper down to the bottom of the cut. This avoids a ridge where the gunite begins and also forms a constricted section protected by a shoulder in a way calculated to resist any tendency of the concrete


FILES DELIVERED TO PLACE BY LOCOMOTIVE CRANE
Each pile is held near the top by a single turn of rope



APPLYING GUNITE TO SEVERAL PILES SIMULTANEOUSLY

shell to slip up the pile as it is being jetted into place. In addition to the metal spacers, four to six wraps of $\frac{1}{8}$-in. wire are nailed on over the mesh in this tapered section to aid in holding it in place and making a firm bond between pile and gunite. While the pile is laid out horizontally a tapered iron tip is fastened to the lower end to aid in turning the pile while it is being coated in the rack.

Instead of guniting the entire length of the piles and then driving them small end down as usual, gunite was omitted on the butt ends and the piles were driven butt down. By this plan the perimeter and bearing value of the portion below mud line was equal to that that would have been obtained with the gunited smaller ends and at the same time the cost of guniting the lower ends of the piles is saved. Because the lower ends are buried gunite there was unnecessary, in the opinion of those in charge, as a protection against borers. Thus the net result of driving the piles butt down was the saving of about 25,000 lin. ft. of guniting. Penetration below the mud line averages about 25 ft. and hence the gunited portion of the pile extends about 10 ft. below mud line. The piles used vary from 46 to 68 ft. in length. They range from 14 to 18 in. in diameter at the butt with a minimum of 10 in. at the top.

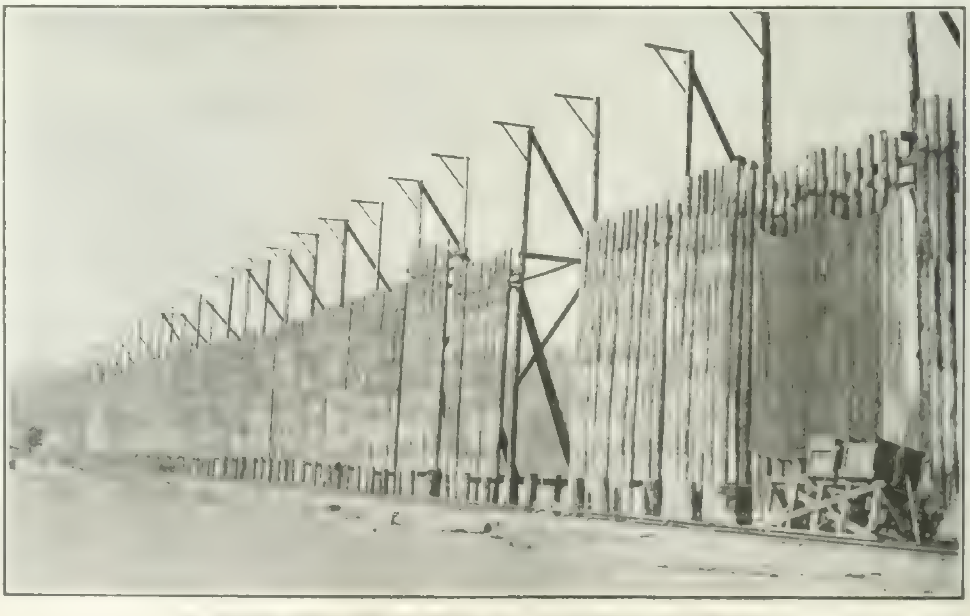
In order to allow for cutting off and fitting the top of the pile under the cap, gunite is omitted for about 5 ft. at the upper end of the pile, although the mesh is fastened in place here the same as elsewhere. When the piles are in place with the caps properly set upon them, gunite is shot on to complete the coating around the upper end of the pile.

As the piles are placed in the bays of the shooting rack they are secured at top and bottom by a rope, a single turn of which is thrown around each pile to hold it to the horizontal timber. Each gun crew consists of five men, two on the gun, one on the nozzle and one at top and one at the bottom of the bay in which work is in progress. The man at the bottom turns the piles with a peavy as the progress of the coating requires, thus making it possible for the nozzle to be worked from one side of the rack only. The man at the top releases or tightens the rope and maintains a clearance between the surfaces of adjacent piles. The ten to twelve piles in each bay are coated simultaneously, the nozzle man beginning at the top and working downward. The nozzle is operated from a scaffold slung from brackets at the top of the rack and the scaffold is lowered as the work advances. Each of the two five-men crews can gunite about 300 lin.ft. of piling per eight-hour shift.

Materials ready mixed for the gun, except for the addition of water, are delivered by the locomotive crane in $1\frac{1}{4}$ cu.yd. boxes. These boxes are set on portable benches that hold three boxes each and have just the right height and deck inclination so that when a trap door in the lower end of the box is opened the materials readily flow into the charging hopper of the guns. Guns, benches and boxes are moved along the rack from bay to bay by the locomotive crane, so the gunite delivery hose does not exceed 80 ft. in length. Water and air pipes run along the rack for its entire length with taps at convenient intervals. The gun is operated with air pressure of about 50 lb. per sq.in., this serving for efficient delivery to a height of 60 ft. which is the maximum height of the nozzle above the gun level.

At first the full gunite covering, $1\frac{1}{2}$ to 2 in. thick, was applied in one operation; this resulted in extensive hair cracking or checking of the gunite. Experiments with various means of preventing this were unavailing and the conclusion reached by those in charge was that jetting wet cement against the wood under pressure forced moisture into the wood fibre of the pile and caused swelling. The cracking was so extensive that in order to adequately protect them it was necessary to put on a tar coating over the gunite on all piles on which the full thickness had been put on in a single application.

A means found to prevent almost entirely this checking was to put on the gunite in two applications. The



RACKS SUPPORTING PILES IN PROCESS OF CURING

first application is made to just cover the reinforcing and is allowed to stand for 48 hours. The second application then follows, increasing the thickness to 1½ or 2 in. Only a very few widely scattered cracks appear in gunite applied in this way and this is in only a small percentage of the piles. From several tests made by breaking out the gunite after it had thoroughly set, it was found that where small hair cracks appeared in the second coat they extended through this coat only. Cracks which appeared in the first coat did not carry through the second coat, nor did cracks occur over or in line with one another.

The gunite, when in place, is required by the specification to be a mixture of one part cement and two and one-half parts sand. Requirements for the sand are that not less than 50 per cent shall pass a No. 20 mesh screen and 100 per cent shall pass a No. 10 mesh screen. The thickness of the gunite is required to be not less than 1½ in. and not more than 2 in. at any point.

During the process of curing the gunite is kept wet by water from pipes run along the top of the scaffold and perforated so small streams play on the upper ends of the piles. Experiments showed that this could be applied without washing out the cement about four hours after the gunite had been shot. The same allowance for initial set before turning on the water is made for both first and second applications. The water pipes are in sections, one section for each bay served by a hose from the water main along the fill, thus sprinkling water in each bay can be controlled independently. The sprays run all day for ten days after shooting. Burlap in large sheets is hung on the sunny side of the piles during hot weather to aid in retaining the moisture sprinkled on at the top.

The piles are allowed to stand in the rack twenty days and are then taken by the locomotive crane to a raft with which they are towed to the pier. The raft consists chiefly of a rack in which about 10 ft. of the upper end of the piles can be fastened, thus preventing them from bumping and scraping, as they are being towed. The water is deep where the piles are delivered to the raft and because of their buoyancy in water it is not believed that this method of handling causes much cross bending in the pile.

The work is under the direction of G. W. Osgood, chief engineer, Port of Tacoma.

American Type of Guyed Derrick in England

High-building construction work in England has been done largely by the aid of stiff-leg derricks mounted on tall timber towers, which towers obstruct the work to some extent. The *Iron and Coal Trades Review*, London, illustrates a "revolution in derrick crane design" which is simply the introduction of the familiar American guyed derrick with steel box-lattice mast and boom. This type of derrick raises itself from floor to floor by its own power as the work proceeds, thus dispensing with any falsework supports. The British "derrick crane" described has an 86-ft. mast and 80-ft. boom, with a hoisting capacity of 7 tons at 80 ft. radius. Seven ¾-in. cables or guys are attached to a spider on the head of the mast. This derrick was designed and built by Caswell & Shearing, London, and is in use by John Mowlem & Co., contractors for the new Belgian Bank in London.

Combined Irrigation and Drainage Plant in Louisiana

One Oil-Engine Pump Delivers or Removes Water as Needed on Rice Plantation—Two Ditch Systems with Control Gates

BY ARTHUR M. SHAW
Consulting Engineer, New Orleans, La.

IN THE economic development of the rice-growing industry in southwestern Louisiana it is necessary to provide for variation of crops and this involves both irrigation and drainage of the same tract of land. On the project described in this article a single pumping plant has been arranged to serve both these opposite

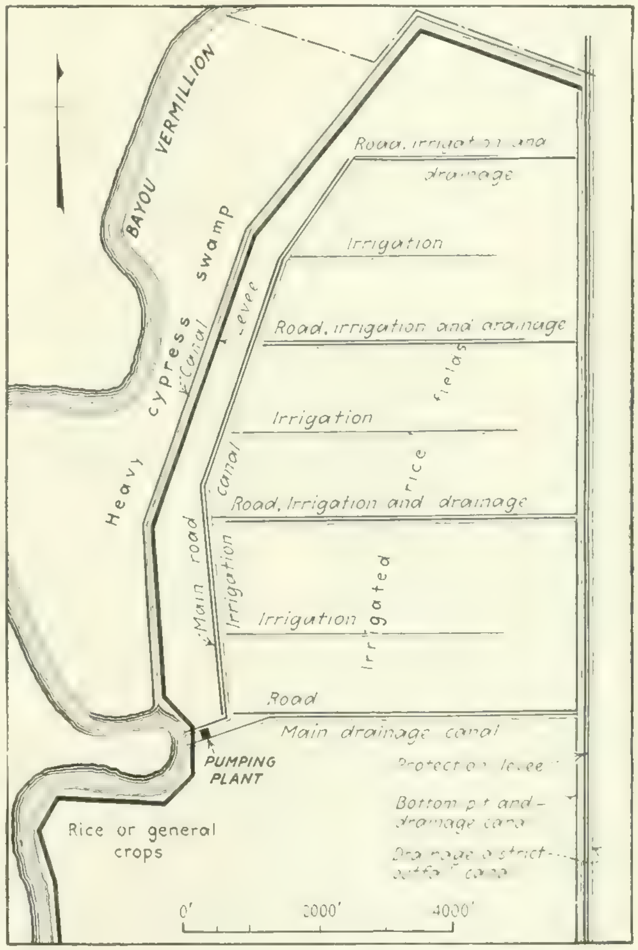


FIG. 1 PLANTATION WITH BOTH DRAINAGE AND IRRIGATION

purposes, thus effecting material economy and efficiency in the supply and use of water and in crop production.

Most of the irrigation water used in the rice growing sections of Louisiana is taken from small bayous, although a considerable amount is taken directly from the Mississippi River and there is some pumping from shallow wells. Plants which pump from the bayous are owned sometimes by private interests and sometimes by canal companies which serve a number of plantations. The amount of water required will vary with the season and is affected materially by the character of soil and methods of application of the water. Under average conditions and with a compact or "tight" soil, it is considered that a pumping capacity of 7 gal. per minute

per acre will suffice; 10 gal. would be the maximum capacity desired and 5 gal. the minimum safe limit.

For the rehabilitation of the Live Oak plantation owned by the Vermilion Farms Co., of Abbeville, La., the writer was engaged as designing and consulting engineer. An area of about 3,600 acres was selected for the first unit, shown in Fig. 1. This is an economical size from an engineering and an operating point of view and it permits the use of all suitable lands owned by the company within certain boundaries. These boundaries are property lines on the north, an outfall canal (serving higher land drainage) on the east, the right-of-way of the proposed Intercoastal Canal on the south, and the bayou Vermilion and a tract of heavy cypress swamp on the west.

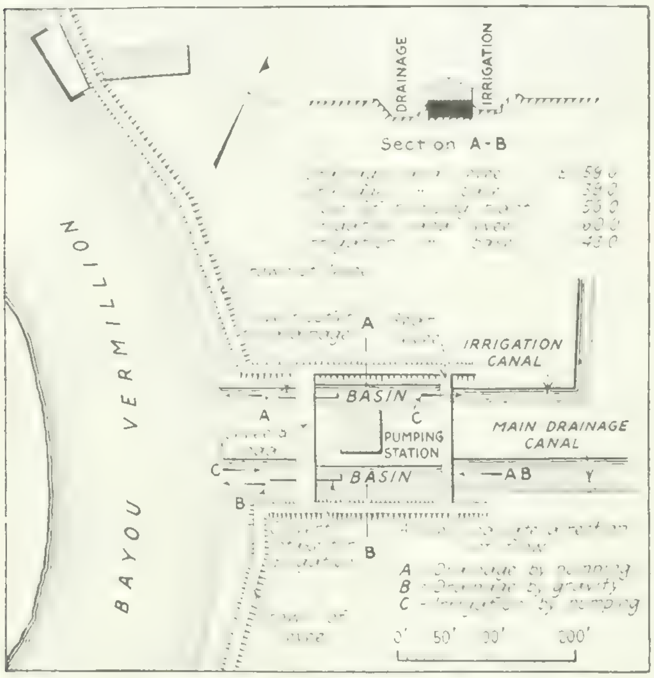


FIG. 2. PUMPING STATION SERVES TWO SETS OF DITCHES

Topography and Soil—Parallel with and usually adjacent to the bayou is the silt-built ridge or natural levee which is common to most of the silt-bearing streams of the Gulf Coast country. The main irrigation canal follows practically the top of the ridge. The greatest elevation above mean gulf level is slightly over 7 ft. while the flat prairie lands are only one or two feet above sea level. Probably 66 per cent of the area is below Elev. 3, or 53 as shown on the drawing, the datum plane for which is 50 ft. below mean gulf level. The ridge is composed of a sandy clay soil, easily cultivated but of sufficiently close texture to facilitate canal construction and to prevent excessive waste of water in irrigation.

Development Works—The varying soil conditions, frequent disasters of "one crop" projects and the economic necessity of rotation of crops were controlling factors in the decision reached by the owners to develop the project for general farming and stock raising, instead of as a rice plantation only. This made necessary the following engineering works: (1) A levee system for protection from storm tides; (2) a system of interior canals for drainage; (3) a separate system of canals and ditches for irrigation; (4) "rice levees" for areas to be used for rice growing; (5) pumping facilities for drainage; (6) pumping facilities for irrigation; (7) a system of interior roads; (8) a wharf for handling water borne freight.

Levees and Canals—As a protection against flooding by severe Gulf storms which formerly had put all but the highest points under water, the tract was enclosed by a levee having a uniform height of 7 ft. above Gulf level, side slopes of 1 on 2 and a top width of 6 ft. At one point where very soft material was encountered, the levee was built up in layers and with slopes of 1 on 3.

Interior drainage canals were constructed as shown in Fig. 1. The main drainage canal, leading to the pumping plant, is 70 ft. wide and has a maximum depth of 14 ft. Other canals are 40 ft. wide with an average depth of seven or eight feet. Additional interior canals or large ditches may be required as the tract is developed. Intermediate drainage ditches are constructed as the particular type of improvement of the section may require. In general, fields used for corn, cane and similarly cultivated crops should be provided with small ditches spaced at intervals of 160 ft. while pasture and meadow lands may be served satisfactorily by ditches at twice or three times that spacing. The spacing depends largely on the surface slope and the texture of the soil. A complete system of irrigation canals for serving the rice lands was outlined, but only the main canal and laterals necessary for the first section were constructed. The trunk canal is designed to carry the normal flow from the pumping plant which is about 52,000 g.p.m.

In rice irrigation it has been usual to construct field levees at each 4-in. drop in elevation; these levees following the 4-in. contours. On the Live Oak project, this interval was reduced to 3 in., with the idea that greater uniformity of flooding could be secured and there would be less danger of the breaking of small levees while water was being applied. These smaller levees offer little obstruction to ordinary farming machinery and are easier to maintain. Since they require less special labor they cost no more than the others, even though more are required for a given area.

Pumping Plant Serves Two Purposes—As pumping for both irrigation and drainage was required, it was decided that the same facilities should serve both purposes. The plant is near the other headquarter improvements along the bayou bank, thus securing convenience of supervision, economy in handling fuel and supplies and available help in case of emergency. Flexibility of operation is secured by a system of culverts, each equipped with a pair of flood gates which can be operated mechanically or permitted to act automatically. No effort was made to secure extreme sensitiveness in automatic action, as the gates are under constant supervision and normally will be controlled by mechanical means. The location of the culverts is shown in Fig. 2 and the gate construction in Fig. 3. If the plant had not been planned for future extension it would have been better to reduce the length of the suction and discharge basins by placing the dams and culverts east of the station as close to the building as practicable.

By suitable adjustment of the gates, any one of the following operations may be carried out: (1) Pump from the bayou into the irrigation canals; (2) pump from the drainage canals into the bayou; (3) pump from the drainage system into the irrigation canals;

(4) drain by gravity from drainage system into the bayou; (5) drain by gravity from the bayou into the drainage system. These last two operations can be carried out only at times of suitable stages of water in the bayou and the canals.

The first two are the "normal" operations for irrigation and drainage respectively, though substantial benefits have been derived from each of the others. It frequently happens that drainage of the pasture lands and of the cultivated crops is required at the same time that water is to be applied to the rice crop. In this way, practically all the drainage that is done during the irrigating season is secured by operation No. 3. During the winter months, when no pumping is required except for drainage, the tide in the bayou is frequently considerably below mean gulf level and the drainage canals may be emptied by gravity. During the past year, demands for drainage alone required the operation of the pumping plant for only twelve days, all other drainage being secured as an incident to irrigation (operation No. 3) or by gravity discharge into the bayou (operation No. 4).

Salt water is blown occasionally up the bayou, making the water unfit for irrigation. This condition existed for a period of several days last year, but the manager foresaw the trouble and filled the drainage canals to the highest permissible stage, thus storing sufficient good water to care for the rice crop. This fifth operation was not contemplated originally but was suggested by the manager and included in the final plans.

Pumping Plant—This plant includes a 48-in. double-suction centrifugal drainage pump, a 180-hp. semi-Diesel oil engine and a 6-hp. engine operating on kerosene for driving auxiliary equipment. There is also a vacuum pump, air compressor, air receiver and miscellaneous shop tools.

Suction and discharge pipes were constructed of ¼-in. plate. Following the writer's usual custom, sketch drawings only were furnished to bidders for the construction of these pipes as it has been found that most boiler shops prefer to make their own shop drawings for such work, but it was required that the drawings be submitted for approval before plates were cut. The sketch was also accompanied with specifications as follows:

"Tapering increasers shall be used for connecting suction and discharge pipes to pump, tapering gradually to a diameter about 10 per cent greater than that of the connecting pump flange. At the end opposite from the pump, pipes shall bell out to an end area equal to four times that of the connecting pump flange, this increase in area being secured by means of a gradual taper of not greater than one foot of increase in diameter to each four feet in length. No sharp bends will be permitted."

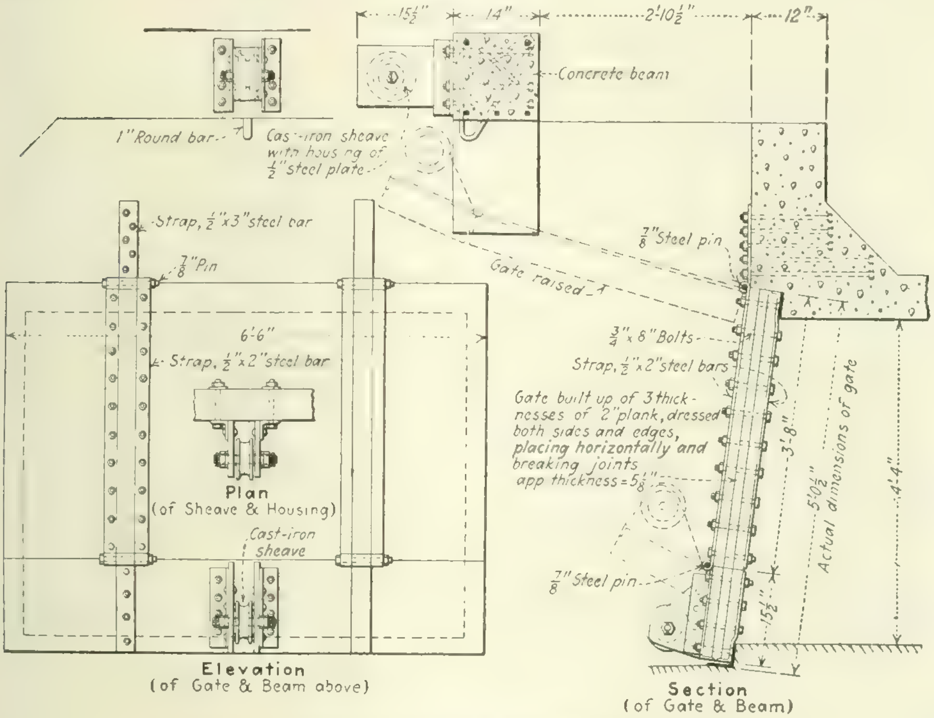


FIG. 3. CONTROL GATES AT PUMPING STATION

Advantages of a Two-Unit Plant—While the machinery has made a good showing in economy of operation and in dependability, a two-unit plant would give greater insurance against interruption of service and would provide greater flexibility in operation. With only 1,000 acres under irrigation, it is not practicable to use the water as fast as it is pumped by the one 48-in. pump, so that a considerable amount of the pumped water is wasted by bypassing to the bayou. Two 36-in. pumps would give slightly greater capacity and would permit the use of duplicate units. In this size also it would be possible to secure pumps suitable for direct connection to internal combustion engines. The cost, however, would be somewhat greater than that of the single unit of approximately equal capacity.

Assuming the capacity of the present unit as ample for the project and that irrigation will never be required for more than half the area enclosed, it is probable that the following equipment would yield the greatest ultimate economy: (1) A 24-in. irrigation pump designed for the greatest attainable efficiency when pumping against the normal irrigation head; this pump to be direct-connected to an engine and operated as near constantly as practicable; (2) a 42-in. pump for emergencies. This latter pump should have a large capacity over a wide range of head but need not be designed for exceptional efficiency at any particular head. It would be belt-connected to an engine similar to that now in use. The smaller unit would be ample for all irrigation demands and would handle the run-off resulting from moderate storms, both pumps being used after heavy storms. With reasonable storage capacity in the drainage canals, it is probable that more than 75 per cent of the pumping would be done by the smaller and more efficient unit.

Construction Methods—Canal and levee construction was done by the Huth Dredging Co., Franklin, La.,

working under a yardage contract. Measurement of work was by completed excavation, though a special time clause was included in the contract to cover special work. Provision was made for multiple layers to be placed on levees under the yardage contract but it was stipulated that the contractor was not to be required to place more than three layers on any one section of levee under the yardage clause and should be paid for moving time under special conditions. For the fourth and succeeding layers, he could be paid on the yardage basis or hourly basis, as he might elect. His equipment consisted of two floating dredges of 1½ and 2½ yd. capacity respectively. Navigable water ways were available to reach the work.

Test borings showed that the sandy clay top soil at the site of the pumping plant merged into the tenacious clay of the rear lands at a depth of only a few feet and this was considered ample for foundations without the use of piles. At about 2 ft. below the excavation required for the deepest culvert, a sand stratum was encountered and interlocking sheet piling was used to prevent seepage and undermining. The piles were jetted down through the sand and then driven into the underlying clay to a depth of three or four feet. Excavation for the culverts was done mainly by the dredges, but in spite of extra care to cut to exact grade one place was carried about 3 ft. below proper grade and the excess excavation became filled with soft mud. To avoid the cost of taking out the mud and protecting the work by cofferdams, brick bats were dumped in and rammed down by heavy timbers until the mud was forced out and a solid foundation secured.

Construction was carried out under the direct supervision of E. P. Putnam, Jr., president and general manager of the Vermilion Farms Co., with E. J. Kevlin as resident engineer. The latter reported to the resident manager in all matters excepting those of a technical nature, which were reported directly to the writer. Most of the work except the dredging was done by plantation laborers, supplemented by special workmen as required. With the exception of a concrete mixer and a small home-made pile-driver, practically all the construction equipment was such as is found on any large, well equipped plantation.

Flume Takes Place of Culvert on Skagit Railroad

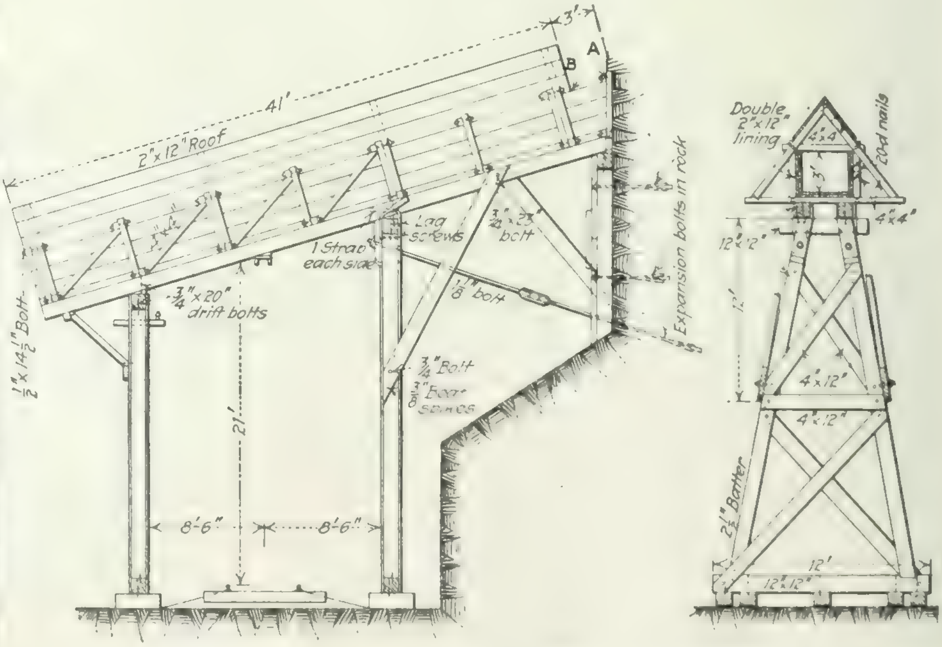
THE construction railroad serving the Skagit hydro-electric project, which is being carried out by the city of Seattle, Wash., operates an electrified extension through the Skagit Gorge. At one point on this line a small stream comes down a precipitous rocky slope above the track in a location such that the stream could not be economically diverted at some level above the track bed. As compared to the cost of providing a channel down the rocky wall and a culvert under the track, it was considered preferable to build a flume above the track, as shown in the accompanying illustration.

A 3 x 3-ft. flume is considered sufficient for carrying all the flow expected in periods of maximum runoff. To catch the entire flow the upper end of the flume is flared from a 3-ft. width at "*C*" to a width of 8 ft. at "*A*." At the upper end the flume timbers were cut to fit closely against the rock and wedges were driven to make the joint as tight as possible. Joints between planks in the sides and bottom of the flume were well caulked to prevent leakage.

The photograph shows a winter view of the overhead flume with ice forming where the water passes through the cold air. No difficulty with ice forming on the track has occurred because the steep slope of the flume gives the water sufficient velocity to carry it to the far side of any ice formation.

A general description of the Skagit project, of which C. F. Uhden is chief engineer, appeared in *Engineering News-Record*, Nov. 18, 1920, p. 994.

CULVERT FUNCTIONING IN WINTER



SECTION AND ELEVATION OF "OVERHEAD CULVERT" SKAGIT PROJECT

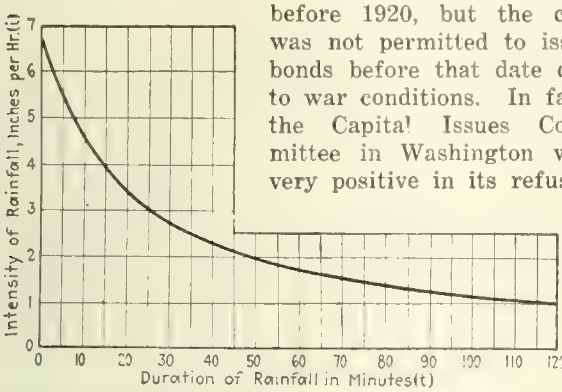
Detroit's Intensive Sewer Construction Program

Relief Sewers in Old Part of City and Trunk and Lateral Extensions Being Built—$31,570,000 of Bonds Authorized—Program and Methods Outlined

By J. R. Hendry
Engineer Sewer Design, City Engineer's Office, Detroit, Mich.

DETROIT is in the third year of an intensive sewer construction program. In 1920 and 1921 nearly 43 miles of main and about 158 miles of lateral sewers were built at a combined cost of over $19,000,000, while the estimated figures for 1922 are 50 miles of main and 90 miles of lateral sewers at a cost of $14,350,000. This large amount of work has aroused more than local interest among engineers and contractors, and I have been asked to write a brief sketch outlining the general situation and design methods.

The need for sewerage extension was very apparent before 1920, but the city was not permitted to issue bonds before that date due to war conditions. In fact, the Capital Issues Committee in Washington was very positive in its refusal.



RELATION BETWEEN TIME AND INTENSITY OF RAINFALL AT DETROIT, MICH.

On the basis of 1918 prices for labor and materials, it was estimated that it would require $60,000,000 to build trunk sewers in the newly annexed districts, two relief sewers in the central part of town, sanitary interceptors to the sites of the three proposed sewage-works, and the units needed at the present time at the three plants just mentioned. On this basis, in 1920, a $31,570,000 sewer bond issue was authorized—$6,570,000 by the Common Council in the yearly budget and $25,000,000 by popular vote. The understanding was that the remainder would be authorized when needed. This money was made available in a lump sum, leaving the Department of Public Works free to apply it to the general plan in whatever way seemed most advisable. This system has been found very convenient to the Engineering Department, saving transfers of funds to cover deficits from surpluses and providing funds for emergencies.

The chief of several reasons for the city being confronted with a sewage program of this magnitude was its extremely rapid growth in both area and population from 1915 to 1920 (see table). Between 1915 and 1917 the area of the city practically doubled.

For a number of years before the war there was a tendency to underestimate either the rate at which the city was growing or the importance of keeping pace with this growth with sewer construction. When these things were recognized the added burden of catching up in some of the older sections was attached to the problem of furnishing drainage in the newer sections.

Sewage-Treatment Problem—The third phase of the problem was the question of sewage treatment. Detroit has always discharged its sewage into the Detroit River without treatment. The river has a steady year around flow of about 210,000 sec.-ft. This heavy dilution, up to recent years, has kept the nuisance created within reasonable bounds. However, the rapid growth of the city and surrounding territory and the extension of the sewer system has brought the question of sewage treatment to a point where it cannot much longer be ignored. The question of sewage treatment was given quite a thorough preliminary study by C. W. Hubbell, who made a report to the city before he became city engineer in 1916. He worked in close conjunction with the International Joint Committee on Pollution of International Boundary Waters. Mr. Hubbell's report covered the Detroit River only, while the International Joint Committee covered the whole boundary between Canada and the United States.

The two reports agreed that an average pollution not to exceed 500 B. Coli per 100 c.c. in the river was a reasonable index of the pollution permissible. The dilution of the river does not produce anywhere near this minimum requirement at the present time and treatment will be necessary in the near future. All the new work in connection with the sewer system is being done with the treatment feature in mind. Diversion chambers, interceptor crossings and like accessories are being built into the new sewers. One of the three proposed sites for sewage-works has been bought.

Detroit's Sewerage History is probably typical of that of the average American town. The first settlement in 1701 was on the river front in almost the exact center of the present city's water-front. It consisted of fifty French soldiers, fifty civilians and one hundred Indians. From that time to the present the town has had continuous and uninterrupted growth to a population of one million persons and eighty square miles of area.

TABLE I—AREAS AND POPULATION OF DETROIT

Year	Area	Population	Year	Area	Population
1806	0.33	....	1908	..	426,592
1815	1 36	....	1909	.	440,412
1827	2.56	1,900	1910	..	465,766
1832	4.17	3 600	1911	..	499 030
1836	5.26	6,927	1912	41.76	536,139
1849	5.85	18,000	1913	..	567,920
1857	12.75	43 300	1914	..	595,000
1875	15 00	103,000	1915	46 97	678,746
1879	16.09	113,000	1916	70.66	734,562
1885	22.19	142,000	1917	78.69	820,778
1891	28.14	213,000	1918	79.62	900,000
1894	28 35	237 798	1919		950,000
1905	28.75	369,805	1920	..	993,739
1906	35 65	377,208	1921	79.92	942,373
1907	40.79	404,782	1922	81.42	1,000,000*

*Estimated.

The town has grown, fan-like, about the original center on the river front, roughly speaking, from seven to eight miles in all directions, except as limited by the Detroit River. As the limits spread along the river,

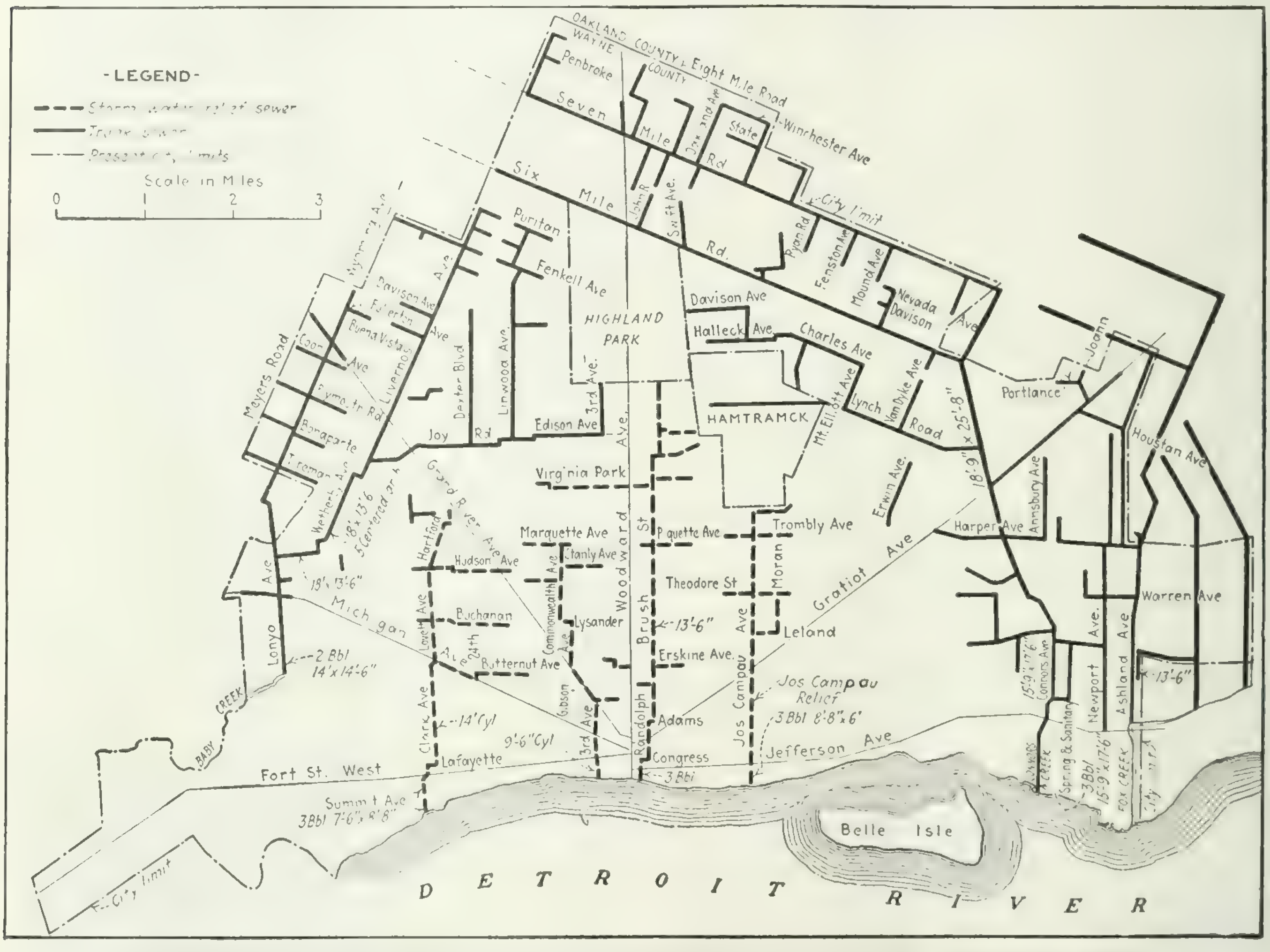
new trunk sewers were started inland, and as the expansion started inland, these trunks were extended to care for territory annexed. As these trunks were built little if any larger than necessary to care for ultimate development of what then constituted city territory, the continual extension inland soon tended to overload the sewers. Occasionally a new relief sewer would be built through the older territory, but on a scale that left the system as inadequate in a few years as the original sewers were when the relief was attempted. This was in brief the condition of the Detroit sewer system in 1915 when the area of the city was 41.76 square miles. Between 1915 and 1917 a belt of land between two and three miles wide, surrounding the entire city, was annexed, making 78.69 square miles or practically doubling the area. The new territory was partly built up and new building was proceeding at a feverish rate. New families were pouring into Detroit to satisfy the industrial demand. The pressure brought to bear upon city departments for needed improvements was unprecedented. Transportation, pavements, water, gas, and other things were not of much use without sanitation, which brings us to the question of the general layout and design features of the new sewer system the city is now building.

All city work is based upon a local elevation datum in reference to which the river level is 95 ± and the highest point in the city in the northwest corner is at El. 178. The slope eastward and southward to the river is quite uniform and gradual and it was found convenient and economical to follow the natural slopes in laying out the system.

These figures also serve to indicate that the grades of the sewers have to be conserved. At no place in the entire system has it been found necessary or even possible to throw away grade with sudden drops. Velocities have been maintained between 5 and 15 ft. per second in the whole system, averaging probably between 6 and 8 feet.

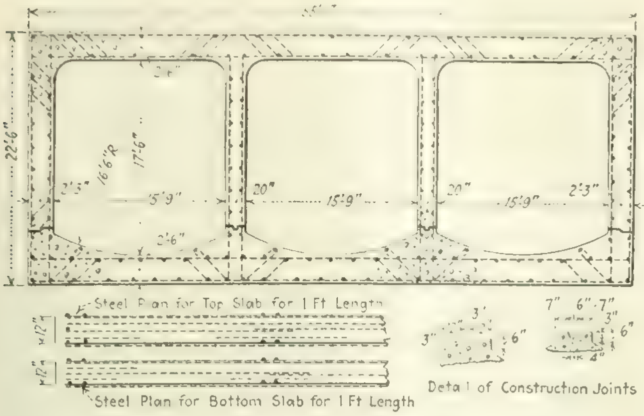
The whole sewer system is of the combined type. About five square miles in the southeast corner of the city will eventually be made a double system, the present combined sewers being of just the capacity for sanitary drainage under ultimate development. This district is very low, parts of it being 2 ft. below river level. The sewage from it is now being pumped and always will be. A storm system will be constructed paralleling the present one.

The Rational Runoff Formula has been used in computing necessary capacities of all combined and storm sewers. By analysis of rainfall records of the past 26 years, the curve of rainfall intensities for design purposes (see diagram) has been taken as $i = 136/(t + 20)$. The coefficient of runoff has been set as low as 0.10 for park and cemetery areas with sandy surface soil and as high as 0.85 for fully built up and



TRUNK SEWERS IN NEW TERRITORY AND RELIEF SEWERS IN OLDER PART OF DETROIT, MICH.

The trunk sewers are all finished or under contract. The storm-water relief sewers are all completed except the Clark Avenue Sewer which is under contract and partly completed.



CROSS-SECTION OF CONNOR'S CREEK THREE-BARREL REINFORCED-CONCRETE SEWER, DETROIT, MICH.

paved blocks in the business district. The average residence district is taken between 0.30 and 0.35; and the average neighborhood business district between 0.45 and 0.60.

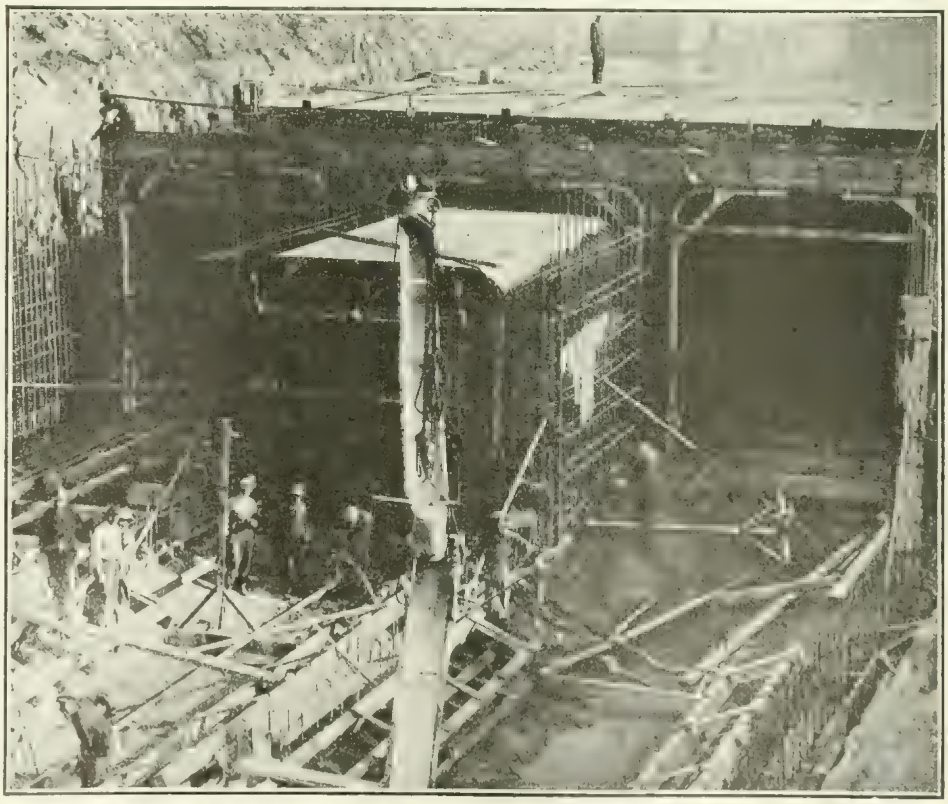
Up to a 50-minute period of concentration we have arrived at our required capacities by summation of quantities, being careful always to use the intensities corresponding to the time as we proceed down the system. Beyond the 50-minute period we have used the summation area method, applying intensity corresponding to time of concentration. This gives a somewhat smaller quantity to care for than summation quantity method, probably in the neighborhood of 15 per cent less in an average case. Others may use the rational formula in this way but so far as the writer knows the method is original with us.

We were led to the methods described by a study of local rainfalls over a period of about four years. Four rain gages were set up on the corners of a four-mile square. We found varying intensities in the same storm and that the centers of maximum intensity were of comparatively small extent compared with the whole storm. The design curve of intensities is naturally made up from the readings at a single location. If applied over too large an area this would lead to over-capacity sewers. Our figures showed that this factor could be cared for by changing from summation quantity to summation area method at from 40 to 60-minute concentration points. Usually we make the change at fifty minutes.

The design of the new sewer system can conveniently be divided into two headings: (1) Sewerage in the new territory recently annexed, consisting of a belt two to three miles wide surrounding the older portion, about 40 square miles in area; (2) storm-water relief sewers for the whole of the older territory, also consisting of about 40 square miles.

Two Great Trunk Systems—The solution of the first problem consisted of the design and construction of two great trunk systems, Lonyo Road and Connor's Creek (see map). Both start in the northwest corner of the city and follow the natural drainage lines to the river. The Lonyo system flows straight south and the Connor's Creek system flows east seven miles, then southerly about the same distance. A glance at the map will give a clearer idea of this layout than any lengthy description. The map shows only sewer mains. The vacant spaces are reached by laterals. The apparent irregularity of location of minor arms is due to topography and other local considerations, such as cemeteries, railroads, and parks. The Connor's Creek system passes north of Highland Park and Hamtramck, two separate municipalities, both entirely surrounded by Detroit, but with their own governments and local sewer systems. Both sewer systems empty into that of Detroit.

The drainage area of the Connor's Creek sewer is 41 square miles. Some of this is not now in the city limits but has been provided for. Under ultimate maximum conditions this sewer will carry 5,000 cu.ft. per second. The lower two miles consist of a three-barrel reinforced-concrete box section (see cross-section and view), each barrel being 15¾ ft. wide and 17½ ft. high. This section is laid on a 0.035 per cent grade. The section from Jefferson Ave. to Warren Ave., 7,700 ft. long, is just being completed at a contract price of $2,190,850 or $284.53 per foot. The four main branches of the Connor's Creek sewer are completed and in operation. These consist of the Lynch Road, Six-Mile Road and Seven-Mile Road sewers on the west and the Gratiot Ave. sewer on the east. The Connor's Creek


CONNOR'S CREEK SEWER, DETROIT, MICH., UNDER CONSTRUCTION
Each of the three reinforced-concrete barrels is 15¾ ft. wide and 17½ ft. high

sewer itself is and will be built entirely in open cut while the branches are practically entirely in tunnel. These branches are at the present time emptying into the open creek and tend to create an unpleasant condition. Complaints have been received from residents in the vicinity. The city is heavily disinfecting the effluents but this condition cannot continue for long. This state of affairs has been caused by delays in court in regard to condemning rights of way through the creek bottom for the sewer. However, the Sewer Department expects to have the section extending from Warren to Lynch Road under contract and construction soon, the rest to follow shortly.

The Lonyo system is practically finished. Those small parts still under construction will be in operation by cold weather. The lower three miles of this system was all open cut and the remainder in tunnel. The Lonyo Road sewer itself is 8,318 ft. long and the contract price was $1,430 000 or $171.91 per foot. It is a double-barrel reinforced-concrete box section, each barrel being 14x14½ ft., on a 0.07 per cent grade. The system has a drainage area of 14.35 square miles, and is designed under maximum conditions to carry 2,530 sec.-feet.

The Wetherby sewer has a five-centered arch section, 18x13½ ft. The upper portion of the Connor's Creek sewer will also be a five-centered arch, but with dimensions of 25¾x18¾ ft. Other sewers are generally of circular cross-section. Up to 6 or 7 ft. in diameter the egg section is sometimes substituted for the circle but this is generally, when done, for the purposes of gaining headroom for workmen, in tunneling, rather than for hydraulic advantages.

The drop in prices of labor and material in the last year and a half has caused quite a noticeable saving on the contracts let during that period over the amounts estimated during the war. In fact at least six large jobs and a number of lesser ones have been entirely financed out of this saving.

Relief Sewers—The problem of relieving the drainage system in the older section of the town is being met by the construction of large parallel storm overflow sewers from 1 to 1½ miles apart. Three of these, the Third St., Bates St., and Joseph Campau Ave. sewers are completed. The Clark Ave. sewer is under construction and two others, one on the east side and one on the west side, are projected.

It is fortunate that in the early days it was customary to build the sewers emptying into the river with more or less free outfalls. In other words, 3 to 5 ft. of grade were thrown away at the start. In building the relief sewers this grade is conserved and, with the flatter grades possible in the larger sizes, it has been found fairly simple to intercept and relieve the old sewers with the relief arms. The new relief sewers will carry only the storm-water overloads, the dry-weather flow being kept in the original lines. This is done by making the relief connections above the dry-weather flow elevations, thus making it unnecessary to intercept the relief sewers with the cross-town sanitary interceptors leading to the treatment sites. The first and smallest of these relief sewers is the Third St., which is 9½ ft. in diameter. The Clark Ave. Relief is 14 ft. in diameter. The Bates St. is 13½ ft. in diameter and the Joseph Campau is 11½ ft. Two and possibly three other reliefs will have to be built. These, with the four now under construction or in use, will care for the portion of the town lying inside the new system—as long as they last. The life of a sewer in Detroit is something we have never satisfactorily determined. Our velocities are not high and not much grit is carried. We have sewers eighty years old that are practically as good as new. The nearest we have come to a failure of a main sewer has been some shattering due to gasoline explosions. We have arbitrarily, therefore, set 80 to 100 years as the life expected.

Financing and Contract System—The main sewers are financed by the sale of bonds, and in general are built in the streets. The lateral sewers are assessed against the property served "in proportion to the benefits derived." This is a difficult provision to interpret We assess the cost directly proportional to the area of the various parcels served. This is not always just but will have to serve until a better interpretation is adopted.

Our specifications for construction work are very similar to those of many other towns. There is nothing radical or new in them, but we feel that they are in good working order as questions of interpretation seldom come up. Contractors on all sewers are required to furnish two surety bonds on each job for 100 per cent of their bid: One to insure the city against non-completion of the work and the other to insure the state against non-payment of sub-contractors, wages or materials.

To expedite this large program, Detroit has been using, since August, 1920, a form of contract which provides a penalty for non-completion by a date set in the advertisement and written into the contract. This penalty takes the form of liquidated damages and amounts to about 6 per cent of the contract price per year. On large jobs this runs as high as $500 per day. No bonus is offered for earlier completion. Quite a number of adjustments on this basis have come up and no litigation or serious difficulties have been encountered in operating this contract. No new contracts are entered into with a contractor while he is in arrears in time.

The chief credit for whatever has been accomplished in the sewerage line is due C. W. Hubbell, city engineer of Detroit from 1916 to May, 1922, at which time he resigned to devote his time to his private practice. The writer also gratefully acknowledges the conscientious efforts of the young men composing the sewer division of the office.

Ditching with Dynamite

A demonstration of ditching with dynamite was part of the exhibits at the National Drainage Congress in Kansas City and is reported as follows by J. W. Dappert, consulting engineer, of Taylorville, Ill. The charges were planted in three rows and 18 to 24 in. apart in each row. As the earth fell it scattered widely so that very little fell back into the ditch. The explosion left a straight and fairly uniform but not large ditch, with slopes and beds well shaped, but with much loose material. A rough estimate of this work is as follows: 2,250 sticks were used, 40 per cent nitro-glycerin, or 562½ lb. At a market price of 25c. per lb. this would cost $140.62; labor, transportation, placing, fuses, etc., would bring the total cost to about $163. The ditch was about 1,000 ft. long and averaged 3 ft. deep, 2 and 12 ft. wide at base and top, giving 780 cu.yd., or about 20.9c. per yard.

Recommended Changes in Highway Contract Practice

Contractors Formulate Improvements Designed to Reduce Risks and Increase Performance—Legislative Action Urged

SUBSTANTIAL improvement has been made in the last three years in the business relations between road contractors and highway officials. It has, however, been an improvement solely of individual relations—between a contractor and the engineer over him or between a state group of contractors and a state highway department. Contractors as they are nationally organized and highway officials as they are nationally organized, are still intolerant of each other's claims, although it will be three years ago in December that a joint committee of the two national associations was created to bring them into closer harmony. The committee's labors have been ineffectual. Indeed it is no secret that intolerance within the committee has prevented it from functioning in any definite manner. The situation requires intelligent treatment.

There is no real question between highway officials and contractors of their mutual obligations. The contractor expects to build a road of the kind and quality specified. He asks a reasonable profit for his work. He also asks that restrictions and risks which do not benefit the quality of the work but do hinder his chances of making a profit shall be eliminated. Highway officials allow all these requirements. Dispute begins when agreement is sought on the contract and construction restrictions which are permissible and necessary. In brief, there is no substantial difference of opinion between contractors and highway officials on the general principles of their contractual relations, but there is a dispute concerning details.

In view of the serious situation which appears likely to confront highway officials and road builders due to a growing reaction of public sentiment against increased expenditures for highway improvement all dispute within the road building industry should be smoothed out. The first step in the particular question being considered is to get a clear understanding of the subjects in dispute. They were briefly stated in these columns (*Engineering News-Record*, Jan. 1, 1920, p. 15) following the appointment of the joint committee of the Associated General Contractors and of the American Association of State Highway Officials to take the question under advisement. Since then opnion has been somewhat modified and conditions have altered so that a restatement appears quite different from the original statement.

The subjects which contractors, as represented by the Associated General Contractors, ask state highway officials to take under consideration may be grouped under three headings: (1) Contract obligations, (2) Award and administration of contracts and (3) Legislative action. In the following presentation of subjects coming under each of these heads it has to be kept in mind that some may be modified, others eliminated and perhaps new subjects added, when the committee actually begins its deliberations.

Contract Obligations—On the question of contract obligations the practices in which contractors ask modification are: (1) Allowances for extra expense; (2) classification of unit quantities; (3) acceptance of work and (4) payments.

Extra expense is caused the contractor when operations are delayed or suspended by action of the highway officials, or when the original quantities are materially increased or decreased or when materials once inspected and approved are rejected upon reinspection. It is urged that an adjustment of contract prices should be recognized as obligatory under these circumstances. In particular, it is contended that a limit should be stipulated beyond which the amount of work cannot be increased or decreased without adjusting the contract price.

Incomplete classification, particularly of excavation, and the grouping of different kinds of work under a single unit prevent accurate estimating and should not be practiced. Another grading operation that is at present not definitely specified is overhaul. A general modification of specifications for overhaul seems required to set a reasonable free haul limit of probably not over 500 ft. and to establish a standard method of accurately computing overhaul.

Arbitrary practice prevails generally in accepting highway work as completed. Delay, maintenance requirements and retained percentages tie up the contractor's funds and prevent prompt shifting of plant. It is believed that this situation can be materially improved by laying down the rule that acceptance is constituted by opening the highway to traffic and by eliminating maintenance provisions. A guarantee of the quality of the work for a year is suggested, in place of a maintenance requirement. Such a guarantee, it is held, is sufficient to protect the highway department against faulty construction and the contractor is not hampered in his future construction operations by the necessity of keeping organized and providing capital for maintenance work.

By the same reasoning, retained percentages ought to be no greater nor the money held longer than is absolutely necessary for a safe guarantee that the work will be completed. It is submitted that this requirement is met when the amount retained is not more than 20 per cent and, after work has reached a certain stage of completion, when the total sum retained is not increased, but, if possible, reduced. Prompt payments on a definite date each month and within a definite period after the completion of the work remove another financial handicap which is common.

Award and Administration of Contracts—Irresponsible bidders have been so common in highway work that forfeiture of contracts and financial failure have increased the difficulties of securing liability insurance and of obtaining loans from the banks. Wrong price standards have also been set up, so that in many states contractors of the highest standing are making no effort to secure road work. To meet this situation it is urged that the practice be followed of eliminating unsuitable bidders before the bids are opened, such action being based, of course, upon a careful investigation of the bidder's past record, financial standing and experience. With this selection made it is urged:

(1) That the contract be awarded promptly and certified checks be returned within a specified time.

(2) That an effort be made to secure the highest possible type of inspectors and field engineers.

(3) That unless a plan for the prosecution of the work is given at the time of sending out proposals, the contractor is to pursue his own plan except in emergencies endangering life and property.

(4) That when the contract specifies the methods to be followed it should not specify the results.

(5) That inspection of materials should be made at the source whenever it is practicable.

(6) That written statement be required of all important orders, particularly those involving delays.

Legislative Action—With a full understanding that highway officials in their acts and procedure are bound by legal restrictions which they cannot modify they are asked to co-operate with contractors to secure legislative action:

1. To enable the highway department to make adjustments of claims by the contractor for damages sustained from (a) orders, acts or omissions of the department and its employees and (b) causes beyond the contractor's control against which he cannot obtain insurance.
2. To repeal laws which prevent bonding companies from making reduced rates for preferred risks; i.e., to thoroughly responsible contractors.
3. To enable the department to reduce the surety bond as the percentage of completed work may warrant.
4. To make optional the substitution of collateral for a surety bond.
5. To establish a court of claims where the law prevents the contractor from suing the state for damages.
6. To make legal an arbitration clause in public contracts.
7. To make funds collected from automobile licenses over and above those required for maintenance, assignable to construction.
8. To make accurate and true cost accounting mandatory in all state construction performed by day labor.
9. To preclude bonding companies from writing bid bonds for any contractor to whom they are unwilling to furnish a surety bond.

The preceding statement of subjects and principles which contractors offer for the consideration of state highway officials is presented with the belief that it in no way jeopardizes the quality of highway work. Practically every provision has in some community or in some individual contract been tested out and found to work satisfactorily. They do not, it is believed, take from the engineer any prerogatives which he must have as the person ultimately responsible for the quality and perfection of the highway.

Putting New Foundations Under an Occupied Building

Work Done in Sections—Economical Combination of Deep Piers and Surface Footings for Heavy and Light Loading

RECONSTRUCTION of the foundations of a Chicago theater and office building without interrupting the occupation of either portion of the structure was accomplished as part of the work of modernizing the McVickers Theater. Special methods were used in carrying out the work. Another feature of this reconstruction is the combination of spread footings in the surface clay with deep concrete piers sunk to bed rock in open caissons. Fig. 1 shows the general scheme of the work.

The old building, which was altered this summer after the completion of the new foundation work, occupied a site 82 x 192 ft. fronting on Madison St., in the heart of the city. It consisted of a 7-story steel-frame office building 50 x 82 ft. at the street front and a theater in the rear, the theater entrance occupying the greater part of the first story of the office building. The foundation walls and footings were of stone, the footings being composed of large flat limestone blocks or slabs resting on the Chicago clay at about 2 ft. above datum or water level in the Chicago River. The load on the clay under the footings of the side walls was approximately 3 tons per square foot, which the reconstructed foundations reduce to about 1½ tons.

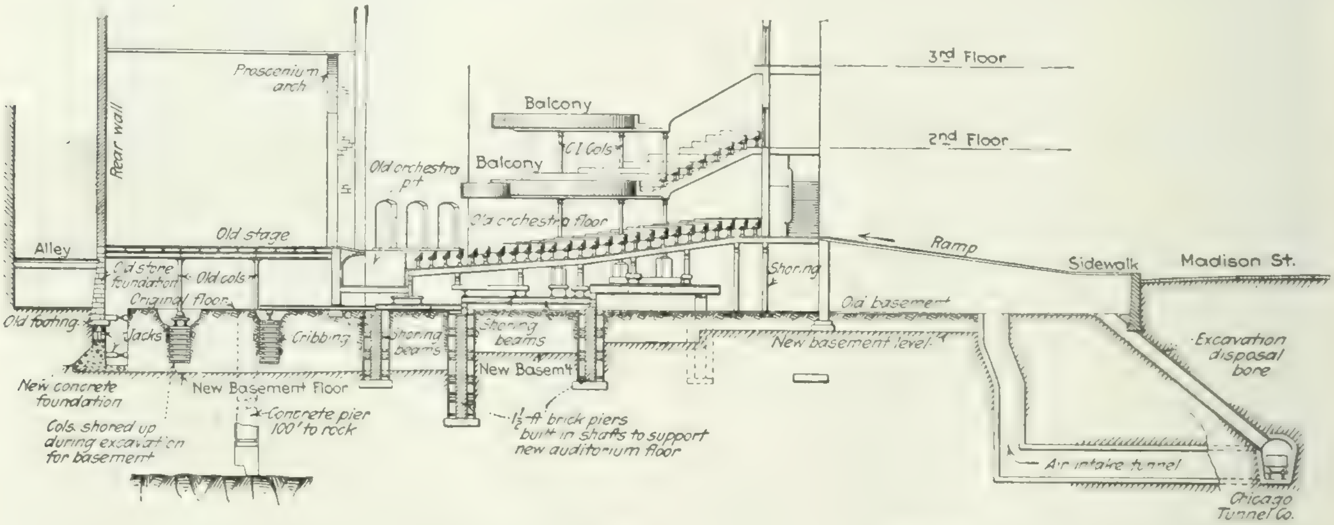


FIG. 1. NEW FOUNDATIONS PLACED UNDER THEATER AT CHICAGO, PRELIMINARY TO RECONSTRUCTION

In the theater, the main or orchestra floor was supported on brick walls and timber posts. A first and second balcony were carried by cast-iron columns on brick piers below the orchestra floor. The roof trusses of the theater were supported on steel columns anchored to the exterior brick walls and resting on the same foundations as the walls. These trusses, which will be retained, carried a two-story superstructure forming an extension of the upper floors of the office building, but this superstructure has been removed and will not be rebuilt.

In modernizing the structure it was decided to: (1) tear down the 7-story office building and replace it with a 3-story structure having the first floor occupied almost entirely by the theater entrance and the two upper

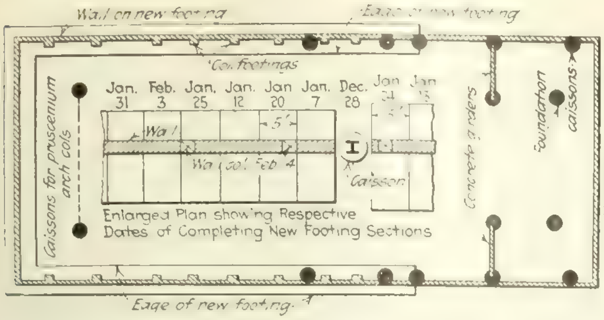


FIG. 2. COMBINATION OF SPREAD FOOTINGS AND DEEP PIERS

floors devoted to offices; (2) reconstruct the interior of the theater so as to eliminate all interior supporting columns and give an unobstructed floor space; (3) retain the old walls, foundations and roof trusses of the theater, underpinning the walls by new foundations carried to a greater depth and giving a wider bearing surface. In order to eliminate the former entrance ramp or incline which ascended from the sidewalk level to the theater lobby, the new orchestra floor and stage were planned at an elevation 4 to 9 ft. below the original level. This change necessitated deepening the basement by an amount varying from 2 to 9 ft.

A single steeply-inclined balcony will replace the two old balconies and will be supported by steel cantilever girders having their upper ends anchored to a steel truss and their lower ends seated in another steel truss spanning the main floor.

At first it was thought that it would be necessary to support the building entirely upon concrete foundation piers sunk to rock or hardpan. But in view of the relatively light wall loading of the theater section, where the walls carry little more than the roof trusses, it was decided that for this part of the building it would be sufficient to underpin the walls by concrete foundation walls having spread footings at an average depth of 9 ft. below datum. This arrangement also gives space for a new basement over the entire area. The arrangement of the new footing wall and foundation piers is shown in Fig. 2.

These new wall foundations, Fig. 3, are of mass concrete, having the inside face vertical and the outside face sloping at an angle of 45 deg., which gave sufficient

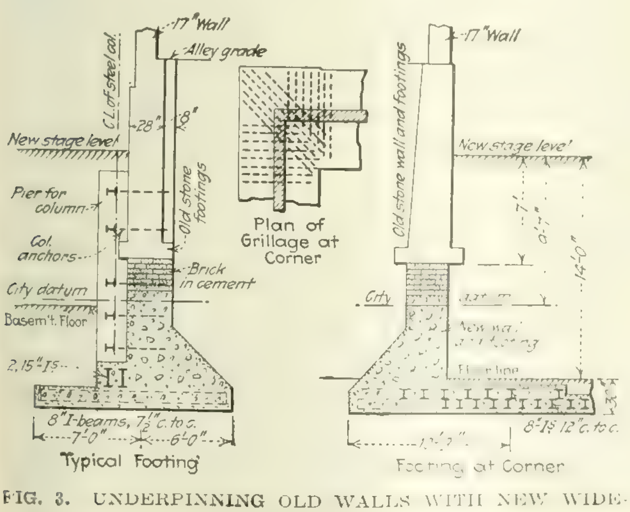


FIG. 3. UNDERPINNING OLD WALLS WITH NEW WIDE-BASE FOOTING

working room in reaching the desired width of footing. Below the basement floor the foundation projects 4 to 5 ft. on the inside of the building, thus giving a footing which varies from 10 ft. 9 in. to 15 ft. 10 in. in width. The footings were reinforced with a grillage of 8-in. I-beams spaced 7½ to 12 in. c. to c. By this construction the load on the clay is reduced to about 1¼ tons per square foot, as noted above.

The foundation walls were built in sections 5 ft. long, remote from each other, so that only small portions of the old walls were underpinned at one time. This is indicated by the dates on the portion of the progress plan in Fig. 2. During the excavation for a 5-ft. section the old footing was supported by posts and building jacks. Each concrete section was finished with its top 30 in. below the old stone footing course. After the concrete had set for seven days, building jacks were placed on the section of new wall and screwed up to take a bearing against the bottom of the old footing. (Fig. 4.) By this method of support any settlement of the new wall could be taken up by the jacks, thus maintaining a positive support for the building. As a matter of fact there was hardly any settlement. After about 60 days the jack screws were removed and the space between top of new wall and bottom of old foot-

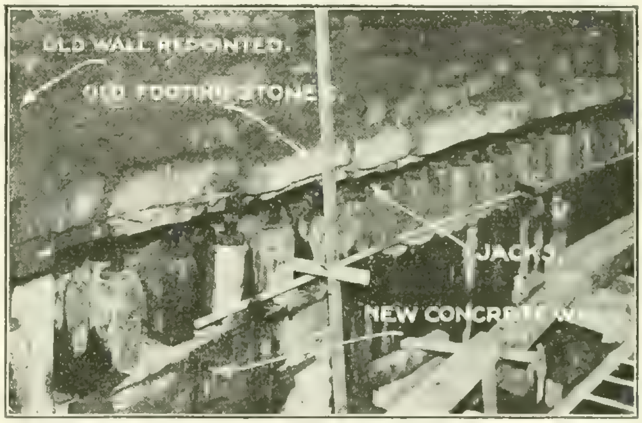


FIG. 4. JACKS PLACED BETWEEN NEW CONCRETE WALL AND OLD FOOTING

ing was filled tightly with brickwork laid in cement mortar. Finally the projecting portion of the old stone footing slabs on the inside of the building was broken off by means of pneumatic drills.

During this foundation work the wall columns supporting the theater roof trusses were shored up on needle beams supported by timber cribbing which was built up from the new footing level and at a little distance from the wall. To permit removal of the foundations of interior columns which carried the balconies and orchestra floor, groups of I-beams were placed in the most convenient positions. Cribbing or blocking was built up on these beams. Jack screws between the cribbing and the old floor framing transferred the load to these temporary supports, leaving the old pedestal and footing free for removal.

The shoring I-beams were supported in part on new brick piers which will serve to support the new auditorium floor. These piers were built in circular shafts just large enough for bricklayers to work, the bottom of the shaft being enlarged for a concrete footing course resting on the clay.

For carrying the heavier loads, sixteen concrete piers were carried down to bedrock at about 100 ft. below datum. Two of these support the truss over the proscenium arch; four carry the trusses forming the fulcrum and rear anchorage for the balcony cantilever girders, and the others support the framing of the front part of the building. These piers are 4 to 5 ft. in diameter and were built in wood-lined open wells or caissons in accordance with usual Chicago practice for deep foundations.

All reconstruction of the foundations was done without closing the theater or office building. Supplies were delivered from an alley at the side of the building. No excavated material was hauled away on the street as all this material was dumped down a chute into cars of the freight tunnel system and hauled away for filling on the lake front. A ½-yd. motor-driven concrete mixer was operated in the space excavated for the new basement. Work was carried on in three 8-hour shifts per day and a total of about 60 men on each shift were employed during the heavier part of the job. Work was commenced on Dec. 12, 1921, and was completed on May 1, 1922, with the old building seated on the new foundation walls and concrete piers ready for the alterations to the superstructure.

This foundation work was planned and carried out by the L. P. Friestedt Co., Chicago, under the personal direction of S. M. Gooder, general superintendent. The architects are Thomas W. Lamb, New York, and Henry L. Newhouse, resident architect, Chicago. J. G. Giaver, Chicago, is the consulting engineer for foundations and structural design.

Achorutes Viaticus Clean Sewage Filters

The inoculation of percolating sewage filters at Glasgow, Scotland, with the insect *achorutes viaticus* for the purpose of cleaning the filtering material, and particularly to prevent ponding, has been successfully practiced during the past summer, according to a letter received by *Engineering News-Record* from F. W. Harris, corporation chemist and city analyst of Glasgow. Experiments with this method were begun on Jan. 21, 1921, on two filters each containing 2 cu.ft. of whinstone—the material used in Glasgow sprinkling filters. Later in 1921, boxes of whinstone, inoculated from the small test filters were embedded in the top layers of the regular filters. The original tests and the further working trial just mentioned were described in *The Engineer,* (London), for Feb. 10, 1922. Regarding the experience of the past season, Mr. Harris writes under date of Sept. 13, as follows:

Although my method of inoculation was adopted in the early part of October, 1921, the results obtained have been remarkably good in spite of the fact that the "trades waste" character of our sewage, the large sized smooth surface media, and the exposed position of our filters are conditions unfavorable to rapid propagation of these insects. Within the last few weeks ocular evidence has been obtained that the area, slightly exceeding 2¼ acres, of our percolating filters has been thoroughly inoculated and, in the greater part, well colonised with these insects, with the result that considerable sections which had previously been constantly "ponded" are now perfectly clean. The surface media is almost in as clean and open a condition as when the filters were first started.

In his article in *The Engineer,* Mr. Harris credits A. Bell, chemist and manager of the sewage-works of Barnsly, with having "first established" this method.

Partners in a Great Adventure

The Relations of the Engineer and Contractor as Seen by the President of the Associated General Contractors

Extracts from address by Arthur S. Bent, President of the Associated General Contractors of America, before the Los Angeles Section of the American Society of Civil Engineers.

The contact between the engineer and contractor should always be one of mutual confidence and co-operation but this is made difficult under the common form of contract which at once sets up an abnormal relationship. Their interests do not run altogether parallel. There is a fertile field for mutual irritation and distrust. The contractor, while we may safely credit him with a desire to do a good job, is primarily in the business to make money and he can't help viewing the acts and attitude of the engineer in the light of their effect on his profits. The engineer is chiefly concerned with the satisfaction and credit he will get from a first-class piece of work. Usually he is generous enough to hope the contractor will make money, but of course he feels no responsibility about this. In the contractor's heart, born of his experience, there is always the feeling that he will be made the "goat" in many little ways, perhaps in big ones, and that he is pretty sure to suffer some injustices on every contract. In the engineer's heart, on the other hand, is the fear that if the contractor isn't watched he may "scamp" the job, or at least neglect it. Such a mental attitude as this is obviously a brake on progress and a heavy handicap to the thing we both are trying to do.

I firmly believe that the origin and foundation of this attitude is the form of contract under which we ordinarily work. In its development one party to it has no voice. It is drawn up for the owner. In every line it breathes distrust of the other party. It is full of drastic provisions which indicate complete lack of confidence in the contractor.

It is true that the unfair contract is seldom written by the engineer. It is the ingenious deviltry of the owner's attorney, whose sole function is a conscientious and cold-blooded effort to secure every possible advantage for his client. Whatever its source, it is out of joint with the spirit of business today. "Caveat emptor" is now a business barbarism. Today we say, "Live and help live."

For more than a year committees from your organization, the Associated General Contractors, the architects, the railway engineers association and the highway engineers have been working together earnestly to develop a fair type of universal contract, which when completed, it is hoped, will receive the formal sanction of these bodies and be officially adopted by them. These contracts will cover the fundamentals of the four great divisions of construction—railways, highways, buildings and public works, and it will only be necessary to make them fit local conditions and specifications in each case. With the official adoption of these contract forms, I firmly believe that three-fourths of the litigation and half of the friction will disappear.

Engineers and Contractors Differ.—In spite of some unfortunate aspects of our contracts, and the disagreements that arise under present systems, able and conscientious engineers have the complete confidence and respect of the contractors. We learn much from you. We are also aware that practically every engineer is sure he would be a better contractor than any he ever saw, and we know from much observation that 99 per cent of you would be dead failures. You can and do put through great projects without contractors. Sometimes you beat our bids (though there is usually an explanation when you do). Often you improve on our methods and equipment. But you do this with the owners' bank account behind you and physical results as your main goal. You are very successful as a department of a contracting organization, but almost always, when you step out into the strictly competitive field, as we have to go,

get your work by being the low bidder for it and put into it your little ten or twenty thousand dollars that you have accumulated, you come quickly to grief.

I have seen many, many such failures and, pondering much over them, have concluded that the answer is one of psychology. I think that which makes a good engineer, the temperament and tastes and abilities which make for his success, *cause* his failure as a contractor. If he is capable of being a good engineer, he is congenitally unfit to drive a bunch of laborers over onto the right side of the ledger, or to bulldoze nature, or to wrest success *with profit* from crude and adverse conditions.

I hope this is so, for I believe there is a full field of usefulness for you and also for us. I think it is an economic mistake when engineers try to eliminate the contractor or are unwilling to let him have private work at a fair profit. I think you should never begrudge us good prices. I think you should try to build us up so that you can have our experience and our organizations and our responsibility to depend upon—available when you need them.

We contractors believe that our craft is the orderly development of a legitimate function. We are convinced that desirable economic conditions flow from this set up. Society needs the contractor, the man who builds up a great fabric of experience and skill and organization and appliances and holds them ready for responsible public service.

Day Labor Versus Contract.—If this is true, then your position is unsound when you recommend or undertake construction work with your own forces, particularly public work of importance. If this is right, it is right all the time, and a final analysis finds the Associated General Contractors and the entire construction army, built up by an endless process of specialization and elimination, swept into the discard. Don't you think this would be a disaster to society? Private construction would then inevitably be the victim of hopeless incompetence, now eliminated by the fierce fire of competition. Public work would become the plaything of politics.

What arguments are there for not letting work out by contract? The common one is that the contractors' profit may by combinations be made too high. I want to assure you that general contracting has passed out of the era of combinations, and it is today absolutely impossible to "frame up" an important piece of work. If bidding is genuine competition, is it to be assumed that all of these great construction organizations, carrying their loads of overhead whether working or not, are willing to let these jobs go by unless they can make exorbitant profits? As a matter of fact we cut our costs as low as we dare go, in the hope of landing jobs, and then add from 10 to 15 per cent.

Do you feel, as engineers, that there is any obligation on you, or that it is worth your while, to gamble in an effort to save part of that per cent; and are you justified in believing that, in spite of his life-time of struggle in the game, you can beat the contractors' costs? You cannot know that bids will be too high until you get them, and you do know how often the opening of bids reveals a gratifying reduction of the engineer's estimate.

Creators—Not Gamblers.—To summarize: The constructor is the precursor of every form of human activity. He cannot be spared. We, like you, are personal service agents. That is the only thing we have to sell. We are creators, not gamblers. The things other men produce remain only materials, commodities, passing through many hands and growing constantly more costly but not more useful, until finally the constructor takes them and transforms them into permanent structures, accomplishes their final destiny of usefulness to man, from which there is no further change. If he fails to do his work well, all that has gone before has failed, too. If he does it well, he is the fruition of a thousand hopes. Is such an agent to be hampered by distrust and injustice? Or should he be upheld, and helped, and encouraged? Should we secretly rejoice when we get the work of his hands for less than it cost him, or should we want him to be well paid for work well done? Should we undermine him and set him aside and find ways to do his work without him, or should we build him up in honorable usefulness and strengthen his character and his hands for this special service to society? As he does his work well or ill, so communities thrive.

Co-operation Needed.—In all the transactions between men, their relations to each other are primarily determined by their attitude of mind and this in turn is largely the resultant of their estimate of each other. If I have before me a business meeting with a shyster lawyer, I approach it with a prejudice and suspicion which at the outset makes it almost impossible for us to work together, even though he might be in a position to serve my interests and be willing to do so. But if I have the same matter in hand with my banker, whom I have long trusted, our minds meet at once and the result is quickly and efficiently reached.

Contracting once was largely a gambling game that encouraged and developed sharp practices; today it is a highly systematized business conducted in all its larger activities upon a scientific basis. Once it operated under crude methods with primitive equipment; today it succeeds only by the highest efficiency, and is supported by a vast organization of designers and manufacturers who furnish it with highly specialized equipment for its efficient conduct. Once it was led by strong but untrained men, who by force of character or shrewdness had fought their way to the front; today its great forces are directed and co-ordinated by men of trained minds, of sterling character and of the highest ideals. The old unfair contract was the natural development of the old condition; today it is an obstructive misfit. Engineers are devotees of efficiency; you are its greatest bulwark. But efficiency in construction will always be based upon co-operation between the engineer and contractor. And such co-operation must rest upon a fair contract and upon mutual confidence.

A. G. C. Promotes Fair Play.—The Associated General Contractors, in working for this fair contract, is an organization of great power, with no aims that are not in public interest, with no secret activities, no veiled propaganda, no accumulated fund, no selfish purposes. Its administration passes at short intervals from group to group, over all parts of this country. Its ethics and objectives are as fine as any. This organization now says to the engineers and architects: "This is the new order we are bringing to pass, this is the new day in our great industry which we are hastening. You are our natural allies. We cannot succeed without you; so will you not stretch out your hand to us, divest yourselves of that old mental attitude of fear and distrust of us? It is now an anachronism, it 'doesn't belong.' Give us at the outset a contract that doesn't assail our self respect, doesn't announce in advance your expectation that we will prove both incompetent and dishonest. Help our success in our work by the same promptness and efficiency on your part that you demand of us. Stop letting us pay for your mistakes and omissions. See that we get our progress payment on the day it is due. Be zealous to give us the final acceptance at the earliest possible moment. See through our eyes, too. Treat us as you would if we paid half your fee. And learn then how marvelously our common life-work can be lifted up."

But most of all, we ask you to recognize that the old order has passed away, that the successful contractor of today deserves your confidence and respect, and that the construction industry and the vast public interests dependent upon it are entitled to results which can be achieved only by real co-operation between you and us.

Cement-Gun Concrete in Metal Mines

The Bureau of Mines of the Department of the Interior has issued a typewritten memorandum of 30 pp. entitled "Gunite in Metal Mines," by Byron Pickard, district mining engineer of the Bureau. It takes up in some detail the application of gunite in mining work, describes a number of installations, and gives several tables of costs, and a bibliography.

Unusual Lift-Locks Proposed For Rhine-Danube Divide

German Engineers Plan Lifts Greater Than 60 Ft., Using Hydrostatic Device and Special Counterweight Designs

IN CONNECTION with the projected canal to connect the Rhine and the Danube via the Neckar as described in *Engineering News-Record*, March 30, 1922, page 521, the engineers have encountered some exceptionally difficult problems in lock design. As explained in the article cited, the Neckar may be canalized as far as Plochingen, which lies at an elevation of 780 ft. above datum. Between this point and Ulm, the head of navigation on the Danube, the waterway must cross the plateau of the Alb, a distance of 14 miles, at an elevation of 1,830 ft. (Figs. 1 and 2). This means an ascent from Plochingen of 1,050 ft. and a descent on the south side of about 300 ft. to the level of the Danube. It is planned to overcome this great difference in level by 29 lifts, some of which may be in the form of ordinary locks; but the problem is much complicated by the absence of an adequate water supply for the summit level of the canal. If ordinary locks were used to make this ascent the water for this operation would have to be raised 300 ft. from the Danube to the summit level. Recourse must be had then to specially designed lifts, certain types of which are already in successful use. In some instances, however, lifts must be negotiated which are much greater than have yet been accomplished even by mechanically operated elevators, for no experience is available with any such structure having a lift of more than 60 feet.

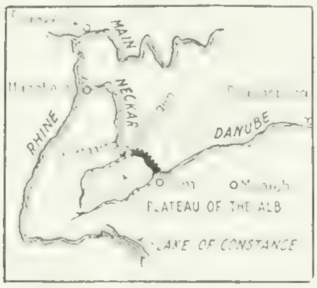


FIG. 1 RHINE-DANUBE WATERWAY

Hydrostatic Lift-Locks.—Several designs have been proposed for installations that would make these lifts and at the same time involve the use of no water. One of these has been proposed by the firm of Grün & Bilfinger of Mannheim, who, working under the direction of the Southwest German Canal Association, have devised a so-called plunger lock or marine elevator. In this design a steel-frame truck carries a trough of water in which the boat floats while being raised or lowered. As shown in Fig. 3, however, the plunger lock differs from the ordinary mechanical lift, in that the weight of the truck, the trough and its contents is counterbalanced by the buoyancy of a large cylindrical displacement-chamber or float, so proportioned that when it is fully immersed as shown in the figure, it carries the total weight of the movable structure.

The power required then is only that needed to overcome starting inertia and friction losses. For lifting a 1,200-ton boat a height of 46 ft. it is estimated that not more than 5 kw.-hr. will be required. The speed of operation being assumed at 20 ft. per minute, the total rise requires 2½ minutes. If we estimate for entering and leaving the lift 7 minutes each way, the passage of the boat through the lock requires about 17 minutes. Working through 16 hours, 50 ships daily could be locked through, making a total capacity for the lock of 9,000,000 tons annually.

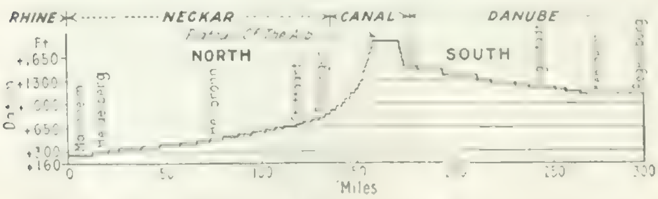


FIG. 2. PROFILE FROM MANNHEIM TO REGENSBURG

The water tank in which the displacement-chamber is immersed may vary in shape according to the nature of the underlying ground and other governing conditions. This device not only is easily adaptable to all sorts of topography but also is free in a large measure from structural and foundation difficulties, for by utilizing the buoyant effect of water a great reduction is effected in the loads for which provision must be made.

Application to Low Lifts.—In another form, the plunger lock is available even for lifts of only 16 to

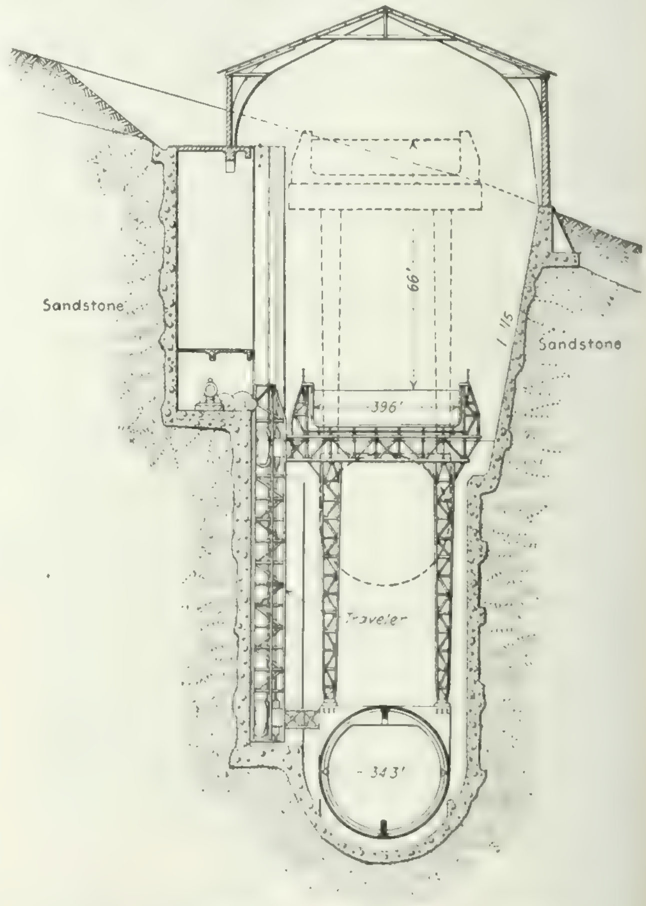


FIG. 3. PROPOSED HYDROSTATIC LIFT-LOCK

By the application of hydrostatic principles this design avoids the necessity for counterweighting and the structure that would be required to receive the great loads involved and distribute them over the foundation.

33 ft., at a construction cost that would not exceed substantially the cost of a chamber lock of equal capacity. In this form the trough in which the boat is carried is inside the displacement-chamber (see Fig. 4). This chamber is a reinforced-concrete tube having an outside diameter of 50 ft. During operation this chamber rises and falls as with the type already described. At both ends of this chamber are reinforced-concrete collars or endwalls. In order that the interior of the chamber may remain in communication with the outside air during the operation of the lock, these endwalls are made to serve also as the end walls of the tanks in

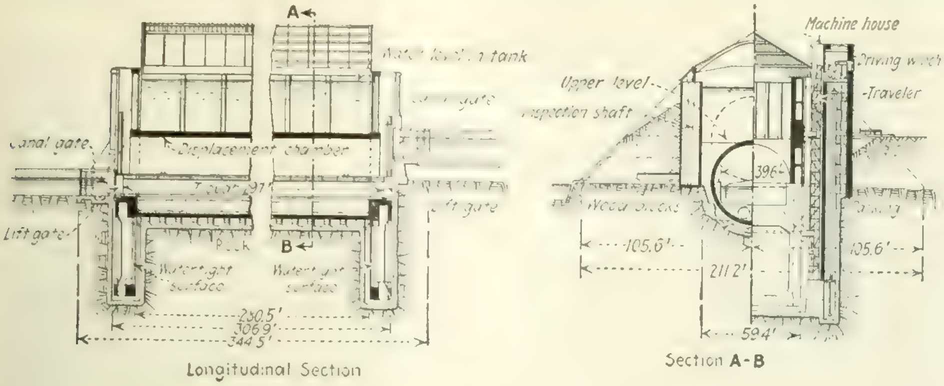


FIG. 4. PROPOSED HYDROSTATIC LIFT-LOCK FOR LOW LIFTS

In this type the displacement chamber is used also to contain the vessel being locked through. The reinforced-concrete end-plates of the chamber are rectangular and of such height and design that they form also the end walls of the tank in which the chamber floats throughout its travel. Lifting power is applied at both ends of the chamber.

which the chamber floats. This is effected by the use of water-tight packing between these movable endwalls and the fixed sidewalls. In this form the steel frame and moving traveler can be installed outside the water tank so that it may always be accessible. The driving machinery is even simpler than before and requires for lifting a 1,200-ton boat a height of 26.4 ft. not more than 3 kw.-hrs.

Economy of Hydrostatic Lifts.—An important advantage of these hydrostatic lift-locks is their exceptional economy. With a lift of 86 ft. as occurs several times in the crossing of the Alb, we have a cost of construction estimated at 3½ million marks (pre-war basis) as opposed to an estimate of 5.6 million marks for the cost of construction of two chamber locks in flight, each of 43-ft. lift and equipped with storage reservoirs for conserving water. The difference, it will be seen, amounts to more than 2.1 million marks. If we take into consideration also the cost of the necessary plant for pumping back the used water in connection with the storage reservoir; and the capitalized annual operating cost, the difference in cost between a lock of this design and a flight of chamber locks increases to about five million marks, all on a pre-war basis. This advantage diminishes, of course, as the lift decreases, but, varying with local conditions, it still obtains at lifts as low as 43 to 46 ft. For smaller lifts, down even to 23 or 30 ft., comparisons show that the second type, with boat inside displacement chamber, may be advantageous.

Counterweighted Lift-Lock.—Another design for a lifting installation has been prepared jointly by four engineering firms; Demag of Duisburg; Dyckerhoff & Widmann Co., of Biebrich; Gutehoffnungshütte, of Oberhausen and the Siemens-Schuckert Co., of Berlin, who specialize in crane design, civil engineering, structural design, and electrical apparatus, respectively. This scheme does not contemplate using the buoyancy principle but relies upon an ordinary mechanical lift, using counterweights to compensate for the weight of the trough and its contents. As this must involve the handling of heavy loads at considerable height, the supporting structure will necessarily be massive and require careful design to provide for uniform distribution over the foundation. The general appearance of the outside of such a structure is shown in Fig. 5.

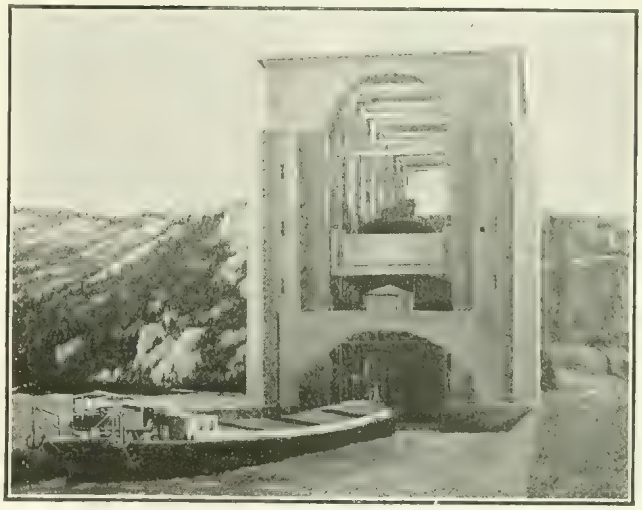


FIG. 5. COUNTERWEIGHTED LIFT-LOCK

In this design the tank and its contents are counterweighted, making necessary a massive supporting structure.

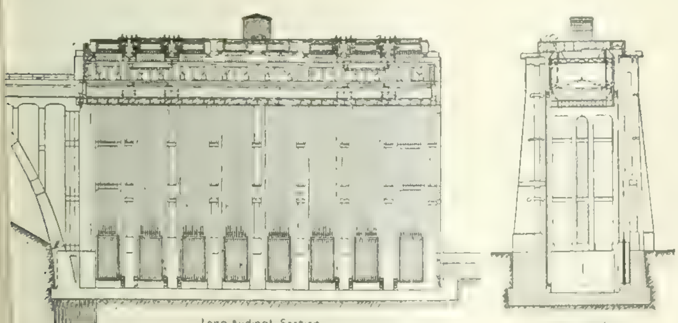


FIG. 6. SECTIONS THROUGH COUNTERWEIGHTED LIFT-LOCKS

The counterweight is divided into many small elements each supported by its own wire-rope but the elements of each group are so yoked together that failure of a rope simply distributes the load of its weight among the other ropes of the group. Lifting power is applied through compensating levers that insure holding the lift-tank level.

Both ends of the trough and of the canal reaches are closed by double-walled gates which provide security in case of damage to either inner or outer walls. The gates are raised by electrically-operated winches which are so interlocked with the main winding-gear that the trough cannot be moved while the gates are open and neither the trough nor the reaches can be opened unless the trough is in an end position.

Raising and lowering are effected by a number of electrically operated winches and endless link chains which travel over sprockets and are connected to the trough by a system of equalizing levers. (See Fig. 6.) These insure an equal distribution of the load and hold the trough level. Two sets of brakes are provided, one electro-magnetic and the other operated by compressed air. Both act automatically in case of accident.

The weight of trough and contents is balanced by a series of counterweights arranged in groups and suspended by wire ropes. As these weights are independent of each other, each rope has only to carry the assigned load; but a frame surrounding each group of weights prevents the fall of any weight. If one

rope should part the load of its counterweight would be distributed evenly among the remaining ropes.

Operation—Vessels are towed into the trough by electric capstans. The operation of the lift is automatically regulated so that it moves slowly until it is clear of the reach. It is then brought up to normal speed, which is maintained until it attains the other reach, when it is gradually reduced. A single locking requires about 17 minutes, ascent and descent requires about the same interval. As in all such cases more time is required to get the boat in and out of the trough than to perform the lifting operation. Owing to the counterweights, power is required only to overcome starting inertia and friction.

A distinctive feature of the design is the handling of heavy loads by subdividing them and distributing them over a large number of comparatively small carrying elements. In this way details are kept within limits that have already been proved adequate and safe in actual practice; and any damage element may be replaced quickly without disturbing the operation of the entire installation. In accordance with this principle, 160 parallel connected ropes are used to carry the trough and its contents. The lifting chains and winches are strong enough to take up the stresses that would be produced if the trough should accidentally run dry.

Water-Power—As a canal only 50 miles in length crossing a high plateau cannot be maintained by tools levied on shipping, it is planned to develop the Neckar as far as Mannheim and the Danube as far as Kehlheim to produce sufficient power to pay for the canalization of the Neckar and Danube as well as for the crossing of the Alb.

Under these conditions the tolls required on the entire canal will be about equal to those which are raised on the Rhine.

We are indebted for the information contained in this article to Dr. Karl Haller, Regierungsbaumeister, Stuttgart, and Emil Krahnen, M.E., Duisburg.

Asphalt Paving Costs of 1916 and 1922 Compared

An itemized analysis of the cost of asphalt paving in Chicago as of 1916 and 1922, based on actual prices, is contained in a report by F. J. Herlihy, general manager, White Paving Co., Chicago, acting for his own concern and the firms of R. F. Conway Co., and the American Asphalt Paving Co. The report is made to M. J. Faherty, President, Board of Local Improvements of Chicago, in rebuttal of charges made by the *Chicago Tribune* that asphalt paving bidding prices in 1922 indicate exhorbitant profits.

Comparison in detail is made of wages and prices, item by item, for 1916 and 1922. As summarized, the results are as follows:

Item	1916	1922
Concrete base, sq.yd.		
Materials	$0.5831	$1.046
Fine grade	0.0470	0.098
Mixing and placing	0.0899	0.185
Plant cost	0.0153	0.042
Total	$0.7353	$1.371
Asphalt: sq.yd.		
Materials	$0.5867	$0.9414
Plant charges	[illegible]	0.1846
Plant operation	0.0766	0.2084
Hauling	0.1065	0.1879
Laying	[illegible]	0.0869
Cement	0.0020	0.0035
Total	[illegible]	$1.6127
General overhead	$0.0382	$0.0770
Discount on bonds	0.0382	0.3080
Construction bond	0.0191	0.0385
Field overhead	0.0680	0.1380
Total, sq.yd.	$1.7954	$3.5452
Profit	$0.1146	$0.3048
Bid price	$1.9100	$3.8500
Per cent profit	6.3	8.6

These figures include pavement only. Grading costs are shown to have similarly increased as follows:

Item	1916	1922
General overhead, cu.yd.	$0.0144	$0.0544
Discount on bonds	0.0144	0.2176
Construction bond	0.0072	0.0272
Operation	0.6133	2.0367
Total	$0.6493	$2.3359
Profit	$0.0707	$0.3841
Bid	$0.7200	$2.7200

For curb and gutter construction at the two dates the figures given are:

	1916	1922
Total per lin.ft.	$0.5933	$1.1214
Profit	$0.0867	$0.1286
Bid	$0.6800	$1.2500

Pulling Concrete Piles at the Galveston Causeway

Utilizing Equipment on Hand 7,500 Piles in the Capped Bulkhead of Old Filled Portion Removed by Portable Derricks

Two traveling derrick plants at each of three points were used to pull the 7,500 reinforced-concrete sheetpiles along the new portion of the Galveston Causeway where concrete arches to give a wider waterway have replaced the former earth fill held in place by bulkheads of sheetpiling. From 10 to 70 piles per day were pulled by each plant, the estimate being 30 piles per day minimum. The cost of pulling and loading on barges was $4.50 per pile; towing, handling and stacking cost $2 to $2.50 per pile.

In the original construction the approaches consisted of an earth fill confined between parallel rows of sheetpiles driven 150 ft. apart with their tops projecting 4 ft. above mean low tide. The top was a reinforced-concrete cap, 18 in. high and 24 in. wide well anchored to the reinforcing steel which was left protruding above the pile heads. The piles were 10 x 18 in. in cross section, 18 ft. long and penetrated the fairly tough clay 8 to 10 ft. The confined fill was sloped upward on a 1 to 2 slope to El. 15 (zero is at mean low tide). This slope was protected by a lightly reinforced-concrete blanket 6 in. thick. The bottom of this slab was supported on top of the cap over the sheetpiling and its top was supported on the base of a concrete railing. The foundation of the railing rested on the sand fill.

During the 1915 tropical hurricane the gulf waters were carried with great force over the top of the causeway undermining the upper support of the slab by scour and rupturing it as it subsided. Passages for the water were opened and the sand fill was rapidly washed out letting the slab fall lower and lower until it became a heap of wreckage, but the sheetpiling bulkheads were not damaged.

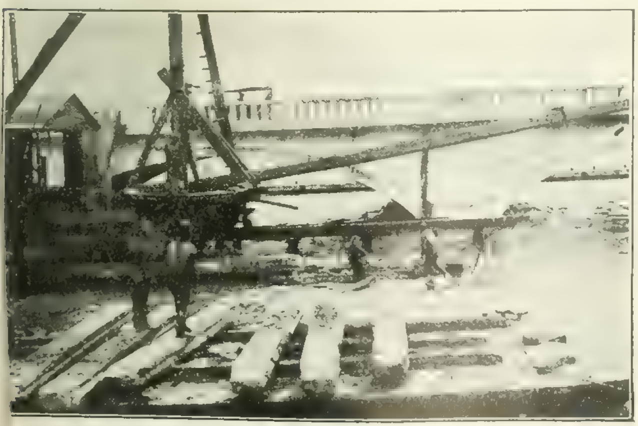
In the reconstruction of the destroyed portion of the causeway, which was begun in the latter part of 1917, the entire approach has been replaced with reinforced-concrete arches similar in design to the main structure which suffered no damage. This old arched structure consisted of 28 reinforced-concrete arches of a clear span length of 70 ft. each. The new or additional work consists of 28 arches on the Galveston

Island end and 51 arches on the Virginia Point or mainland end of the causeway. All new arches have 60-ft. clear span and are supported on piers 10 ft. wide, making the span of additional arches 70 ft. c. to c. of piers. The arched structure is 63 ft. wide, thus leaving the two rows of sheetpiles 44 ft. from the arches on each side.

The sheetpiles, which extended 4 ft. above mean low tide, were considered an obstruction to the flow of water through the arches. As one of the main purposes in adopting the arch type of construction was to get a maximum of waterway, it was decided to pull all of the piles after completion of the arches. Their presence during construction was valuable as a cofferdam for excavation and foundation work as they were so closely and well driven that it required very little pumping to make dry excavation possible.

In deciding on the best and cheapest method for the removal of the piles, consideration had to be given to the various obstacles to be encountered. Floating equipment appeared to be the logical plant to be used but owing to frequent low tide conditions and a large amount of debris from old wreckage strewn along both sides of the sheetpile wall it was decided impracticable to use such a plant. Furthermore as no floating plant had been used in construction it would have had to be provided at great expense. A number of traveling derricks of heavy type from the construction plant were immediately available. It was also found that these derricks could be operated regardless of tide conditions. Therefore this equipment was used. One rail for the movement of the derrick plant was laid on top of the concrete cap; the other rail was supported on a line of old timber piles capped with 12 x 12-in. stringers which were driven as the work progressed.

The operations of pulling were as follows: One derrick was used to drive the piles for the track of which there was 300 lin.ft. used. It also removed all debris and wreckage found within reach of the boom. The boom on this derrick was headed in the direction of travel, the mast being placed over the concrete wall support. Following was the second or pulling derrick, which not only pulled the piles but also dismantled the track as it went along and loaded the withdrawn piles on pontoons. As fast as the wooden piles and stringers were dismantled they were floated ahead to the forward plant and redriven. This arrangement made necessary a minimum amount of piles, track rails and stringers all of which were from the construction material.



PULLING CONCRETE PILES AND LOADING ON LIGHT-DRAFT SCOW

Boom down giving a side pull to break bond and disengage pile. Derrick, supported on pile cap, is moved back at intervals, cap dynamited and pulling continued.

BULKHEAD OF FORMER FILL ACTED AS COFFERDAM DURING ARCH CONSTRUCTION

Dynamite was used in the removal of the concrete cap, which was shattered and then picked loose with picks. About six ½-lb. cartridges of dynamite were placed on top of the concrete cap every 5 ft., mud-capped with clay about 8 in. thick and discharged with electric exploders. About 18 ft. of cap was broken off at one time. The boom was then lowered and a side pull made on the sheetpiling to break the bond between the piles and to disengage the core lock binding them together. A chain sling was then made around the pile head, the boom raised and a vertical pull exerted lifting the pile out of place. After pulling 10 or 12 piles in this way, the derrick was rolled along and the operation was repeated. Most of the piles pulled came out fairly easily but in some cases it required as much as 45 min. to extricate one pile.

The water of the bay is very shallow and at low tide insufficient to float barges. Small gasoline tow boats were used in towing the piles away after pulling. Several small 16 x 30-ft. scows were built for a displacement of 6 in. light. They were able to haul the piles at the rate of 8 to 12 per load depending on the tide. At full tide the bay was usually so rough that navigation was impossible, making the removal of piles a difficult and rather expensive operation. The piles weighed nearly 2 tons each and had to be towed on an average of 3,000 ft. to a point where they were unloaded by a stiff-leg derrick to small tram cars pulled by a dinkey engine to the material yard, a distance of 1,500 ft. farther away. Here they were unloaded by another derrick and stored for further disposition.

This work was done by and under the immediate direction of H. F. Jonas, who took over the completion of the Causeway after the work was abandoned by the contractor, June 15, 1920. Prior to this date from Oct. 1, 1917, Mr. Jonas had been supervising engineer.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

A Tribute to the Late Thomas B. Bryson

Sir—The article in *Engineering News-Record*, Sept. 21, p. 493, containing a record of the career of the late Thomas B. Bryson, omits note of a very important and hazardous piece of work which occupied much of his time for two and a half years. During 1914, 1915 and 1916, the work of building the cofferdam for the 46th St. pier rock excavation was carried out by Holbrook, Cabot & Rollins under the direction of the writer. Very little knowledge was at hand concerning the exact action of the 70-ft. steel sheetpiles forming the core of a high gravity dam with a head of 55 ft. Much movement, which at times became alarming, took place. Mr. Bryson, as vice-president of the contracting firm, gave his constant attention to this work, and the writer desires to acknowledge in full his indebtedness to the memory of this great engineer-contractor for his having overcome many serious difficulties successfully.

CHARLES W. STANIFORD,
Former Chief Engineer, Dept. of Docks and Ferries,
New York City.

New York, Sept. 22.

Which Is the Highest Dam in the World?

Sir—Permit me to ask a simple question to which engineers may give different answers: Which is the highest masonry dam in the world? This depends upon what one calls the height of the dam. Is it the distance from the top to the lowest point in the foundation, measured in a vertical line, or is it the elevation of the crest above the lowest point in the foundation, wherever it may be, measured, if necessary, in vertical offsets?

To take a practical example, based upon data recently furnished to the writer by the United States Reclamation Service: The elevation of the crest of the Arrowrock Dam above the lowest point in the foundation, which in this case is at the downstream toe of the dam, is 348.5 ft., while the vertical distance from the crest to the lowest point in the cutoff trench is only 326 ft. Which of these two distances is the height of the dam? It seems to the writer that the answer should be that the latter distance is, strictly speaking, the height of the dam and that the former is simply the elevation of the crest above the lowest point in the foundation.

If a railroad embankment were 50 ft. high, except near one of the slopes where the ground was 50 ft. lower, no engineer would call the height of this embankment 100 ft. If a rectangular tower were 100 ft. high, except at one corner where the foundation rock sloped to an elevation 50 ft. lower, the height of this tower would undoubtedly be called 100 ft. and not 150 ft.

According to information given the writer by engineers connected with the construction of the Camarasa Dam, built in Spain in 1918-20, this dam is founded on rock which is practically level, and its maximum height, measured in a vertical line, is 334.66 ft. In an article by W. Ranney in your issue of Aug. 17, 1922, the maximum height of this dam is given as 333 ft. Even if we take this figure, the Camarasa Dam is 4.5 ft. higher than the Arrowrock Dam, measured vertically from the top to the bottom.

New York, Sept. 22. EDWARD WEGMANN.

[Mr. Wegmann's next to last paragraph illustrates perfectly the difficulties involved in any definition of maximum height. He arbitrarily defines his embankment as a 50 ft. one and his tower as a 100 ft. one. Fifty feet above what; one hundred feet above what? Neither embankment nor tower presumably is resting on a plane perfectly horizontal except for a single geometrical point below the remainder.

Our opinion is that the Arrowrock Dam still leads the world from the viewpoint of bigness or maximum height, which is the most common and reasonable conception of magnitude of a dam expressed in one dimension. "How High Is a Dam?" is discussed at some length in our editorial pages this week.—EDITOR.]

The Use of Diagrams for Reinforced-Concrete Design

Sir—In considering design in reinforced concrete we are faced at the outset with difficulties that do not occur with other materials. Bearing in mind that the best design is not necessarily the one that uses the least material or the one in which the material is most fully and uniformly stressed but is the one which fulfils best the requirements of the case with due regard to cost, it follows that a satisfactory standardization of reinforced-concrete sections is a difficult thing to attain by reason of the larger number of variables involved and the much more complex way in which they enter into the problem. Hence, in general, a far greater amount of individualistic designing is brought in.

Such work may be done in two ways, either by working out every case from first principles, using the standard formulas and methods based on generally approved assumptions, or by reducing these to the form of diagrams with or without making simplifying assumptions. Reinforced-concrete design, by reason of the cumbrousness of many of the rigidly correct algebraic expressions involved, lends itself naturally to treatment by graphical charts. It is an easy matter to prepare a set of graphs which will give the solutions of all the fundamental formulas for stresses, sectional areas, etc., and I have used a series of such charts to cover all ordinary problems of beams, slabs and columns where definite maximum unit stresses in concrete and steel are specified.

If plotted sufficiently carefully and to suitable scales such diagrams are capable of simplifying design arithmetic considerably without sacrificing in any way the accuracy of the algebraic calculation. Most of them can be found, either plotted right out or indicated diagrammatically in the principal text-books and involve no novelty of any sort. They are the limit to which it is possible to carry graphical treatment without introducing simplifying assumptions. It is this latter process which produces the crops of diagrams to which the articles in *Engineering News-Record* have from time to time referred, and the inexhaustible supply is due apparently to the large variation in the assumptions made.

In an endeavor to simplify as far as possible the routine of my own calculations I have examined at different times various diagrams and theories published in the engineering press. As a result I have become chary of accepting published charts without a rigid examination of the methods by which they are produced. The simplifications admissible in one case may be of dubious validity when applied to another type of structure. It is the exception rather than the rule for the inventor of a new designing diagram to enter into the algebraic processes by which his results are achieved and to publish the degree of accuracy of his chart in its applications. Yet it should be the rule. Otherwise serious errors may arise easily by the use of the diagram for cases for which it is not adapted. The user of the chart usually implicitly believes its accuracy and develops a faith in it born of a blissful ignorance of the shortcomings of its basic assumptions.

There are a number of calculations which frequetly arise in reinforced-concrete design where the only alternative to using a chart based upon approximations is to make tedious arithmetical calculations on the basis of trial and error. Such cases occur with beams and slabs which have to resist combination of direct and bending stresses. For these the graph is of great value provided its limitations are kept fully in view when it is being used. In a doubtful case stresses can always be figured as a check after the section has been designed.

I conclude, therefore, that the most suitable procedure in reinforced-concrete design is that in which the fundamental formulas are developed out in the form either of charts or

tables which are used to form the basis of simplified arithmetical work. This method absorbs somewhat more time in practice but has the great advantage of giving complete confidence in the results. If the office be one in which there is specialization in any particular form of structure it will pay to develop a series of standards adaptable to it. These can be determined once for all and tabulated in much the same way as structural steel details can, but a greater degree of latitude must be allowed in the standards if they are to meet successfully the more varying conditions of reinforced-concrete construction. It is unwise to use all-embracing diagrams unless fully conversant, by direct analysis and test, with their limitations, particularly when their origin and the process of their development is at all obscure.

London, Eng. E. G. WALKER, M. Am. Soc. C.E.
Aug. 1.

Net Section of Riveted Tension Members

Sir—Referring to Prof. C. R. Young's comment on my letter concerning net section in riveted tension members, in your issue of Sept. 21, page 490, I wish to point out two things. First, there is a distinction between a riveted seam in two tank or boiler sheets and a tension member that is perforated with holes for rivets. Second, the important question of economy enters in a way Prof. Young does not seem to appreciate.

As I stated in my earlier letter a plate seam has a zigzag

NINE TENSION TESTS ON PERFORATED BARS

line of holes, and each hole contains a rivet pulling against the metal. This constitutes a concentrated load tending to tear the plate beside the rivet hole. Naturally the zigzag line will be the one to rupture, and the stress will not approach uniformity between the rivets.

In a perforated tension member the rivets, excepting at the end connection or a splice, are merely holding the parts together and are under little or no stress. The stress of the member has ample opportunity to distribute itself, with approximately uniform intensity, over the area between the holes.

Of course the detail of the end or of a splice is a governing detail in a tension member, and, as Prof. Young points out, I emphasize this in my book; but it is also true that the end detail need not govern the section of the body of the member. In my book, "Steel Designing," page 202, this very thing is emphasized, for it is recommended that the rivets in the splice be tapered so as not to take out unnecessary holes in the body of the member. Also it is pointed out, on page 191, that the area beside a pin hole should be 50 per cent greater than the net section of the member requires. This corresponds in a measure to a rivet seam, where a concentrated load occurs at the rivet.

Another distinction between a plate seam and a structural member end connection is that the structural member has the rivets distributed along a fraction of the length of the member. The necessity of this, in good design, I also point out.

On the question of economy: If a rivet seam requires 10 per cent or 30 per cent excess area in a zigzag section, as determined by test, it should of course be so designed; and if an end detail requires like excess area, because of stress in the rivets, the same should be supplied. But it is not economical to penalize a bridge member perhaps 40 or 50 feet long because the end detail needs this provision. In proper design end details are commonly given excess area in any event.

It is in long angles of girders and tension members, which have several rows of holes, and in component plates of girder flanges and tension members, where the rule of adding 10 to 30 per cent extra area in a zigzag section means a large addition to the weight of a structure. This is not a mere academic question. It affects designing very vitally. It should not be determined on the basis of unsupported theory, especially a theory having no confirmation in tests. Tests of perforated plates, not of riveted seams, should be the criterion.

Prof. Young points out that some of my tests published in *Engineering News*, May 3, 1906, p. 488, are unsymmetrical, and therefore other effects are brought in. This is conceded, but he does not dwell on tests 28 to 36, which were symmetrical and which had three ways of breaking through the holes, one transversely through a central hole, one transversely through two half holes on the edges, and one in a zigzag line. All have equal area. I do not see how the ultimate unit stress in these tests, or any other of my tests, has any bearing on Prof. Young's theory. His theory is supposed to prove that a large percentage of area is required in a zigzag line for strength equal to that in a transverse line. If that theory is correct, every one of these nine tests, or of nine hundred, should break in the zigzag section. Not one of the nine broke solely in that section. One broke transversely through the central hole, five broke on the diagonal line on one-half of the bar, three broke on the diagonal line on one-half and simultaneously on the transverse and the diagonal line on the other half (see sketch).

This seems to indicate clearly that the strengths on the transverse and diagonal sections of equal area are about equal.

EDWARD GODFREY,
Structural Engineer.
Pittsburgh, Sept. 30.

Painting Galvanized Sheets

Sir—There is apparently a wide difference of opinion as to when and how galvanized iron sheets for roofs of buildings are to be painted.

It is pretty generally accepted that new sheets are difficult to paint, and moreover the paint does not adhere to them as it should, owing to the grease on the sheets. Allowing the sheets to be exposed to the weather for several months before painting is probably quite a good method. It is not practicable to lay the sheets outside for the necessary time, and so they are usually put direct onto the building and after 6 or 9 months painted. This has one very bad feature, and that is that it is not possible to paint both sides of each sheet at the overlaps and also behind the purlins, girts, etc.

What is really wanted is a preparation to wash the greasiness off the sheets and still not destroy the zinc coating.

In Trautwine's "Civil Engineering," page 1162, he says: "Paint does not adhere well to new zinc, and this is the principal reason why new galvanized roofs are not painted; but this may be remedied by first brushing the zinc over with the following: One part chloride of copper, one part nitrate of copper, one part sal-ammoniac. Dissolve in 64 parts of water. Then add one part of commercial hydrochloric acid. Dries within 12 to 24 hrs. and may then be painted." Hool & Johnson's "Building Construction," page 1015, says: "If galvanized iron is allowed to weather for a year before painting, ordinary oil paints may be used, but if new the surface must be specially treated to enable the paint to adhere. A satisfactory method is to brush the surface of the galvanized iron with a solution of 6 oz. of acetate of copper to a gallon of water, allowing this to dry for about 24 hrs. before painting."

Objections have been raised to these methods on the grounds that the chemical action which takes place between the copper and the zinc is highly detrimental to the zinc. Is this the case? Has a solution of caustic soda ever been tried and, if so, with what results?

Owing to the large number of buildings throughout the world which are covered with galvanized sheets, I think it would be of great advantage to many people if the opinions of some of our well known authorities could be given through the medium of your valuable pages.

F. H. THOMSON,
Clerk of Works, Glenfield & Kennedy, Ltd.
Kilmarnock, Scotland, Sept. 26.

NEWS OF THE WEEK

New York, November 2, 1922

Dates Set for Hearings on Rail Consolidations

I. C. C. To Take Up During November Plans for Western Mergers—Southern Hearings Now On

With the approach of the dates set by the Interstate Commerce Commission for hearings on some of the important elements of its tentative plan for the consolidation of the railroads of the country into not more than eighteen or twenty groups, public interest has begun to focus on the proposal. At present three developments are in the immediate foreground.

At a hearing now in session in Atlanta, Ga., representatives of the Georgia, Florida & Alabama R.R., have suggested a system having as its main stem the Seaboard Air Line. The plan contemplates the inclusion also of the St. Louis-San Francisco Ry., from Memphis to Birmingham; the Western Ry. of Alabama, from Selma to Montgomery; the Southern Ry. from Selma to Meridian, and from Warm Springs to Columbus; the Alabama & Vicksburg Ry., the Atlanta, Birmingham & Atlantic Ry., the Carolina, Clinchfield and Ohio Ry., and the Georgia, Florida and Alabama Ry. Such a system, it is contended, would provide for an adequate outlet to the Mississippi, the Ohio, and the coalfields.

In the Northwest, the first hearing scheduled is for Nov. 17, when it is expected that the Great Northern, the Northern Pacific and the Chicago, Burlington and Quincy roads will try to convince the commission that they should be consolidated into one group. In the plan of the commission the Northern Pacific and the Burlington have been grouped with the Denver & Rio Grande, the Western Pacific and other smaller roads, while the Great Northern has been linked with the Chicago, Milwaukee and St. Paul, the Minneapolis and St. Louis and others to form another trunk system. The three roads that seek consolidation are the so-called Hill roads and now represent a community of interest, but the purpose of the commission is to provide a strong partner for the St. Paul so that there may be a fair competition in the northwestern territory.

The Western Situation

The situation in the far West will be aired at a hearing, called for Nov. 21, on the application of the Southern Pacific Co. for permission to retain control of the Central Pacific. Under a decision of the Supreme Court, that control has been dissolved as being a violation of the Sherman anti-trust law, but the Southern Pacific now applies under the terms of the Transportation Act of 1920.

This law gives to the Interstate Commerce Commission the authority to permit common control when it appears to be in the public interest. Meanwhile the Union Pacific R.R. is preparing to urge that the petition of the Southern Pacific be denied with a view to a later union of the Central Pacific with the Union Pacific itself. The Ripley plan upon which the Interstate Commerce Commission's plan was based, provided for such a step in order to complete the Union Pacific road from its present terminus at Ogden, Utah, to the coast; but the commission modified this plan so as to include the Central Pacific with the Southern Pacific, as was the condition prior to the decision of the Supreme Court. Public opinion throughout the territory served by the roads has been much aroused and both parties to the controversy are conducting campaigns of education to win public support for their contentions.

Meanwhile reports from Washington indicate that Senator Cummins is planning a move to make compulsory, rather than permissive, the grouping of the roads into a limited number of systems as is contemplated by the tentative plan of the Interstate Commerce Commission. According to Thomas De Witt Cuyler, chairman of the Association of Railway Executives, the railroads will adopt no policy with respect to such a proposal until the nature of the legislation had been clearly defined.

To Investigate Brake Equipment

The whole question of the adequacy of power brakes and appliances in use on the equipment of the railroads of the country is to be considered at a hearing Nov. 8 before Examiners Mullen and Borland of the Interstate Commerce Commission. One of the main questions involved is whether or not air-brake manufacturers are applying to their product the improvements which are available or whether the situation is such as to make it impracticable to apply commercially many of the improvements which are worked out but which for economic reasons, under present conditions cannot be applied promptly to the commercial product.

Permit Sought for Developing Mexican-U. S. Power Site

The first power project affecting the international boundary with Mexico, which has come before the Federal Power Commission, is that covered by an application of R. W. Morrison, of St. Louis. It involves the erection of a power dam 30 ft. high in the Rio Grande 10 miles above Laredo, Texas. No public lands are involved but Congress has declared on various occasions that the Rio Grande is to be regarded as navigable as far up as El Paso.

The Federal Power Commission cannot authorize the construction of that part of the project located in Mexican territory but it is understood that the necessary permission already has been obtained from the Mexican government. It is the intention to install equipment capable of generating 5,000 hp. to supplement the 5,000 hp. steam plant which now is furnishing the electricity used in Laredo.

Congress to Provide Funds for Waterways Projects

Important Items in River and Harbor Bill Include Projects on Three Coasts and Great Lakes

Washington Correspondence

Appropriations covering most of the river and harbor act, approved by the President on Sept. 22, will be made during the December session of Congress. The more important projects included in the act of Sept. 22 are as follows:

Expenditure of $10,400,000 has been recommended by the Chief of Engineers for the improvement of the New York and New Jersey channels. There is a demand for a better channel from Sandy Hook to South Amboy. An initial appropriation of $3,000,000 is desired, to be followed by such appropriations as may be necessary to complete the work in five years.

Proposed improvement of Newark Bay and of the Hackensack and Passaic Rivers calls for an estimated expenditure of $2,150,000. The plan is to dredge the channel in Newark Bay 30 ft. deep and 1,800 ft. wide at the entrance, narrowing to 400 ft. below the Central Railroad of New Jersey bridge across the bay. That width is to be continued to the junction of the dredged channels in the Passaic and Hackensack Rivers and up the Hackensack to the bridge of the Central Railroad of New Jersey; thence 20 ft. deep and 300 ft. wide to deep water 4,800 ft. above the Lincoln Highway bridge.

Other Recommendations

To extend the present sea-wall at Galveston to the south jetty will require an expenditure of $670,000.

Expenditure of $1,759,000 has been recommended by the Chief of Engineers for the further improvement of the waterway which extends from Sabine Pass through the Port Arthur and the Sabine-Neches Canals and the Neches River to Beaumont, Texas. Proposed improvements in the vicinity of Aransas Pass and the construction of a safe and adequate harbor at Corpus Christi involve an estimated cost of $5,051,900. The plan is to complete this work within two years.

The plan for the further improvement of the Monongahela River calls for the ultimate expenditure of $6,640,439.

It is proposed to improve Milwaukee Harbor by extending the present north breakwater 1,760 ft., so as to give a total length of 10,370 ft. A new south breakwater having a total length of 9,650 ft. has been recommended. The channel is to be deepened to 21 ft. The total estimated cost of the project is $4,000,000, with an initial appropriation that need not exceed $1,000,000.

The further improvement of the entrance to San Francisco harbor involves the dredging of the channel through the outer bar to a depth of 40 ft. and a width of 2,000 ft.

Road Engineering Education Subject of Conference

Educators, Engineers and Automotive Men to Harmonize Differences in College Curricula

Education in highway engineering and highway transport was discussed at a conference of educators, highway officials and representatives of the automobile industries in Washington, D. C., on Oct. 26, 27 and 28. About 400 delegates were in attendance. Addresses were given by leaders in the field and eleven committees sitting several hours a day brought in preliminary reports on various phases of college training in highway engineering and transport. These reports were referred to a co-ordinating committee which will formulate a recommended curriculum for engineering schools which wish to fit students for highway work.

Speaking of the opportunities for engineering college graduates in highway engineering, Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, pointed out that "on the basis of the more conservative estimate of actual expenditures, and without attempting to fix closely the proper percentage of cost for engineering services, there should be invested annually, at the present rate, for the engineering and administrative control alone, from 30 to 60 million dollars. The tendency of highway legislation is most favorable to the man who will consider the highway field as his future work. There are opportunities in more than a dozen of major fields directly connected with highway work. The rate of highway improvements has not kept pace with the demand which, together with the program now definitely recognized, make certain a long period of activity."

In the automobile industry and highway transport, C. C. Hanch, vice-president, Automobile Chamber of Commerce, urged the need and opportunity for college trained men for research, production, purchasing, sale extension and highway transport. So important is this supply of college men that the industry is now working out a plan by which close touch can be kept with graduates.

Highway Research

Research in highway engineering and particularly highway transport was urged by Dr. W. K. Hatt, director of the advisory board on highway research of the National Research Council. Pointing out that very few problems in highway engineering could be approached with any considerable number of determined facts, action was urged by engineering colleges to develop plans for research work.

Highway finance was the subject of an important paper by A. J. Brosseau, U. S. Chamber of Commerce.

Mr. Brosseau urged that five steps be taken to insure adequate and uniform financing. They are: preparation of a construction budget by every state; that cost of construction shall be borne by state bond issues; preparation of a budget of current operating costs; expenditures in all states should be under the supervision of the state highway department, and regulatory power should be as flexible as possible and lodged entirely with the highway department.

The highway education board under whose direction the conference was held and which will handle the educational committee reports and co-ordinate their suggestions into a specific course of college training consists of John T. Tigert, U. S. Commissioner of Education, chairman; Thomas H. MacDonald, chief of the Bureau of Public Roads; F. C. Boggs, colonel, Corps of Engineers, U. S. Army, representing the War Department; Roy D. Chapin, president of the Hudson Motor Car Co., representing the National Automobile Chamber of Commerce; Harvey S. Firestone, representing the Rubber Association of America; F. L. Bishop, dean, school of engineering, University of Pittsburgh, representing the Society for the Promotion of Engineering Education; H. W. Alden, representing the Society of Automotive Engineers, and Walton C. John, secretary.

Col. William D. Uhler

Col. William D. Uhler, for a dozen years a prominent figure in the highway field and since 1915 chief engineer of the Pennsylvania State Highway Department, died in Harrisburg, Oct. 27, after a week's illness. A cerebral hemorrhage occurred Oct. 23 and from then until the time of his death Col. Uhler was unconscious, his entire left side and throat having been paralyzed. During the war he served first with the rank of major in the Ordnance Department and later as lieutenant-colonel in the Motor Transport Division.

He was born at Nazareth, Pa., Nov. 8, 1872, and began engineering work in 1890 as rodman and instrumentman on the Lehigh Valley R.R. For the next 14 years he was engaged principally in railway work with the Lehigh Valley, the Maryland & Pennsylvania, and the Queen Anne's (later the Maryland, Delaware & Virginia) Ry.

His entrance into the highway field dated from 1904, following a period of six months at the U. S. Naval Academy as inspector in charge of quay-wall construction. His first highway assignment was as road engineer for Caroline County, Md., a position from which he was promoted four years later to be engineer in charge of maintenance for the Maryland State Roads Commission. In this post he continued until 1912 when he resigned to join the staff of the Bureau of Highways of Philadelphia as principal assistant engineer.

When Samuel D. Foster resigned as chief engineer of the Pennsylvania State Highway Department, Governor Brumbaugh selected Col. Uhler as his successor, effective April 7, 1915. He had been the engineering head of the Pennsylvania State Highway Department from that time until his death.

Col. Uhler has taken an active part in engineering society affairs, particularly as they related to road work. He was the American Society of Civil Engineers' representative in joint relations with other national societies and committees on paving brick. He is a past-president of the American Association of State Highway Officials and was a candidate, this year, for president of the American Road Builders Association.

The Engineer in Public Life

ARTHUR S. BENT

In spite of his responsibilities as senior member of the firm of Bent Bros., contractors, of Los Angeles, Calif., and president of the Associated General Contractors of America, Arthur S. Bent finds time for participation in a wide range of public activities. He is a director of the Merchants and Manufacturers Association of Los Angeles, an organization which has been credited with keeping Los Angeles industrially free for the last twenty years and which has a membership of thousands of business men. In addition, he is a director of the local Rotary Club, director of the Civic Development Department of the Chamber of Commerce of the United States, trustee of Pomona College, and a member of the Los Angeles Chamber of Commerce and the Municipal League.

He is the son of a mining engineer and was born in California in 1863 in the mining region of the high Sierras, near the Yuba dam. After attending the public schools in Los Angeles until he was sixteen years old, he started work as a reporter for the *Daily Express* of that city and after a couple of years of journalism he drifted into construction work and laid the foundation of the general contracting organization of which he is now the head. Included in the list of completed works which the Bent organization constructed are the Sweetwater dam at San Diego, the Gibraltar dam at Santa Barbara, half a dozen concrete-lined oil reservoirs, numerous water-works and sewerage systems irrigation works and a large mileage of California state highways.

Mr. Bent's technical associations, in addition to the Associated General Contractors, include membership in the American Society of Civil Engineers, the American Association of Engineers, the American Concrete Institute, and other organizations, national and local. His practical knowledge and experience are regarded as an important asset to the work of the Civic Development Department of the U. S. Chamber of Commerce, which includes service and assistance on organization problems of local chambers of commerce, education, housing, city planning, and zoning, citizenship, immigration, Americanization, and civic research.

To Take Bids on Narrows Tunnel

The Board of Estimate and Apportionment of New York City has approved the plans, specifications, and necessary bond issue of $575,000 to cover the construction of the Brooklyn shaft of the Narrows tunnel to Staten Island. Bids are to be opened on Nov. 24, 1922.

Engineers Explore Colorado River Canyons

Expedition Makes Trips in Small Boats From Above Utah-Arizona Line to Needles

A boat expedition through some of the canyons of the Colorado River both above and below the Grand Canyon has just been completed by a group of engineers and other interested individuals for the purpose of examining some of the principal dam sites of the various proposed developments now under consideration.

The expedition was arranged by E. C. La Rue, hydraulic engineer, U. S. Geological Survey, who had previously made two other exploring journeys over a considerable portion of the river. The other members of the party were A. P. Davis, director of the U. S. Reclamation Service, Col. C. R. Birdseye, chief of the topographic division, U. S. Geological Survey; R. E. Caldwell, state engineer of Utah; H. W. Dennis, construction engineer, Southern California Edison Co.; Charles P. Kahler, electrical engineer, Union Pacific System; Herman Stabler, chief engineer, Land Classification Board, U. S. Geological Survey; Clarence C. Stetson, secretary Colorado River Commission, Department of Commerce; Franklin Thomas, professor of civil engineering, California Institute of Technology; John A. Widssoe, ex-president, University of Utah, and R. D. Young, Mayor of Richfield, Utah.

The party reached the river in Glen Canyon at Hall's Crossing about 100 miles by river above the Utah-Arizona line on Sept. 7, after traveling four days, the last three by wagon, for a distance of 175 miles from the Denver and Rio Grande R.R. at Richfield, Utah. The descent of several hundred feet from the plateau country to the river's edge at Hall's Crossing, while the most favorable in a distance of 200 miles, is particularly hazardous because of steep grade and side slope, and one of the two wagons carrying the supplies and bedding of the party narrowly escaped sliding off the edge of the cliff where a freighter had met such misfortune a few years ago.

Awaiting the party at Hall's Crossing were five boatmen, who had brought up the river 120 miles from Lees Ferry four boats belonging to the Southern California Edison Co. These 18-ft. flat-bottom rowboats were lashed in two tandem pairs with an Evinrude motor on each stern boat. The start down the river was made on Sept. 8 with each of the boats carrying approximately 1,000 pounds.

The average slope of the river in Glen Canyon is slightly less than two feet per mile and, while there are several rapids in this portion of the river, all can be run safely in an open boat. The river channel is irregular and the boats frequently became grounded on sand bars or submerged rocks when at times it was necessary for crew and passengers to disembark and work the boats into deep water.

Nine possible dam sites were examined in Glen Canyon and detailed topography by plane table was taken at four sites.

The distance covered daily varied from ten to thirty-five miles. Night camps were located usually near sites which were to be examined and when possible at side canyons with tributary streams for water. Side canyons were not always available and the river water was palatable after an opportunity had been given for the silt to settle.

ONE-HALF OF THE COLORADO RIVER EXPLORING EXPEDITION

A side trip of great interest was made up Aztec Creek five miles to the great Rainbow natural arch. Aztec Creek enters from the east and is sixty-nine miles above Lees Ferry and nine miles below the mouth of the San Juan River. An easy walk of two hours took the party to this great wonder of Nature which has been visited since its first known sight by white men in August, 1909, by about a hundred people according to the register at the arch. The usual approach to the bridge is by stage for 120 miles followed by 80 miles with pack animals. The arch has a span of 275 ft., a rise of 300 ft. and the arch ring at the crown is 40x40 ft. in section.

Throughout Glen Canyon the width of the river surface varies from 500 to 600 ft. with the canyon walls rising abruptly in most places and frequently to heights of one thousand or more feet. The canyon lies in a red-brown sandstone of regular and massive formation generally free from bedding. Of the sites in Glen Canyon those in the lower portion just above Lees Ferry appear as most favorable, but accurate estimates of construction cost cannot be arrived at until borings are made to determine the depth of bed rock.

The party left the river at Lees Ferry on Sept. 18 and proceeded by automobile and truck 140 miles to Flagstaff, Ariz., where some of the members separated from the party. On Sept. 21 and 22 the James B. Girand power project was visited. This project which is located in the lower Grand Canyon at the mouth of Diamond Creek is reached by automobile and saddle horse from Peach Springs, on the Santa Fe R.R. Mr. Girand, who piloted the party to the river, was accompanied by Messrs. Davis, Stetson, Caldwell, Stabler, Kahler, La Rue and Lewis R. Freman of Pasadena.

The party just named then proceeded by rail to Los Vegas, Nev., and by U. S. Reclamation Service truck to Boulder Canyon on Sept. 24, where a 20-ft. rowboat was utilized to navigate through Black Canyon and on 110 miles to Needles, Calif., which was reached on Sept. 28 after encountering strong head winds for a considerable portion of this distance, which is for the most part in open country below the canyons.

Sanitary Section of A. P. H. A. Discusses Sewage Treatment

Fifty engineers attended the meeting of the Sanitary Engineering Section of the American Public Health Association, in Cleveland Oct. 16-19. Special attention was given to sewage treatment and to typhoid as an index of the purity of water supplies. George W. Fuller started the discussion on sewage treatment by an outline of the Lima situation similar to the one presented at the meeting of the American Society for Municipal Improvements reported in *Engineering News-Record*, Oct. 19, p. 658. Mr. Fuller stressed three points: the financial impracticability of the direct-oxidation process, the meager data available concerning that method and the degree of efficiency required in any treatment. The Section appointed a committee to investigate the process.

Langdon Pearse in a comprehensive study of the water supply, sewage disposal and typhoid of the larger cities on the Great Lakes elicited an extended discussion, the consensus of which was that typhoid fever death rates are still the best index of the quality of a water supply. Mr. Pearse also presented a progress report of the committee on sludge which was a duplicate of that presented to the A. S. M. I. meeting.

The committee on definition of sewage treatment terms had its report referred back for further consideration. A special committee on standard specifications for plumbing, with Paul Hansen of Chicago as chairman, was appointed to consider the specifications sent out by the building code committee of the Department of Commerce.

The Sanitary Section elected the following officers: Kenneth Allen, chairman, and H. A. Whitaker, vice-chairman. E. D. Rich, Lansing, Mich., continues for a second year as secretary.

Live Topics Feature Bridge and Building Convention

Concrete Piles, Painting Structural Steel, Framing Bridge Timbers Discussed at Cincinnati

Methods of handling and driving concrete piles; paints and painting for structural steel; concrete and steel tanks; pile-driving methods and records, and the framing of bridge timbers before treatment were subjects discussed at the annual convention of the American Railway Bridge and Building Association, held in Cincinnati Oct. 17-19.

Specifications for wood piles and precast concrete piles, together with the matter of pile-driving formulas from "Foundations of Bridges and Buildings," by Jacoby and Davis, were presented in a report which brought out some discussion as to the rule for straightness of a wood pile. In the opinion of G. W. Rear, Southern Pacific Ry., a variation not exceeding 1 in. in 10 ft. is permissible. The report on concrete piles dealt mainly with practice of different railroads, and opinion appears to favor jetting where this method is practicable.

Concrete Prominent in Discussions

High cost of concrete tanks is largely offset by long life and low maintenance cost as compared with steel and treated wood, according to a committee report. There seems to be little trouble with concrete tanks in severe northern climate and the early troubles in waterproofing appear to have been practically eliminated.

Concrete was again brought forward in the discussion of a report on labor-saving devices, when two or three engineers advocated the use of small concrete mixers in preference to hand mixing on small jobs and for preparing paving compositions for highway crossings. A great variety of devices were noted in the report.

That framing and boring of bridge and structural timbers is generally advocated was stated in another report, but the treated timber needs to be handled carefully to avoid breaking or piercing the outer surface. There is apparently some economy in framing at the mill rather than in the field, but no reliable figures are available, and in any case allowance must be made for additional cost of preparing drawings, marking material and selecting the parts during erection.

Officers Elected

In painting bridges the spray machine was said to be increasing in favor and reference was made to the use of zinc, aluminum and other metallic powders in protective paints for metal in order to increase their rust-resisting properties. Prompt cleaning and painting of spots that show incipient rust was approved in the discussion instead of waiting until complete repainting is necessary.

The new president is Arthur Ridgway, assistant chief engineer of the Denver & Rio Grande Western Ry.; C. A. Lichty, Chicago & Northwestern Ry., Chicago, was re-elected secretary. The next convention of the association will be held at Seattle, Wash., in 1923.

Industrial and Economic Subjects Feature A.S.M.E. Meeting

The annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, New York City, Dec. 4-7. A feature of the meeting is the fact that joint sessions will be held with the American Economic Association, the American Society of Safety Engineers, the American Society of Refrigerating Engineers, and the American Engineering Standards Committee. The economic forum promises particular interest. Addresses will be delivered by Dr. W. C. Mitchell of the National Bureau of Economic Research and professor of economics at Columbia University, and Prof. H. R. Seager of Columbia, president of the American Economic Association.

Sessions of the professional divisions will cover a wide range of industrial and technical progress, including developments in aeronautics, fuel, management, forest products, ordnance, railroads, textiles, gas power, machine-shop practice, and material handling. Education will also be considered.

During the annual meeting John L. Harrington of Kansas City will succeed Dean Dexter S. Kimball of Cornell as president of the society.

Electric Steel Founders' Research Group Holds Meeting

The chief executives and the operating officials of the companies comprising the Electric Steel Founders' Research Group recently held a three-day meeting at Wernersville, Pa., at which exhaustive progress reports were presented on researches being conducted by the organization into annealing; core practice; facing practice; furnace practice, and the elimination of slag from castings. It is stated that there has been gratifying progress in each group investigation and that the improved volume of business in the industry at present affords better opportunity for the prosecution of certain researches than when operations were curtailed during 1921.

The group members report that the standardization of practices has recently been extended to cover methods of chemical anaylsis.

The group consists of the following companies: Electric Steel Co., Chicago; Fort Pitt Steel Casting Co., McKeesport, Pa.; Lebanon Steel Foundry, Lebanon, Pa.; Michigan Steel Casting Co., Detroit; and Sivyer Steel Casting Co., Milwaukee. The group began active work a little more than two years ago and its development has been observed with interest by many within and without the industry.

Grays Harbor Dedicates Terminal

The first unit of the Grays Harbor port terminals at Hoquiam, Wash., was dedicated on Sept. 30, marking the first step in port development conceived more than eleven years ago. The improvements provide a central pier, 2,000 ft. long by 300 ft. wide, with a large transit shed. Slips on either side of the central pier are 300 ft. and 400 ft. wide, respectively, 2,000 ft. long and dredged to a depth of 28 ft. at mean low water. Railroad tracks run the length of the pier, which has storage space for 28,000,000 ft. b.m. of lumber.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17 and 18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

The Western Society of Engineers has an effective and unique annual get-together meeting of officers and members of its twenty-two standing and special committees. Eighty engineers Oct. 26 listened to the schedule of proposed work the chairmen were to present in three- and five-minute reports. The program committee has found too many meetings have been provided and has cut the number to one a week. In finances the society is more than living within its income. The library serves daily 15 to 50 inquirers and is buying $500 worth of new books. The noonday luncheons which more or less failed last year are to be revived with high-class speakers. The young men's forum has a series of talks on economics planned. Most interest centers around the public affairs committee which has 56 members assigned to nine sub-committees covering all phases of civic activity which have an engineering slant.

Personal Notes

Hon. G. D. MacLean, Provincial secretary for British Columbia, has been appointed Minister of Railways for that province, in place of Hon. John Oliver who recently resigned.

Sir Henry W. Thornton, recently appointed president and general manager of the Canadian National Rys., sailed for England on Oct. 14. He will resign his position as general manager of the Great Eastern Ry. and will return to Canada to enter upon his duties in about a month.

George G. Wald has resigned as city engineer of Venice, Calif., effective Nov. 1, and will be succeeded by J. B. Griffin, formerly with the American Trona Corp.

J. H. Gwyn, chief engineer of the Denver, Rio Grande and Western R.R., was chosen as chief engineer for the Denver Terminal Ry., in the election of officers of that company held Oct. 12. He will serve both companies.

Vincent Kelley was recently appointed superintendent of streets at Winsted, Conn.

E. E. SANDS, formerly city engineer of Houston, Tex., has been appointed by the mayor a member of the City Plan Commission. The other members are M. E. Tracy, a newspaper editorial writer; J. B. Jackson, a real estate dealer, and H. L. Cole, an attorney.

THE C. C. JONES CONSTRUCTION CO., general contractors, Charleston, W. Va., announce the admission to partnership of A. G. Higginbotham, formerly of Higginbotham, Knapp and Haviland, architects. The business will be conducted under the firm name of HIGGINBOTHAM & JONES, general contractors and builders.

F. L. COOPER who has been serving as extension agent of Conejos County, Colorado, has been appointed a specialist in agricultural engineering at the state agricultural college, Fort Collins. F. R. LAMB takes the place in Conejos County made vacant by Mr. Cooper's promotion.

M. L. KINGSLEY, who has had charge of design and construction of the Selfridge and Co. extension in London, England, has returned to Chicago to take up similar work with Graham, Anderson, Probst & White, architects, of that city.

DOUGLAS L. MCLEAN, a graduate in civil engineering at McGill University, Montreal, has been appointed Deputy Minister of Public Works for Manitoba. He has held several important positions and was recently chief engineer of the Manitoba Drainage Commission.

A. B. CUTTER, president of the port commission and city engineer of Everett, Wash., has been granted a six months' leave of absence during which time he will take a course at the National Institute of Public Administration in New York City. Mr. Cutter served with the A. E. F. during the World War, being first commissioned as a first lieutenant and assigned to the 18th Engineers, Railway. Eventually he was appointed section engineer of Base Section 6, A. E. F., and stationed at Marseilles, France.

CHARLES M. REPPERT, chief engineer, Bureau of Engineering of the Department of Public Works, Pittsburgh, Pa., has resigned to enter private practice. His definite future plans will be announced after his return from an extended trip he is now making to the Pacific Coast. Mr. Reppert was connected with the Engineering Department of the City of Pittsburgh from the time he graduated from Cornell University as civil engineer in 1904 until just before the war, having charge of the sewer work of the city in the latter years of his service. During the war he was deputy chief engineer of the Housing Division of the United States Shipping Board which built so many of the small cities and housing developments in connection with the government shipyards. After the war he entered the firm of Morris Knowles, Inc., consulting engineers in Pittsburgh, where he stayed until about a year ago when he accepted the position from which he has just resigned.

GEORGE C. BROWN, of Lufkin, Texas, has been appointed county engineer of Hardin County, Texas. Mr. Brown was appointed county engineer of Liberty County when the precincts voted $1,700,000, but the entire issue was not approved by the attorney-general. As a result of his new appointment he will not be an applicant for the place with Liberty County when the bond matter is straightened out.

L. N. COPE & SON has been dissolved as a contracting-engineering firm of Decatur, Ill., Roy M. Cope and L. N. Fisher having purchased the interest of the senior member of the firm, L. N. Cope. The firm will hereafter be known as COPE & FISHER.

ROBERT A. ALLEN has been appointed state engineer of Nevada and ex-officio member of the Nevada State Public Service Commission for the unexpired term of Col. James G. Scrugham, democratic nominee for Governor of Nevada. Col. Scrugham was appointed March 28, 1919, for a four-year term. Mr. Allen has served as deputy state engineer for three and one-half years.

ROLLEN J. WINDROW, former chief engineer of the Texas Highway Department and at present consulting engineer with the Missouri State Highway Commission, has acquired an interest in the contracting business of Smith Bros., general contractors, Dallas, Tex. Mr. Windrow is actively connected with the business as chief engineer. He still maintains his connection with the Missouri State Highway Commission retaining an office in Kansas City, and dividing his time between that work and private business in Texas. Smith Bros. is one of the largest general contracting firms operating in Texas, having under contract about $10,000,000 worth of work, including highway construction, street paving, sewer and water-works installations, levee, irrigation and railroad work.

A. ANTOINE, engineer of Ponts et Chaussées, of Strasbourg, France, has recently returned to his home after an extended visit through the eastern part of the United States inspecting American engineering projects in the field in which his department is interested.

J. W. STONE, formerly assistant valuation engineer of the Pennsylvania R.R. system, has been appointed valuation engineer, effective Oct. 1, 1922. He takes the place of C. A. Preston, whose death was noted in these columns recently. Mr. Stone was born in Philadelphia and educated at Treemont Seminary, Norristown, Pa. Like many other officers of the Pennsylvania, Mr. Stone began his railroad career as a rodman in the engineering department. He was seventeen years of age when he entered the service. After four and one-half years in the engineering department he was transferred to the operating department, serving successively as transitman, assistant supervisor, supervisor and division engineer at various points on the lines east of Pittsburgh and Erie. In May, 1915, Mr. Stone was appointed assistant valuation engineer of the Pennsylvania R.R., Lines East, and served in that capacity until his present appointment.

P. H. DEVINE of Hidalgo County, Texas, has been appointed highway engineer for Starr County. He is stationed at Rio Grande City.

FRED. D. KING, attached to the engineer's office of the city of New Orleans, has resigned to accept a position with the Louisiana State Highway Department. Mr. King will be connected with the maintenance department, with headquarters at Monroe, La. Mr. King has been in the city engineer's office for nearly seven years.

H. P. HEVENOR has joined the staff of Dwight P. Robinson & Co., Inc., New York, as consulting engineer. Until recently he was a member of the firm of Engel & Hevenor, Inc., where he specialized in track construction, taking part in numerous large projects in the East, Middle West and South. Mr. Hevenor is a member of the A.S.M.E., Brooklyn Engineers Club, New England Street Railway Association, the A.R.E.A., and other associations.

OBITUARY

DR. R. B. FITZ RANDOLPH, chief of the hygienic laboratory of the New Jersey State Department of Health, died at his home in Trenton Oct. 22, aged 50 years.

MAJOR SAMUEL P. HATFIELD, retired civil engineer, died Oct. 22 of heart disease in Brooklyn, aged 85. For nearly fifty years he had been engaged in river and harbor improvement work under the Corps of Engineers, United States Army.

HUGH MONTGOMERY COPELAND, well known in engineering circles in Brooklyn, N. Y., died suddenly on Oct. 19. He was 45 years old and a native of Brooklyn. He received his early training in the Brooklyn Polytechnic Institute and was graduated from the Rensselaer Polytechnic Institute, Troy, N. Y., in 1904.

THOMAS H. MCCANN, at one time city engineer of Hoboken and a consulting engineer of that city, died Oct. 25, age 76 years. He had been identified with public improvement work in Hoboken practically most of his professional career, having had much to do with the design of the first tunnel under the Hudson River. Later he designed and superintended the erection of many of Hoboken's wooden shipping piers and acted as consultant when those piers were replaced with fireproof structures. Other structures which he designed and erected were two truck elevators, one at Hoboken and the other at Weehawken for elevating freight from the river. Later he became a member of the engineering firm of Beyer & McCann, of Hoboken. He was a member of the American Society of Civil Engineers, having been elected in 1890.

DURWARD B. KENNEDY, president of the firm of Kennedy & Smith, Inc., contractors of Flushing, Long Island, died Oct. 23, at his home in Flushing, age 56 years.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Equipment Makers and Users Confer on Standards

Leading Manufacturers and Contractors on Joint Committee Begin Important Program

Washington Correspondence

WORK has been begun by the joint committee of construction equipment manufacturers and members of the Associated General Contractors of America on the suggestions recently put forward regarding standardization. For the next few weeks the committee will consider the suggestions from the experience of its own members and by means of correspondence with other contractors and manufacturers. By Dec. 1 there will probably be a meeting of the committee to go over the plans and present at least some of the results in concrete form.

The suggestions cover a wide range, from specifications for shovels to a standard capacity, even if not standard material, for concrete mixers, hoisting engines and other heavy equipment for various classes of construction. At the recent conference where the appointment of this committee was agreed upon, it was stated, for instance, that there are 2,000 possible variations of a simple hand-shovel.

It is hoped at least to bring forward specifications which will enable manufacturers to know what prospective purchasers want for a particular job and to enable contractors to order intelligently, thus reducing costs to both.

Members of Committee

The joint committee is composed of C. E. Bement, Novo Engine Co., Lansing, Mich., chairman; H. B. Bushnell, Western Wheeled Scraper Co., Aurora, Ill.; Philip Koehring, Koehring Co., Milwaukee; F. H. King, Marion Steam Shovel Co., Marion, O.; C. D. McArthur, Blaw-Knox Co., Pittsburgh; H. H. Baker, Sterling Wheelbarrow Co., Milwaukee; and H. M. Howard, General Motors Truck Co., representing the manufacturers. In addition, the contractors are represented on the committee by Stanley D. Moore, Moore & Young, Waterloo, Ia.; W. A. Rogers, Bates & Rogers, Chicago; A. P. Greensfelder, Fruin-Colnon Contracting Co., St. Louis; W. G. Will, Samuel Gamble Co., Erie, Pa.; C. W. Lundoff, Cleveland; Frederick L. Cranford, Brooklyn; W. A. Waldridge, Detroit, and Gen. R. C. Marshall, Jr., Washington.

September Motor Truck Output 27% Above Last Year

Reports of the U. S. Department of Commerce record that motor-truck production in September, 1922, was 27 per cent above September, 1921, though showing an expected decline from summer business. The output for September this year was 18,843, for August this year 24,200 and for September, 1921, 13,648.

Winter Buying of Pipe Evokes Discussion by Water-Works Men

Since the publication of the article in the Oct. 19 issue of *Engineering News-Record* (p. 675), many water-works engineers have expressed their views on the proposal, made by the manufacturers, to spread purchases of cast-iron pipe throughout the 12 months of the year by winter buying. A continuation of the discussion begun in last week's issue follows:

C. R. Henderson
Manager, Davenport (Ia.) Water Co.

The pipe makers are now and at this season of the year usually are behind in filling their orders. Many private water companies and some forehanded municipalities place orders early in the year for spring delivery, thereby gaining some advantage in price. If this practice is not general enough to equalize manufacture it might be possible for water departments in the South to lay pipe during the winter months, but any effort to induce water-works people in the North to lay pipe between Nov. 1 and April 1 would fail because the weather is so unreliable that plans cannot be made with certainty and so pipe gangs are laid off, the men seeking inside work for the winter.

The winter would seem to be a good time for pipe makers to fill up their yards with made pipe and this they doubtless do. We are all interested in any plan that will make for economy in manufacture and delivery of pipe, and are willing to consider any suggestions of the makers which will bring about improved conditions.

J. A. Jensen
Supervisor, Water Works Department, Minneapolis

Regarding seasonal buying of cast-iron pipe, there is no doubt that the situation might be relieved if the demand could be spread over the year. Some of our spring orders have not yet been filled and in smaller cities around Minneapolis it is impossible, for the present, to get pipe at all.

To purchase pipe in advance might involve a risk in loss by changes in price, and there is usually a financial burden to be carried by the purchaser unless payments are deferred. A price differential would probably solve this problem.

In this latitude frost interferes with winter work. When frost penetrates 4 to 6 ft. it is useless to attempt work of this kind unless high costs are ignored.

George G. Earl
General Superintendent Sewerage and Water Board, New Orleans

In New Orleans we have not the usual reasons for seasonal work to anything like the same extent as in the North, and our work goes ahead just about the same all year round. We do have more rainy days, but the advan-

(*Continued on p. 766*)

Gary Sees Prosperous Future for American Industry

In his presidential address before the American Iron and Steel Institute at its meeting in New York City, Oct. 27, Judge Elbert H. Gary, chairman of the board, United States Steel Corp., forecast a period of prosperity in American industry.

"There are no obstacles to continued prosperity in the iron and steel business of the United States," said Judge Gary, "except such as may arise from interference with the natural course of supply and demand. Steel is needed immediately for buildings and other structures, for railroads, for farms, automobiles, airplanes and many other purposes. Order books are well filled, finished steel, aggregating many thousand tons, is stored at the producing mills, ready for shipment, and this notwithstanding the recent labor troubles at the mines and in transportation."

After announcing that steel manufacturers are now producing about 75 per cent of their capacity Judge Gary commented on the general business situation. "As to general business conditions," he continued, "in addition to what has already been said, great significance should be given to the publications concerning the enormous savings bank balances. These show conclusively a disposition to economize, whatever may be the reasons. Economy and saving are fundamental to thrift and prosperity."

Touching upon the present labor shortage Judge Gary advocated a change in restrictions on immigration. He said, in part: "These laws ought to be promptly changed. The restrictions upon immigration should be directed to the question of quality rather than numbers of foreigners coming to this country. Measures for limiting the number of immigrants to those who are clearly shown to be healthy, morally, politically and physically, ought to be clear, strict and enforceable; but the number allowed to come here should be equal to the necessities of our industries. The administration of the law could be under the control of a competent and impartial governmental commission or department to be managed for the benefit of the general public and not for the protection of any special class or the exploitation of any impractical or injurious theory. This is one of the most important questions now debated throughout the nation."

Crushed Stone Association to Hold Convention

The National Crushed Stone Association will hold its next annual convention in Chicago, Jan. 15-17, at which time and place the convention of the American Road Builders' Association and the Good Roads Show will be in session. Although the details of the program have not yet been announced, quarry operation and management will be topics of central interest and will be covered by contributed papers and discussion from the floor. The program committee consists of Nathan C. Rockwood, editor, *Rock Products*, chairman; W. Scott Eames, president of the association; William H. Hoagland, president, Marble Cliff Quarries Co., Columbus, Ohio; John Sloan, secretary, Wisconsin Granite Co., Chicago; and A. P. Sandles, secretary of the association.

Discuss Winter Buying of Pipe

(*Continued from p. 765*)

tage of cooler weather offsets this disadvantage. Our ground never freezes to help delivery conditions over soft ground, and often this constitutes one of our greatest difficulties.

As suggested in the article, a reduced price for winter delivery would doubtless be a strong consideration to influence the users of pipe to stock up as far as possible during the winter.

William W. Brush
Deputy Chief Engineer, Department of Water Supply, Gas and Electricity
New York City

The main reasons for the present rather general practice of buying pipe when needed, rather than anticipating pipe demands, are: (1) Cost of rehandling pipe from point of freight delivery to storage yard, and from storage yard to site of work. (2) Lack of funds with which to make purchases materially in advance of use of materials. (3) Lack of authority for city officials to pay for pipe cast and stored at foundries on account of municipal contracts. Pipe so cast cannot be paid for until delivered to the city. (4) Uncertainty of future demands for various sizes of pipe.

My personal belief is that these reasons, either individually or collectively, are not sufficient to warrant the larger cities delaying their purchases until the spring or summer months. If the larger cities should place their contracts for pipe with the foundries so as to permit of the fabrication and delivery of the pipe during the winter months, the greater part, if not the entire output, of the foundries would be taken during the winter as well as during the summer months. We in New York have endeavored, but in general unsuccessfully, to secure our appropriations early in November to permit of placing our contracts in November or December, and securing our pipe during the winter so as to have a relatively large stock on hand at the beginning of the working season. This is true, however, only of the smaller sizes of pipe, as the larger sizes are generally furnished directly to the contractor and the contractor has no storage space within which to place his pipe. For the larger pipe, I doubt whether it would be feasible for a city like New York to have the pipe cast during the winter.

From the viewpoint of laying the pipe during the winter we find it to be impracticable on account of frost conditions, the increased cost of the work, the uncertainty as to the extent to which the cost will be increased by frost and the annoyance occasioned by opening a street during the winter and having to delay the completion of the work and the backfilling of the street on account of frost.

If the manufacturers of pipe should offer purchasers a price differential during the winter months, which frequently they do at the present time, this would materially aid in securing orders for the manufacture of pipe during the winter period. We have just made an estimate of something over $1,000,000 as the amount required for our extension of small pipe next year, and we hope to get the appropriation in time to have the greater part of the material required fabricated and delivered by the time the spring work opens.

[*Further discussion next week*]

Business Notes

Michigan Valve & Foundry Co., Detroit, has purchased the business and assets of the Flower Valve Manufacturing Co., Detroit, including patterns, designs and patents. With present manufacturing facilities increased by the installation of additional machinery the Michigan company will continue the manufacture of its line of hydrants, sluice-gates, valves and heavy industrial castings.

C. A. Jennings, district sales manager at Chicago for the Wallace & Tiernan Co., Inc., has resigned, effective Nov. 1, to become Chicago manufacturer's sales representative for the Michigan Valve & Foundry Co., of Detroit; Roberts Filter Manufacturing Co., of Darby, Pa.; Universal Destructor Co., of Pittsburgh, and other firms manufacturing water-works and sanitary engineering equipment.

American Rock Asphalt Corp., Pittsburgh, Pa., has been incorporated, under the laws of Delaware, at a capitalization of $3,000,000.

Paul J. Kalman Co., Chicago, manufacturers of building products and distributors of reinforcing steel, has recently changed its corporate name to Kalman Steel Co., under which its present executive organization and policies are to be continued.

William B. Wood, president of Gifford-Wood Co., Hudson, N. Y., manufacturer of excavating and conveying machinery, died Oct. 28 at the Albany City Hospital, after a two weeks' illness. Mr. Wood was born in Arlington, Mass., July 15, 1869. He became a member of the firm of William T. Wood & Co., of Arlington upon the death of his father Cyrus in 1896 and continued as a partner with William E. Wood, and later as a member of Gifford-Wood Co. when incorporated in 1905. He moved with his family to Hudson in 1911 and succeeded Malcolm Gifford as president upon the latter's death in 1919.

Richard Horn, who for the last four years has been district sales representative at Portland, Ore., for the Cleveland Tractor Co., has resigned to represent Bear Tractors, Inc., New York, as district sales manager on the Pacific Coast.

John W. Wooley, vice-president, Minneapolis Equipment Co., distributor for the Jaeger Machine Co., Columbus, Ohio, was killed in Ironwood, Mich., last month. Mr. Wooley was the innocent victim of a stray bullet fired during a quarrel between two other men. He had previously served several years as sales manager of the Oshkosh Manufacturing Co.

Walter S. McKee has resigned as vice-president and director of the American Manganese Steel Co. and will develop the business of the Inland Engineering Co. of Chicago, of which he is president.

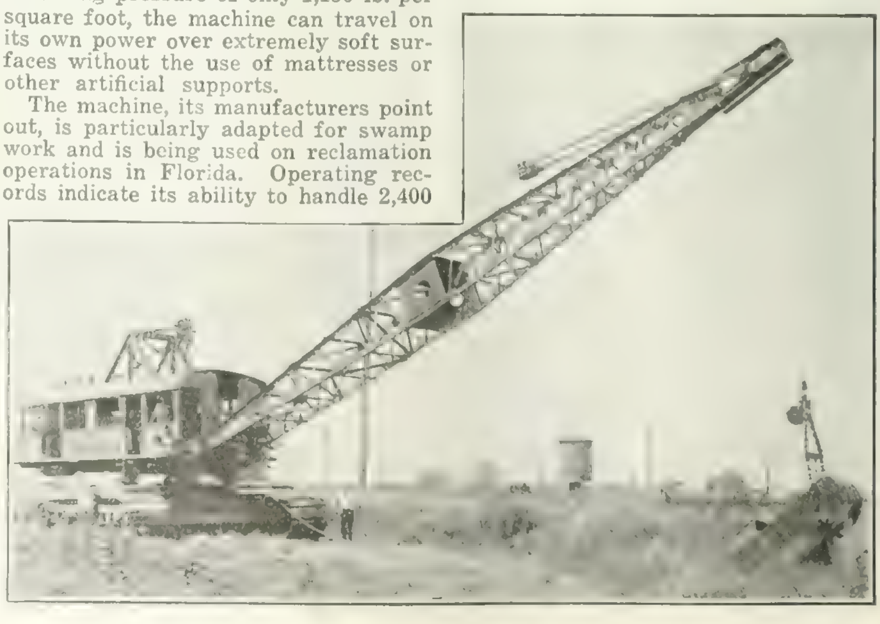
Equipment and Materials

New Dragline Has 60-Ft. Boom and 2½-Yd. Bucket

A dragline excavator of the full revolving type, mounted on two multipedals and equipped with a 250-hp., six-cylinder heavy-duty type of gasoline engine, is announced by the Austin Machinery Corp., Chicago. Semi-Diesel engines can be substituted if desired. Standard equipment is a 2½-cu.yd. Page bucket and a 60-ft. boom. With a bearing pressure of only 1,150 lb. per square foot, the machine can travel on its own power over extremely soft surfaces without the use of mattresses or other artificial supports.

The machine, its manufacturers point out, is particularly adapted for swamp work and is being used on reclamation operations in Florida. Operating records indicate its ability to handle 2,400 cu.yd. of material in 10 hr. It has a low speed forward of ½ mile per hour and a high speed forward of ¾ mile per hour.

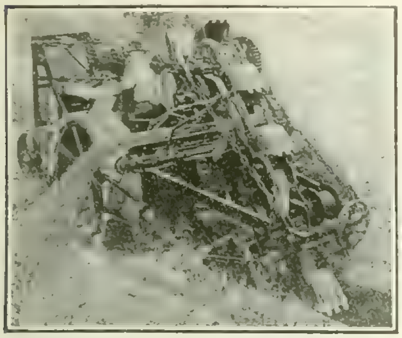
An air compressor and storage tank, the former operated through a direct connection to the main motor, supply the air rams which control the drag and hoist drums, the swinging mechanism of the machine and an air starter for the main motor. Machines of this type are ordinarily worked day and



night so that electric lights constitute a part of the equipment. One detail of the equipment on machines shipped into hot climates is an electric fan which serves both to cool the operator and blow mosquitoes away.

Light-Weight Ditcher Mounted on Fordson Tractor

By Jan. 1 the Charles T. Topping Machinery Co., Pittsburgh, will be in a position to start deliveries on its new light-weight pony ditcher designed as a general purpose trenching machine. The equipment consists of a framework carrying an endless chain of excavating buckets mounted on a standard Fordson tractor which supplies power both for traction and for trench digging. The working length of the machine is 16 ft., its width 7 ft. 2 in., and wheel base $92\frac{1}{2}$ in. Its weight complete, with tractor, is 6,900 lb. and it is designed to excavate a trench from 12 to 18 in. wide and 48 in. deep. Fuel



consumption is given by the manufacturers as approximately $2\frac{3}{4}$ gal. of kerosene per hour.

Excavated material from the buckets is delivered on a 12-in. wide conveyor belt at right angles to the digging boom. This conveyor discharges the earth at the side of the machine and about 5 ft. from the center line of the trench. The conveyor may be reversed to discharge on either side.

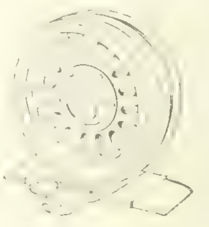
The digging buckets are of electric manganese steel with sides extending through the chains forming the inside link, thus making the bucket sides a part of the chain. A hardwood board, spring mounted, extends up the digging boom back of the buckets to increase the carrying capacity by preventing dirt from falling through.

The motor of the Fordson tractor is a four-cylinder, 25.6-hp. unit using either gasoline or kerosene. Power for digging is transmitted from the engine through the standard Fordson power take-off assembly, on which a special steel socket is substituted for the belt pulley.

The pony ditcher, its manufacturers state, is not intended to replace the more powerful machines of large capacity and heavy weight. It is intended primarily to perform a service which has heretofore been done largely by hand. The ditcher may be readily mounted or dismounted from the tractor, permitting the tractor to be used for general hauling. The ditcher can be readily converted from the center type to the offset type without special tools by shifting the excavator boom sideways.

Portable Scale Weighs Trucks Without Jacking

The State of Pennsylvania is using the portable scale illustrated herewith in the enforcement of its motor vehicle laws. The feature of the device, which has been developed by H. C. Berry, of the University of Pennsylvania at Philadelphia, is its elimination of the process of jacking up a truck to determine its weight. The scales are semi-automatic. One is set in each wheel track. The front wheels of the truck are then driven slowly across the tilting platform without stopping. The hand on the maximum - pressure reading dial indicates and retains the weight reading. The rear wheels are weighed in the same manner, and since they are always heavier than the front wheels it is not necessary to reset the hand on the dial.

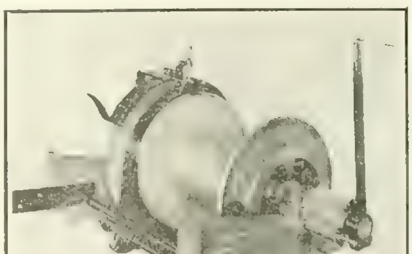


The capacity of the Berry scale as used in Pennsylvania is 15,000 lb. The scale is only $2\frac{3}{4}$ in. high and weighs 64 lb. The scale, with approach blocks and steel plate, may be packed in a case 18 x 7 x 30 in.

(*Editor's Note*—It is understood that the firm of Black & Decker, Baltimore, have patents pending for a similar device.)

Hoisting Engines Improved by Several New Features

Several new features have been incorporated in the design of its hoisting engines by the J. S. Mundy Hoisting Engine Co., Newark, N. J. Non-burning friction blocks of "asbestall," instead of wooden blocks which were apt to burn out, are now being employed on the frictions of hoists, especially those designed for long lifts at high speeds. Another innovation is the coring out of the brake flanges, producing openings through which air can circulate and cool the brakes. This feature



THIRD-DRUM HOIST ATTACHMENT

of design is employed usually on hoists for heavy-duty steel derricks where a rapidly descending boom must be caught by the brakes. The brake bands are equipped with "asbestelin" brake lining.

On its electric hoists the Mundy company is using a patented brake to prevent accidents by falling loads in case of failure of the supply of electric current. In such an event the brake functions automatically, holding the load in mid-air.

By the use of the third-drum extension, shown in the accompanying photograph, a double-drum hoist may be adapted to work involving the use of an excavating bucket or dragline. The third drum may be incorporated as a part of existing hoisting engines by bolting it onto the main frame.

Another recent innovation designed to increase the service of any two- or three-drum hoisting engine is a patented swinging drum for operating the bull-wheel of a derrick. This device, like the third drum extension noted in the previous paragraph, may be attached to existing hoisting engines, without necessitating a separate swinging engine.

Publications from the Construction Industry

Truck Mounted Crane—BYERS MACHINE Co., Ravenna, Ohio, features its "Truckrane" in an illustrated bulletin just issued. The equipment consists of the company's autocrane model No. 1, which has a special base to permit of its being mounted on a motor truck, thus combining light crane service with ability to move quickly from one job to another. The company furnishes the crane unmounted; it can be used on any standard truck of 5 tons capacity or larger having a minimum chassis length of 8 ft. 10 in. from rear of driver's seat to center of rear axle. The outfit has an operating radius of 20 ft. and uses a $\frac{1}{2}$-yd. clamshell bucket. The weight of the crane without bucket or counterweight is 11,200 lb. The boom is of the latticed panel type, 25 ft. long. Power for operating the crane is supplied by a four-cylinder, 35-hp. Hercules gasoline engine. The crane has a capacity of 5,000 lb. at 10-ft. radius and 2,500 lb. at 22-ft. radius. The bulletin illustrates the use of the crane in handling sand and crushed stone, coal and broken asphalt.

Business Analysis—WILLIAM H. RANKIN Co., advertising agents, Chicago, has compiled from Government and other sources a book of statistics for business men. For each county in the United States are shown the values of bonds, crops, and manufactures. There is also a tabulation, by counties, of the white population, number of automobiles registered, and mileage of all roads. The figures for surfaced roads are recorded separately. An estimate also has been made of the income tax paid by the people of each county. The summary of statistics for each state includes, in addition to the items given for the counties, a record of climatic conditions. The information is presented in two loose-leaf volumes with flexible leather bindings. The price is $200.

Hardwood Lumber—HARDWOOD MANUFACTURERS' INSTITUTE, Chicago, has issued a 30-p. booklet entitled "Waste Elimination in the Production and Consumption of Hardwood Lumber." Much of the text is devoted to explaining the purpose of rules in grading and inspecting hardwood lumber and to forest conservation.

Business Side of Construction

Facts and Events that Affect Cost and Volume

October Contracts Nearly Equal September Total

Gains In Waterworks, Sewers, Excavations and Industrial Works—Total for Ten Months Over Billion

Contracts awarded in the United States and Canada, on important engineering projects, during the month of October, reached a total of $137,877,000 as against $138,648,000 in September. This comparison indicates the reluctance, on the part of an unparalleled construction boom, to yield even to seasonal diminution.

The minimum costs observed in Construction News, from which these tables were compiled, on each class of construction, are as follows: water-works, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

Lettings in the Middle Atlantic States during October, aggregated $34,302,000, or 25 per cent of the total for the United States and Canada. The Middle West came next with $32,801,000, or 24 per cent.

Contracts let on waterworks, during the month, increased 95 per cent over September awards; industrial construction increased 70 per cent and sewers, 48 per cent. Excavating and dredging during October, more than doubled the lettings for the preceding month.

Bridges, streets and roads, commercial buildings and miscellaneous construction fell off slightly from the September levels. Federal Government awards dropped only $640,000.

The value of contracts let for the whole United States, from Jan. 1 to Nov. 1, 1922, reached $1,309,593,000; $612,182,000, or 47 per cent of which was for commercial buildings alone.

Outlook Favors Continuance of Building Activity

A. G. C. Expects Demand for Building to Continue with Resulting Rise in Construction Costs

That construction costs will continue to increase to a higher level than at present, and that the demand for construction will continue for some years to come, is the opinion of the Associated General Contractors of America, in a statement made today to James A. Wetmore, acting supervising architect, who is quoted as authority for the statement that within the next eighteen months the country may look for a very material drop in the cost of building. In the *United States Advertiser* it is reported that $15,000,000 worth of federal buildings throughout the country are

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Engineering News-Record Construction Cost Index Number

November, 1922	188.60
October, 1922	188.60
November, 1921	166.32
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is exactly the same as last month, due to stability in prices of steel, cement and lumber. Steel is now $2.00 per 100 lb., Pittsburgh mill. The average rate for common labor remains at 45c. Thus, general construction cost is 13 per cent higher than one year ago and 31 per cent under the peak; it is 88.6 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
October, 1922	127
September, 1922	129
October, 1921	109
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 127 for the month of October, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 127 for October, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA IN OCTOBER, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Waterworks			$185,000	$799,000	$5,945,000	$7,000	$750,000	$7,686,000
Sewers	$189,000	$1,240,000	63,000	1,868,000	1,441,000	153,000	42,000	4,996,000
Bridges	241,000	21,000	223,000	179,000	462,000	773,000		1,899,000
Excavating and dredging	25,000	22,000	509,000	393,000	1,051,000	365,000	25,000	2,390,000
Streets and roads	635,000	4,729,000	2,521,000	3,138,000	7,487,000	3,702,000	950,000	23,162,000
Industrial works	9,795,000	10,729,000	2,200,000	6,825,000	929,000	850,000	251,000	31,579,000
Buildings	4,407,000	15,687,000	4,262,000	18,411,000	7,670,000	4,639,000	738,000	55,814,000
Federal Government	2,117,000	1,319,000	1,510,000	15,000	302,000	1,766,000	....	7,029,000
Miscellaneous	50,000	555,000	491,000	1,173,000	172,000	519,000	362,000	3,322,000
Total	$17,459,000	$34,302,000	$11,964,000	$32,801,000	$25,459,000	$12,774,000	$3,118,000	$137,877,000

VALUE OF CONTRACTS LET IN THE UNITED STATES, JAN. 1 to NOV. 1 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total
Waterworks	$2,754,000	$5,972,000	$2,787,000	$5,627,000	$10,844,000	$4,421,000	$32,405,000
Sewers	548,000	9,576,000	3,647,000	15,450,000	4,412,000	2,599,000	36,232,000
Bridges	2,311,000	13,214,000	5,865,000	4,801,000	6,283,000	3,213,000	35,687,000
Excavating and dredging	118,000	918,000	7,942,000	1,486,000	3,674,000	2,863,000	16,941,000
Streets and roads	10,075,000	69,379,000	58,766,000	73,236,000	50,577,000	34,066,000	296,099,000
Industrial works	30,524,000	48,720,000	20,525,000	47,617,000	8,632,000	8,452,000	164,470,000
Buildings	51,557,000	233,185,000	36,436,000	182,269,000	58,228,000	50,507,000	612,182,000
Federal Government	2,658,000	15,258,000	7,657,000	1,698,000	2,694,000	8,818,000	38,783,000
Miscellaneous	5,057,000	45,064,000	3,761,000	7,658,000	7,290,000	7,964,000	76,794,000
Total	$105,602,000	$441,286,000	$147,386,000	$339,842,000	$152,634,000	$122,843,000	$1,309,593,000

being held up for a drop in the cost of construction expected within the next eighteen months.

Not only has the cost of building been going up for several months, according to the Associated General Contractors, but so has the cost of materials. Wages in the building trades have more recently begun to increase also. The general average of wholesale prices has been increasing since the first of the year.

"The behavior of all these prices in increasing during a time of recovery from business depression" declare the contractors, "is entirely normal. It is a phenomenon which always occurs during like periods. We believe it is a very strong indication that prices in general have been stabilized for the present on a new price level in the neighborhood of 70 per cent higher than that which prevailed in 1913. This means that prices will continue to go up until the present period of prosperity is fully established and will not go down again until the beginning of the next business depression. The next depression will probably be only a moderate one—such as we were familiar with before the war—and will be accompanied by only moderate decreases in prices.

"Instead of expecting that building costs will be materially lower eighteen months from now, we anticipate that they will continue to increase during the greater part of that period, and that they will be at that time, perhaps, at about the beginning of a decrease but at a point higher than the present. We believe, further, that the decrease which may be expected to begin at about that time will not go to a point very much below the figures reached during the past winter."

In explaining the reasons for their opinions, the contractors say that the costs of building materials are going up partly because they are partaking of the general tendency of prices to rise during this part of the economic cycle, and partly because we are experiencing a building boom of unprecedented volume. Wages of building labor are increasing partly because of the shortage brought about by this same building boom and partly because of a recovery in other lines of industrial activity, which is already beginning to produce labor shortages.

"One important aspect of this phe-

(*Concluded on p. 770*)

Labor Rates and Conditions Throughout the Country

Improved business conditions and increased employment, together with a shortage of common labor and an unusually heavy demand for skilled mechanics in nearly all trades, are the outstanding features of today's labor market.

In its survey of current industrial conditions throughout the country, the National Industrial Conference Board states: "The tendency of wages during the last two months has been distinctly upward. Labor shortages have developed during the past few months in face of only a moderate upward swing in industry. This has served as a warning that labor is not to be had in sufficient quantities. The industries of the United States are undoubtedly going through a period of nation-wide wage adjustment. The high wages in the coal mining industry, on the railroads, in the building trades and in other favored industries have set a high standard. Less-favored industries—both men and managers—realize their position. The voluntary wage increases that have been made in a large number of industries are indicative of this general leveling up. Wage increases in such basic industries as iron and steel, cotton, textile and the like, will inevitably be converted into higher prices."

Local industrial conditions as reported by *News-Record* correspondents are given as follows:

Atlanta—Unsettled situation of a month ago somewhat eased up since strike settlements. Lack of cars still a retarding factor in resumption of normal industrial activities.

Cleveland—Hod carriers awarded 75c. as against 60c. and common laborers 57½c.@75c. as compared with a maximum of 57½c. per hr., one month ago.

Dallas—Sufficient skilled building trades mechanics to meet all demands.

Denver—No unemployment. Building season longer than usual owing to clear, warm weather.

Detroit—Supply of all trades about equal to demand. Little unemployment.

Kansas City—Scarcity of carpenters; paid \$1.12½ as against \$1.07½ per hr., last month. Fair supply of bricklayers but some idle hoisting engineers, pile drivers and structural iron workers. Very few unemployed hod carriers.

Montreal—Minimum wage for common labor now 35c. as against old rate of 30c. per hr.

New Orleans—Labor conditions stable. Building boom at peak.

New York—Still some degree of unemployment existing, particularly in clerical occupations. Increased activity in manufacturing. Building retarded by shortage of materials, due to freight congestion. Distinct labor shortage in skilled trades. Unskilled common laborers receive minimum of 45c. with a maximum of 62½c. per hr. on certain construction projects. Average pay for pick and shovel men in building construction about 60c. per hr.

Philadelphia—Scarcity of bricklayers, carpenters, hodcarriers and common laborers. Fair supply of other trades. Carpenters receive maximum of \$1 as against 90c.; common laborers, 35c.@45c. as compared with 35c.@40c. per hr., one month ago.

St. Louis—Bricklayers scale, \$1.25 per hr. but men being paid \$1.37½.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	\$0.90	\$0.70	\$0.70	\$0.30	......	\$0.65	\$0.30@.35
Baltimore	1.25	.80	.87½@.90	.60@.75	\$0.75	1.00	.35@.40
Birmingham	1.00	.75	.50@1.00	.15@.25	......	1.00	.15@.20
Boston	1.12½	1.00	1.00	......	1.00	1.00	+.55
Cincinnati	1.25	.95	.95	.72½	.....	.95	.35
Chicago	1.10	1.00	1.10	......	1.10	1.05	.72½
Cleveland	1.25	1.10	1.10	+.75	.91	1.10	+.57½@.75
Dallas	1.00	1.00	1.00	.60	1.00	1.00	.25
Denver	1.25	1.00	1.00	.75@.81¼	1.00	1.03⅛	.35@.50
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	+1.12½	1.00	1.00	.70	1.00	1.00	.35@.60
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.56¼@.62½
Minneapolis	1.00	.80	.80	.65	......	.80	.35@.50
Montreal	.90	.65	.50	.35	.50	.55	+.35
New Orleans	1.00	.85	.90	.50	.80	1.00	.35@.40
New York	1.25	1.12½	1.25	.87½	1.00	1.12½	+.45@.60
Pittsburgh	1.30	1.12½	1.00	.90	1.00	1.00	.50
St. Louis	1.25	1.10	1.12½	.85	1.12	1.12½	.30@.40
San Francisco	1.12½	1.00	1.00	.75	1.00	1.12½	.47½@.50
Seattle	1.00	.80	.90	.70	1.00	.80@.90	.50@.60
Philadelphia	1.25	+.90@1.00	+.90@1.00	.75@.90	1.00	.90@1.00	+.35@.45

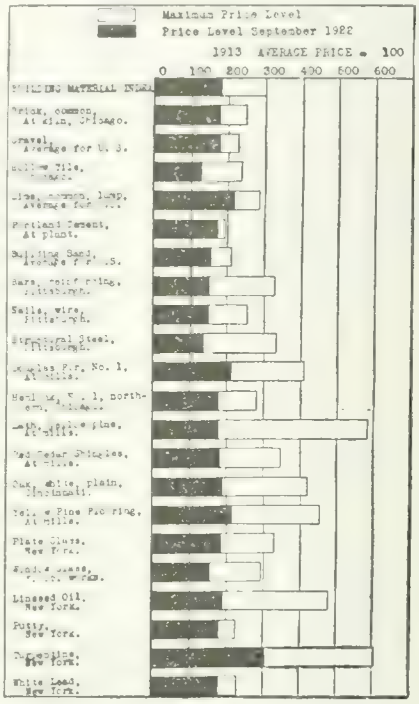
(*Concluded from p. 769*)

nomenon" they state, "is the shortage of common labor, which is due, in large measure, to the almost complete extinction of immigration for the past nine years, caused first by the Great War and latterly by our present restrictive immigration act. That this shortage of common labor in fields other than the building trades is a very real one is proved by the recent action of the United States Steel Corporation, and a number of the other important steel companies, in making large voluntary increases in their wage scales.

"It may be that some believe the present building boom has about run its course, and that, for that reason, building activity will soon diminish and building costs go down. We believe the outlook to be far otherwise. The boom shows no sign of abating. For six successive months the figures for contracts let have been record-breaking. The slight recession of August is less than the usual seasonal recession. As a result of very painstaking investigations it has been estimated that the deficit in building, the country over, is so great that building could continue for ten successive years, beginning with this year, at 25 per cent above normal before catching up with that deficit. We do not predict any such sustained activity, but we do point to the figures as proof that there is no possibility of the present building boom coming to an end within the next few months, because of having completely filled the demand for new construction."

Lower Wholesale Prices in September

The September level of wholesale prices was slightly below that of



August, according to latest information gathered in leading markets of the country, and issued Oct. 19 by the U. S. Department of Labor through the Bureau of Labor Statistics. Measured by the Bureau's weighted index number, which includes 404 commodities or price series, there was a decrease from August to September of 1⅓ per cent, or from 155 to 153.

Farm products showed an increase of 1½ per cent over the August level. Cloths and clothing increased 1 per cent, chemicals and drugs 1½ per cent, building materials 4½ per cent, and metals and metal products 6¼ per cent in average price in the period stated. In the group of miscellaneous commodities there was an increase of less than 1 per cent.

On the other hand, a decrease of approximately 10 per cent took place in the important group of fuel and lighting materials, due to decreases in bituminous coal and coke. No change in the general price level was reported for foods and house furnishings.

The considerable increase shown for building materials and for metals and metal products is due largely to advances in structural steel and other articles included in both groups.

Comparing prices in September with those of a year ago, as measured by changes in the index numbers, it is seen that the general level has risen 8½ per cent. Fuel and lighting materials show by far the largest increase, 34¾ per cent. Building materials and metals and metal products increased approximately 15½ per cent, farm products 7½ per cent, and cloths and clothing 2¾ per cent in price in the year.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Production increasing with the lowering of coke prices. No. 2 foundry iron down $1 in Chicago, $1.50 in Pittsburgh and $3 in Philadelphia. Basic, $2.50 lower in Pittsburgh and $4.50 in Philadelphia. Bessemer declined 50c. in Pittsburgh and gray forge, $1 per ton in Philadelphia, during month. Prices slowly receding.

Railway Supplies—Maximum on light rails, $47 as against $45 per ton, f.o.b. Pittsburgh; advanced 20c. per 100 lb. at Birmingham. Re-rolled rails, $28@$32 as compared with $26@$29 per ton at Pittsburgh mills, one month ago. Red oak ties slightly lower in St. Louis. Track bolts up 10c., spikes, 15c. and section angle bars, 35c. per 100 lb., Pittsburgh. Track supplies higher in St. Louis. Railroads buying heavily.

Pipe—Wrought-pipe discounts reduced two points on Pittsburgh basing card of Oct. 19; equivalent to rise of $4 per ton on both black and galvanized steel pipe. Mill advance reflected in lowering of discounts in New York and Cleveland warehouses. Cast-iron pipe, 6-in., up $2.50 per ton at Birmingham mill, during month, despite lower pig-iron and fuel costs. Sewer pipe higher in Philadelphia and New Orleans but lower in St. Louis. Clay drain tile, however, $5 per 1,000 lin.ft. higher, in St. Louis.

Road and Paving Materials—Road oils up ½c. in New York and 1c. per gal. in St. Louis. Mexican petroleum situation also responsible for advances in bulk asphalt, of $1 in Baltimore, Atlanta and Philadelphia and $2 per ton in New York. Wood paving blocks up 5c. per sq.yd. in New York; down 40c. in Philadelphia.

Sand, Gravel and Crushed Stone—Gravel, $2 as against $1.75 in New York and $2@$2.25 as compared with $2 per cu.yd. in Detroit, one month ago; sand prices unchanged. Crushed stone, up 10c. in Detroit and 20c. per cu.yd. in Atlanta. Transportation conditions and local labor adjustments responsible for advances.

Lime—Hydrated finishing lime up 20c. in St. Louis, 50c. in Philadelphia and $1 per ton in New York. Hydrated common, up 50c. in Philadelphia and $2 in St. Louis. Lump finishing lime advanced 50c. per ton in Philadelphia. Common lump lime 5c. per bbl. higher, in Atlanta; advanced 50c. per ton in Philadelphia and $3 in Baltimore. Hydrated finishing lime, however, down $3.50 per ton in Minneapolis; common lump also reduced 10c.@15c. per bbl.

Cement—Price advances made during acute coal situation have receded to meet winter demand. Mill prices down 5c. at Mason City, Ia.; 15c. in Fordwick, Va.; 25c. in Mitchell, Ind., Hudson, N. Y. and Northamption, Pa., and 30c. at La Salle, Ind. Mill drop reflected in following declines: f.o.b., New York, 25c.; Toledo, 5c.; Peoria, 2c.; Cedar Rapids, 3c. and Cincinnati, 8c. per bbl. Montreal and Philadelphia, however, quote rise of 10c. per bbl., during month.

Structural Steel—Steel plate demand for car, tank, ship and boiler construction, in excess of production. Plates quoted at minimum of $1.90, with maximum at $2.25, or an average price of about $2 per 100 lb., f.o.b. Pittsburgh. Shapes quoted, however, at $2@$2.10 and bars at $2@$2.15, f.o.b. mill.

Brick and Hollow Tile—Common brick, $14@$15.50 as against $15@$17 per M. wholesale, alongside dock, New York, one month ago. Kansas City also quotes reduction of 50c. per M. Prices, however, slightly higher in Detroit and Philadelphia. Hollow tile up in Kansas City, Philadelphia and St. Louis. Declines due to seasonal falling off in demand; but unusually large amount of brick construction under way, for this time of the year, in some sections.

Lumber — Production sharply curtailed by transportation difficulties; but prices steady in the face of lessened buying activities. Yellow pine structural timbers, base sizes, up 50c. in Kansas City and Philadelphia; $1 in Minneapolis; $2 in Detroit and $5 per M. ft. b.m. in Dallas. Douglas fir up $2 in Kansas City and $6 in Dallas; down $2 in Minneapolis and Denver. Hemlock, higher in Kansas City but cheaper in Denver and Minneapolis. No change in spruce.

Scrap—Market weaker. St. Louis, however, quotes higher prices on all grades except cast scrap.

Explosives—Dynamite, 40 per cent gelatin, down 1c. in Seattle and 2c. in Minneapolis and St. Louis; up ¾c. per lb. in Philadelphia.

Linseed Oil—Quiet; few changes.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	**$31 55**	$24.50
Northern Basic	**33 27**	22.52
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	34.27	23.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	36.27	30.26
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	27.50	20.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25 @ 2.75 sil.)	*33.64*	22.76
Virginia No. 2 (silicon 2.25 @ 2.75)	37 17	28.74
Basic	*29 50*	20.75
Gray Forge	*32.00*	21.75
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	*31.00*	22.70
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	**33.50**	26.66
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	*33.50*	22.96
Basic	*30.00*	21.96
Bessemer	*32.50*	21.96

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43 00	$45 00		$43 00	43 00
Standard openhearth rails	43 00	47 00	$43 00	43 00	43 00
Light rails, 8 to 10 lb.	**45@47**	1.65@1.75*	**2 00***	43.00	41.00
Light rails, 12 to 14 lb.	**45@47**	1.65@1.75*	**2.00***	43.00	41.00
Light rails, 25 to 45 lb.	**45@47**	1.65@1.75*	**2.00***	43.00	41.00
Rerolled Rails	**28@32**	....	...	.	

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1 40	$1.55
Chicago, Hardwood and Red Oak	1.25	1 40
Chicago....Empty Cell Creosoting (add'l)	.45	50
San Francisco .. Green Douglas Fir	.92	1 19
San Francisco, Empty Cell Creosoted, Douglas Fir	1.93	2 39
St. Louis, Red Oak*	*0.80*@1 30	*1.00*@1 60
St. Louis (creosoted) (zinc treated)	1.65	2.00

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, $\frac{9}{16}$-in. and larger	$2 75@**3 00**	$2.30@2.40	$2 55	**$3 02½**	$4 45	$3 29
Track bolts	**3 85**@4.50	3.25@3.55	3.65	**4.02½**	5.45	4.29
Standard section angle bars	**2.75**	2.75	2.40	**2.92½**	4.10	2.94

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	**66**	**54½**	¾ to 1½	34	19

LAP WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	**59**	**47½**	2	29	15
2½ to 6	**63**	**51½**	2½ to 4	32½	19
2 to 8	**60**	**47½**	4½ to 6	32½	19
9 to 12	**59**	**46½**	7 to 12	30	17

BUTT WELD, EXTRA STRONG, PLAIN ENDS

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 1½	**64**	**53½**	¾ to 1½	34	20
2 to 3	**65**	**54½**			

LAP WELD, EXTRA STRONG, PLAIN ENDS

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	**57**	**46½**	2	30	17
2½ to 4	**61**	**50½**	2½ to 4	33	21
4½ to 6	**60**	**49½**	4½ to 6	32	20
7 to 8	**56**	**43½**	7 to 8	25	13
9 to 12	**50**	**37½**	9 to 12	20	**5**

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	**57%**	62½%	61½%
2½ to 6 in. lap welded	**54%**	59½%	58½%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	**44%**	48½%	51½%
2½ to 6 in. lap welded	**41%**	45½%	**50½%**

Malleable fittings, Class B and C, from New York stock sell at list less **10%**. Cast iron, standard sizes, *32-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Current	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	**$45 50**	$60.30	$52.30@53.30	$52.70	$44.50	$55.00
6 in. and over	**43 00**	55 30	47.30@48.30	48.70		51.00

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45 00	$40 00	$40 00	$50 00	.....	$55.00
4	55 00	50.00	40 00	60.00	$76.50	65 00
5	80.00	80.00	**75 00**	80.00	97.75	84 00
6	105 00	105.00	**75 00**	100.00	127.50	110 00
8	170.00	175.00	170 00	150.00	212 50	181.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.14	$0 105	..	..	$0 12	$0.12	.....
4	.14	105	$0 10	$0.0875	.12	.15	$0.18
5	.20	1575	.125	*1025*	.18	.18	.165
6	.20	1575	.150	*1225*	.18	.21	.26
8	.34	245	.225	*20*	.28	.30	.35
10	.51	.3675	.2925	*28*	.42	.42	.....
12	65	.4725	.3825	*.36*	.54	.54	.80
15	1.03†	.63	.5625	[illegible]	.72	.90	.....
18	1 50†	875	.765	*.68*	1 00	1.32	.....
20	1.80†	1 05	1.0125	*.92*	1 20	....	.....
22	2.40†	1 40	1.2575		1 60	...	.....
24	2.70	1 575	1.4625	*1 20*	1 80	2 16	2.40
27	4.50†	2 795	....	*2 25*	3.75†	3 00	.....
30	5.00	3 096	.	*2 70*	4 75†	3 60	.....
33	6.50	4 14	..	3 35	5.50†	....	.....
36	7.50†	4.715	...	3.65	6.00†	.....	.....

	3	5	8	12	24	36
Boston	...	.		......		
Minneapolis	......	....	$0 40	$0.72	$2 55	$5.66†
Denver	$0.135*	$0.18*	27	.47	1.70	.....
Seattle	.13	.....	.325	.65	2.34†	....
Los Angeles	..		..			.....
New Orleans	**1120***	**.168***	**28**	**476**	**1 82†**	...
Cincinnati	.111*	.1665	259	.4995	1 665	3.7925†
Atlanta	.10*	.14*	.225	.425	1 55	....
Montreal, *delivered*	.68‡	.45†	70	1.35	4 50†	
Detroit	.102	153	.238	.459	1.98†	6.15†
Baltimore	.1225	.2275	35	.6870	2 29	5.23
Kansas City, M	.135	19	.30	.54	2 16	
Philadelphia	.114	**1755**	.266	.513	1 71†	3.895†

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Current	One Year Ago
New York, 45% asphalt.... (at terminal)	$0 **06**	$0.05½
New York, 65% asphalt......(at terminal)	**06**	05
New York, binder..........(at terminal)	**06½**	.08
New York, flux............(at terminal)	**06½**	06½
New York, liquid asphalt (at terminal)	**07**	.06½
St. Louis, 50 @ 60% asphalt (*f.o.b. Wood River, Ill.*)	**.04½**	*01½**
Chicago, 40-50% asphalt	.05¼	.05
Chicago, 60-70% asphalt	.05½	.05¼
Dallas, 40-50% asphalt	.10	.10
Dallas, 60-70% asphalt	.13	.13
Dallas, 75-90% asphalt	.15	.15
San Francisco, binder, per ton	13.00†	15.00†

* Freight $21 75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages 350-lb. bbl. or 425-lb. drums and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (Mexican)	$[illegible]	$16 00
Boston (Mexican)	[illegible]	16 00
Chicago ([illegible])	26 00	22 00
San Francisco, f.o.b. refinery, Oleum, Cal.	19 50*	13 [illegible]
Dallas (Texas)	35 00	27 00
Seattle (D. grade California)	23 75	13.00†
Denver ([illegible])	41 [illegible]	
Minneapolis f.o.b. Twin Cities (Mexican)	33 00	27 50
St. Louis (Mexican)	26 00	22 00
Baltimore (Mexican)	20 00	16 00
Los Angeles, [illegible], Bakersfield (California)		
Montreal (Mexican)	28 [illegible]	21 00
Atlanta (Mexican)	23 00	17 50
Detroit (Mexican)	22 50	19 50
Cincinnati (Mexican)	22 50	19.50
Maurer, N. J. (*Trinidad and Bermudez*)	28 50	26 50
Maurer, N. J. (Mexican)	18 00	15 50
Philadelphia (Mexican)	20 00	16 00
Kansas City, *petroleum*	28.83	[illegible] 50

*Freight to San Francisco, 80c. per ton.

†F.o.b. Richmond, Cal.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums.

PAVING STONE—

New York *delivered*	5-in. granite, 28@29 blocks per sq.yd.	$1[illegible]5.00 per M
Chicago	About 4x8x4 dressed	3 35 sq.yd.
	About 4x8x4 common	3.10 sq.yd.
San Francisco	Basalt block 4x7x8	70 00 per M
Boston	5-in. granite	no report
Atlanta	Granite	2.10 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	100 00 per M
Baltimore	Granite	2.00 sq.yd.
Montreal *delivered*	Granite	100 00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 sq.yd.
Cincinnati	Granite	3.84@4 sq.yd.
St. Louis	4x8x4 dressed	3 10 sq.yd.
	4x8x4 common	2.90 sq.yd.
Kansas City	No. Granite	3.95 sq.yd.
Philadelphia	Granite	128.00 per M.

FLAGGING—

New York	Bronx, 5 ft	$0 30@ 35 sq.ft.
	Manhattan, 4 ft	.26 sq.ft.
	Queens, 5 ft	.26 sq.ft.
	6x20-in. cross-walk	1 00 lin.ft
Chicago	18 in. wide	.99 lin.ft

CURBING—Bluestone per lineal foot, in New York, costs 77c.@85c. for 5x16 in.; 88c. for 5x18 in., in cargo lots. 5x18 in., 1.44c. per lin.ft. delivered in St. Louis. 6x18 in., Chicago, $2 per lin.ft.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (delivered)	3	16	$2 14
New York (delivered)	3½	16	2 34
New York (*delivered*)	4	16	2 66
Boston	3½	16	2 [illegible]
Chicago	4	16	3.00@3 25
Chicago	3½	16	2 50
St. Louis	3½	16	2 00
St. Louis	4	16	2 00
Seattle	4	16	Off market
Minneapolis	3½	16	2 [illegible]
Atlanta	3½	16	2 3[illegible]
New Orleans	3	16	1 70
New Orleans	3½	16	1.95
New Orleans	4	16	2.25
Dallas	4	18	3.90
Baltimore	3½	16	3 44
Montreal	4	16	4 50
Detroit	3	16	2 84
Detroit	4	16	3.00
Cincinnati	4	16	2.35
Kansas City	4	16	3 25
Philadelphia	3½	16	[illegible]

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$2 00	$2 00	$2 00	$2 00	$1 00	$1 25
Denver	1 75	2 50	1 75	2 50	0 75†	1 10
Chicago	2 25	1 65	2 25	1 65	2 25	1 65
St. Louis, *per ton*	1 40	1 30	1 45	1 25	1 20	1 2[illegible]
Seattle	1 00	1 50	1.00	1.50	1.00	1 50
Dallas	2 25	2 25	2 25	2 25	2 25	2 2[illegible]
Minneapolis	1 75	1 50	1 75	1 50	1 00	0 5[illegible]†
Cincinnati	1 40	1 87	1 40	2 [illegible]	1 15	1 [illegible]
San Francisco	2 25	2 25	2 25	2 25	1 50	1 [illegible]
Boston	....	2 65	....	2.65	....	2.00
New Orleans	2.85	2 85	2.85	....	1.35	1.[illegible]5
Los Angeles, per ton	....	1.35†	....	1.35†	....	1.20
Atlanta, per ton	2 00	2 00	2 00	2 00	1.35	1.35
Detroit	2[illegible] 2 25	2 [illegible]	2[illegible] 2 25	2 [illegible]	2 [illegible]	2 [illegible]
Baltimore, per ton	1.40	1 40	1 60	1 60	0.70†	2.40
Montreal, per ton	1 25	1 25	1 5[illegible]	1 50	1 25	1 25
Birmingham, per ton (Crushed [illegible])					1 20	1 28
Philadelphia	1 70		1 7[illegible]		1 [illegible]5	
Kansas City, per ton	2.00‡	....	2.00‡	...	0 66†	....

New York—Grit, $1 75 per cu.yd.

Los Angeles—Freight from [illegible], 85c. [illegible]

* Fine white sand: Pacific, $5 per ton; Ottawa, $6.

† At pit.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1 65	$1 80@1 90	$1 75	$1.80@1.90
Chicago	2 25	1 60	2 25	1.60
St. Louis *delivered*	2 10	1.55*	2 20	1 55*
Dallas	1 65	3 20	1 65	3.20
San Francisco	2.25	2.25	2.25	2.25
Boston, *delivered*		3 00*	....	3 00*
Minneapolis, *at plant*	2 00	2 00	2.25	2.25
Kansas City	2 00	2.75	*2.00*	2.75
Denver	3.50	3.50	3 50	3.50
Seattle *delivered*	3 00	3 00	3 00	3 00
Atlanta	2 10*	2 25*	2 10*	2 25*
Cincinnati *delivered*	1.55*	2.37½	1.55*	2.08
Los Angeles		1.60*	....	1 70*
Detroit	1.90@2*	1.90*	1 90@2*	1.90*
Baltimore	1.70*	1.75*	1 60*	1 65*
Montreal	1.50*	2.00*	1.90*	2.10*
Birmingham *delivered*	3.20	3.20	3.10	3.10
Phildelphia	1 75*		1 60*	....
Pittsburgh	2 85		2.85	....
Cleveland	3.00*		3.00*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1 In.	¾-In	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1 30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1 40	1.40	2.00	1 40
East Canaan, Conn.	1.25	1.35	4.00	1 00
Easton, Catasaqua, Pa.	1 00	1 00	2.00	0 90
Birmingham, Ala.	0.75	0.75	0 75	0 25
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20		1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$16 80@$17.17	$13.10	$3.63½*	$2.75@$3.13½*
Chicago	20 00	18 00	1.50†	1.40†
St. Louis	21 20	19 00	....	17.75‡
Boston				
Dallas	25 00		....	2 50†
Cincinnati	14 80	12 30	....	10 75‡
San Francisco	22 00	16 00	....	1.75†
Minneapolis	[illegible]	22.00 (white)	1.70†	1.40†
Denver	24 00		.. .	2 70†
Detroit	18.00	16 00		17.00‡
Seattle *paper sacks*	24.00	. ..	2.80†	
Los Angeles				
Baltimore	21.00	15 75		15 00‡
Montreal	21 00	21 00	15.00‡	11.00‡
Atlanta	23.00	13 00	2.25†	1.85†
New Orleans		17 25	2 40†	
Philadelphia	15 50	14 50	13 00‡	12 00‡
Kansas City	25.60	24 00	2.34†	*2.20*†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton. -Refund of 10c per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is *$1.55*, Sheboygan *$1.45*. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2 80	$2.80
Kansas City (Ft. Scott)	1.75	1.60
Atlanta (Magnolia)	11 00 ton	11 00
Cincinnati (Utica)	1.72	1 77
Boston (Rosendale) per bag	. .	0.85@0.95
St. Louis (Carney)	*1.75*	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Nov. 2	One Month Ago	One Year Ago
New York, del. by truck	$2.60	$2.60@2.75	$2.40
New York, alongside dock to dealers	[illegible]	2 55	2 10
Jersey City	2.73	2.73	2 28
Boston			2.61
Chicago	2.20	2.20	1.97
Pittsburgh	2 24	2 24	2.02
Cleveland	2.46	2 46	2.28
Detroit	2 48	2 48	2.31
Indianapolis	2 41	2.41	2.23
Toledo	[illegible]	2 53	2.31
Milwaukee	2 37	2.37	2.19
Duluth	2 14	2.14	1 95
Peoria	[illegible]	2 41	2.14
Cedar Rapids	[illegible]	2.48	2 28
Davenport	2 43	2.43	2.22
St. Louis	2 35	2 35	2 25
San Francisco	2 71	2.71	2 84
New Orleans	3 30	3.30	2 88
Minneapolis	2.39	2.39	2 26
Denver	2 85	2.85	3.10
Seattle	2 [illegible]	2.90	3.10
Dallas	2 25	2.25	2.55
Atlanta	2 54	2 54	2 60
Cincinnati	[illegible]	2 5[illegible]	2.37
Los Angeles		3 [illegible]	3.31
Baltimore	2 90	2 90	2 88
Birmingham	2 40	2 4[illegible]	2 27
Kansas City	2.85	2 85	2 45
Montreal	2 88	2 78	3.10
Philadelphia	2 51	2 41	
St. Paul	2 3[illegible]	2 39	2 26

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

[illegible]	$1 75	[illegible]	$[illegible]
Universal, Pa.	2 00	La Salle, Ind.	[illegible]
Steelton, Minn.	1 95	[illegible], N. Y.	[illegible]
[illegible]	[illegible]	[illegible]	2 20
[illegible], Ind.	[illegible]	Hannibal, Mo.	2.10
[illegible], Kan.	2 10	Lehigh Valley District	[illegible]

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	Dallas	San Francisco
032	22	$0 85	$0 95	$0 92	$1 15	$1 20
049	28	1 08	1 23	1 18	1 46	1 55
068	35	1 31	1 48	1 43	1 80	1 89
093	45	1 69	1 91	1 84	2 30	2 43
126	57	2 08	2 35	2 27	2 86	3 00
153	68	2 48	2 81	2 71	3 40	
180	78	2 85	3 22	3 12	3 93	
245	103	3 76	4 25	4 11	5.15	
287	119	4 34	4 90	4 74	5 96	6 31
336	138	5 04	5.69	5 51	7 32	....
395	160	5.84	6 60	6.38	8 00	....
PAVING						
036P	17	$0 65	$0 72	$0 71	$0 88	....
053P	24	91	1 02	99	1 26	....
072P	31	1 15	1 29	1 26	1 57	....
097P	40	1 48	1 67	1 62	2 02	....
049R	24	91	1 02	99	1 24	....
067R	31	1 15	1 29	1 26	1 57	....
089R	40	1 48	1 67	1.62	2 02	.

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft long, or 600 sq ft

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St Louis	San Francisco	Dallas
27 Dia.	2.3	$22 00	$23 25	$20 22	$20 78	$25 50
26 "	2.5	22 00	24 75	21 64	21 43	27 58
25 "	3.0	22 00	27 25	[illegible]		30 71
24 "	3.4	24 00	29 25	26 10	24 28	33 16
22 "	4.33	27 00	33 75	31 60		35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
¾ and larger	$2 00@2.15	$2 35	$3 04	$2 80	2 75	$4 00	$3 00
⅝	2 05@2 20	2 45	3 09	2 85	2 80	4 05	3 05
½ ..	2 10@2 25	2 55	3 14	2.90	2 85	4 10	3 10
⅜ .	2 25@2 40	2 60	3 19	3 05	2 95	4 15	3 25
¼ .	2 50@2.65	2 65	3 54	3 30	3 20	4 40	3.50

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	$2 10	$2 45	$3 50	⅜	$2 35	$2 75	$3 95
⅝ in........	2 15	2 50	3 75	¼	2 60	3 00	4 20
½ ...	2 20	2 55	3 80				

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	$16 90@18.55	$18 20@20.20	$18 40	$42 00†	$50 00†
New York (at dock)	14@15.50	15@17	15 00		
Chicago	11 00	11 00	11 00	34 00	42 00
St. Louis, salmon......	14 00	14 00	17 00	30 50	34 50
Denver, salmon ..	12 00	12 00	14 00	..	. .
Dallas....	10 90	10 90	12 72	no market	
San Francisco	15 00	15 00	18 00	...	
Los Angeles (del.)....	..	15 00	15 50	(not used)	
Boston (del.)..........	.....	.....	17 00	44 00†	53 00†
Minneapolis (del.)....	18@19	18@19	17.00	.....	43 00
Kansas City..........	14 00	14 50	14 50	.	.....
Seattle..............	14 00	14 00	14 00	44 00	.
Cincinnati............	17 00	17 00	18 00	41 00	36.50
Montreal	16 00	16 00	16 00		68 00
Detroit (del.)........	16.50@17.50	16 50	17 00	36 50	39 50@41
Baltimore (del.).......	20 00	20 00	20.00	36 00‡	.. ..
Atlanta	12 00	12 00	11 00	39 00	......
New Orleans..........	15 75	15 75	14 00	.	......
Birmingham..........	12 50	12 50	11.50		......
Philadelphia..........	20@28	19@24	......	40 00	48.00
Pittsburgh (del.)......	16.00	16.00	......	.	......
Cleveland	16.00	16.00	......	.	

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡ Vitrified, f.o.b. plant, Baltimore

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current on Trucks*	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12.	$0 1230	$0.11370	$0 0808	$0 12	$0 095	$0 108	
6x12x12...	1844	15160	1112		134	156	
8x12x12...	2305	20210	.1516	1875	174	244	$0 2147
10x12x12	... .	..	1879	.	212	.....	2653
12x12x12	... .	.....	.2147		242	......	3448

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston....................	.. ..		
Minneapolis (f.o.b. cars)........	$0 08	$0 13125	$0.23
Minneapolis (delivered).......	09	14675	.245
Cincinnati....................	1093	1861	....
Kansas City..................	09	15	..
Denver......................	.065	123	.188
Seattle (delivered)	.11	.25	.36
Los Angeles factory............	....	....	....
New Orleans..................	12	.23	.36
Detroit (delivered)............	.09	.175	.260
Montreal.....................	.08	.15	.29
Baltimore....................	.14	.25	.39
Atlanta.....................	0776	.1453	......
Dallas......................	.115	.. .	......
Birmingham..................	11	18	......
Pittsburgh (del.)........ ...	.068	.128	.179
Cleveland	.08	.164	

San Francisco, Philadelphia, Atlanta, New York and Chicago quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburg and Birmingham together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh, *Mill*	Birmingham *Mill*	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in. ...	2.00@2.10	$2 40	$3.14	$4 20	$3.00	$3 02½	$3.25
Channel, 3 to 15 in. ...	2.00@2.10	2 40	3.14	4 20	3.00	3.02½	3 25
Angles, 3 to 6 in., ¼ in. thick ...	2 00@2 10	2 40	3 14	4 20	3.00	3 02½	3.25
Tees, 3 in. and larger...	2 00@2.10	2 40	3 14	4 20	3.00	3.02½	3.25
Plates	2 00@2 25	2 40	3 14	4 50	3.00	3 02½	3 40

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse: New York Current	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$3 15	$3.85	$3.70	$3.35	$3 85	$4 50	$6.00
CONE HEAD BOILER							
¾ in. and larger	3.25	3.95	3 80	3 45	3.95	4.60	6 15
⅝ and 11/16......	3.40	4.11	3 95	3 60	3 95	4 75	6 30
½ and 9/16..... ..	3.65	4.35	4 20	3 85	3 95	5.00	6.55

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire...... .	$2.70	$3 10	$4 00	$5 00	$3.60	$4 95
Cut........	3.00	5 50	5.65	7 75	6.00	5 00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square, f.o.b., as follows:

	New York: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.
No. 1 grade..	$2 10	$2 55	$3.00	$1 90	$2 35	$2 80
No. 2 grade...	1.85	2.15	2.55	1 70	2 00	2.40

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.50 per package (sufficient to cover 50 sq ft) in carloads; $5 75 in smaller quantities, in Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia. l.c.l., $5.90

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft...........	$2 00
Tar pitch (in 400 lb bbl), per 100 lb	1 65
Asphalt roofing (in barrels), per ton, f.o.b. plant*.....................	40.50
Asphalt felt (light), per ton, f.o.b. plant*..........................	64.50
Asphalt felt (heavy), per ton, f.o.b. plant*..........................	68.50

* Delivered in Metropolitan Dist., $3,00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10...........	$2 50@$2.85	4.10	$4 00	$4.35	$4 19
No. 12...........	2.60@2 95	4.15	4.05	4.40	4 24
No. 14...........	2 70@3 00	4.20	4.10	4 45	4 29
No. 16...........	2.90@3.30	4.30	4.20	4.55	4.39
Black					
*Nos. 18 and 20...	3.20@3 60	4.65	4.70	5 70	4 70
*Nos. 22 and 24...	3.25@3 65	4.70	4 70	5 75	4 75
*No. 26..........	3 30@3 70	4.75	4 75	5 80	4 80
*No. 28..........	3.35@3.75	4.85	4.85	5.90	4.90
Galvanized					
No. 10...........	3.35@3 85	4.85	4 85	....	4.90
No. 12...........	3.45@3 95	4.95	4 95	5.85	5 00
No. 14...........	3 45@3 95	4.95	4 95	5 85	5.00
Nos. 17 to 21.....	3.75@4 25	5.10	...	6 15	5.30
Nos. 22 and 24....	3 90@4 40	5.40	5 40	6 30	5.45
*Nos. 25 and 26...	4.05@4 55	5.55	5 55	6 45	5.60
*No. 28..........	4.35@4 85	5.85	5 95	6 75	5.90

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Current	One Year Ago	Chicago: Current	One Year Ago
Raw in barrel (5 bbl. lots).	$0 93	$0 72	$0 94	$0.72

WHITE AND RED LEAD [illegible]

	Red				White	
	Current		1 Year Ago		Current	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	12 75	14 25	12 25	13.75	12 75	12 25
25 and 50-lb. kegs	13 00	14 [illegible]	12 [illegible]	14 00	13 00	12 50
12½-lb. keg	13 25	14 75	12 75	14 25	13 25	12 75
5-lb. cans	15 75	17 25	15 25	16 75	15 75	15 25
1-lb. cans	17 75	19 25	17 25	18 75	17 75	17 25

LUMBER

Prices wholesale, per M. ft. b.m., [illegible]

San Francisco—Price of rough Douglas [illegible], in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$30 00	$33 00	$33 00	$35 00
3x6 and 8	30 00	33 00	33 00	36 00
4x4-6 and 8	30 00	33 00	34 00	37 00
3x10 and 12	30 00	35 00	34 00	38 00
3x14	34 00	35 00	36 00	38 00
4x10 and 12	30 00	33 00	34 00	37 00
4x14	34 00	35 00	36 00	38 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$32 00	$35.00	$37 00
6x14	34 00	37 00	39 00
8x10	32 00	35 00	37 00
8x14	34 00	37.00	39 00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine:

	New York		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22-24 Ft.
3x 4 to 8x8	$47 00	$48 00	$45 00	$47 00
3x10 to 10x10	50 00	51 00	48 00	50 00
3x12 to 12x12	54 00	55 00	51 00	53 00
3x14 to 14x14	60 00	61 00	56 00	58 00
3x16 to 16x16	67 00	68 00	60 00	62 00
3x18 to 18x18	80 00	81 00	67 00	69 00
4x20 to 20x20	90 00	91 00	77 00	79.00

*Wholesale price to dealers, to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston						
Seattle		$24 50	......	......	......	$24.50
New Orleans	$30 00		.....	....	$35 00	
Baltimore	58 00	......	......	......	70 00	.....
Cincinnati	40 00				45 00	
Montreal	50.00	50.00	$35.00	$38.00	78 00	50.00
Los Angeles						
Denver	.....	38 75	38 75	38 75		39 75
Minneapolis	47 00	39 75	[illegible]		50 00	39 75
Atlanta	37 00	.....	.....	.....	42 00	.....
Dallas	45 00				45 00	
Kansas City	47 00	47 00	47 00	49 50	49 50	
Birmingham	28 00	.....	.....	.....	36.00	.....
Philadelphia	40 00	38 08	45.00	50.00	48 50	40 00
Detroit	44 75	46 75			53 75	46 75
St. Louis	44 00				51 00	

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston					
Seattle	.....	$20 00	.....	.....	$23 50
New Orleans, at mill	$70 00	.....	.....	$37 00	
Baltimore	40 00	.....	.....	40 00	
Cincinnati	65 00	80 00	.....	37 50	.....
Montreal	66 00	45 00	$27 00	45 00	45 00
Los Angeles					
Denver		[illegible]	[illegible]		33 25
Minneapolis	48 50	[illegible]	[illegible]	43 75	[illegible]
Atlanta	24 00			28 00	
Dallas	37 50	36 00		48 60	
Kansas City	44 50	40 50	39 25	43 75	40 00
Birmingham	24 00			30 00	
Philadelphia	33 00	38 50	45.00	35 00	38 00
Detroit	47 50	39 50		45 00	[illegible]
St. Louis	75 00		....	50 00	

Montreal—Up to 32 ft.; over which, $3.00 per M. ft. increase up to 30 ft.
Birmingham—Quotes carload lots [illegible]. $7 [illegible] additional per M. ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers prices to contractors on large projects.
St. Louis—Wholesale price to contractors, $7–$11 per M. ft. additional.
Seattle—[illegible] to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M. ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.

Baltimore	$0 [illegible]	Detroit	$0 295
Birmingham	69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	265	New York	34
Chicago	.34	Pacific Coast (all rail)	1.50†
Cincinnati	.295	Philadelphia	.325
Cleveland	.215	St. Louis	.43
Denver	1.275*	St. Paul	.595

*Minimum carload, 40,000 lb.
†Minimum carload, 50,000 lb., structural steel only; 80,000 lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2 50	$2 50	$1 80@1 90

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	25%
Patent flattened strand, special and cast steel	25%
Patent flattened strand, iron rope	10%
Plow steel round strand rope	40%
Special steel round strand rope	35%
Cast steel round strand rope	27½%
Round strand iron and iron tiller	10%
Galvanized steel rigging and guy rope	12½%
Galvanized iron rigging and guy rope	+7½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾ in. the price is ½ to 2c extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¾-in., 8 ft.; ⅞-in., 6; 1-in., 4½; 1¼ in., 3½; 1½-in., 2 ft. 10 in.; 1¾-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coil:

Boston		New Orleans	$0 17½
New York	$0 17	Los Angeles	..
Chicago	.19	Seattle	.18
Minneapolis	20	St. Louis	.17½
San Francisco	15	Montreal	30
Atlanta	20	Detroit	.19
Denver	20	Baltimore	.17
Cincinnati	19	Kansas City	.19½
Dallas	.29	Birmingham	.20
Philadelphia	.18		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0 27	$0.30
Boston		
Kansas City	.2225	.2525
Seattle	.165	.195
Chicago	.245	.275
Minneapolis	.189	.209½
St. Louis	.22	.24
Denver	.2025	.2325
Dallas	.29	.375
Los Angeles		
Atlanta	.2525	.2825
Baltimore	.195	.225
Cincinnati	.23	.25
Montreal	.195	.235
Birmingham, delivered	19	21
New Orleans	235	265
San Francisco	195	235
Philadelphia	2475	28

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt		30 to 50 ft.	$0. 13	$0. 17
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0. 17½	0. 22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0. 19½	0 24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0. 23	0. 32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0. 25	0. 34
14 in.—2 ft. from butt	6 in.	80 to 89 ft.	0. 32	0 38

SCRAP—The prices following are [illegible] paid to dealers and producers f.o.b. New York, [illegible] per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$14 50	$11 50	$16 00
Stove plate	13 50	12 00	15 50
No. 1 machinery cast	18 00	16 50	[illegible]
Machine shop turnings	9 00	4 00	10 00
Cast borings	12 00	5 50	10.50
Railroad malleable cast	15 00	12 50	19 00
Re-rolling rails	16 00	13 00	19 50
Relaying rails	28.50	30 00	23@32

SHIP SPIKES—Current prices per 100 lb.:

	San Francisco		Seattle
In.	Galv.	Black	Black
¼	$6 75	$5 50	$8 55
⅜	[illegible]	5 05	8 25
½	[illegible]	4 90	8 30

Pittsburgh base in lots of 200 kegs or more $3 25@3 75

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren
Editor

Volume 89 — NEW YORK, NOVEMBER 9, 1922 — Number 19

A Rapid Transit Railroad

RAILROADS entering our biggest cities are more and more taking on, so far as their passenger service is concerned, the characteristics of the urban rapid transit lines. Around New York notably, but with increasing degree at Chicago, Philadelphia, and Boston, the suburban railroad is becoming a rapid transit railroad; that is, it runs on a separate level from the street, has closely spaced stations with express and local services, and is or should be operated by electricity. So far the Lackawanna's New Jersey division, described on another page of this issue, has not been electrified, but with that exception it is a model of modern suburban railway development. Slowly, because of the war, the opposition of some of the cities through which it passes and the difficulties of construction in a narrow right-of-way carrying a train a minute several hours each day, the road has gone ahead with this regrade until now there is in sight an express and local line without a grade crossing through 35 miles of its length. The structures, some of them of unique design, are permanent and artistic, the stations are convenient and pleasing to view, the traffic has been maintained at fair effectiveness under conditions of congestion almost insurmountable, all of which testifies to high quality of engineering, and the whole improvement shows to what expense a railroad can go to get and to hold a purely passenger traffic which pays a low rate per ride, but which is continual and of uniform distribution through the year.

Are Highways "Located"?

IN A letter published elsewhere in this issue R. S. Blinn raises two questions: Is railroad locating a lost art? Does highway engineering suffer from the lack of engineers trained in railroad location? Mr. Blinn answers both of these in the affirmative; the first with a qualifying "in the main," and the second without qualification. Unquestionably the meager railroad construction of recent years has offered small opportunity in this country to raise up new locating engineers in the place of those who have passed on. But doubtless there are some; and it would be interesting to learn how many of them, like Mr. Blinn, are now in highway work. If location training is so important in highway practice as he asserts, these men should be in a fair way to keep their hands in and thereby preserve the art. But here arises the second question, to which it would be worth while to have an answer from the highway engineer. Just how great is the need in highway engineering for locating skill? What share of our highways can be located as a railroad would be, and what share must stick closely to existing roads? To what extent is the location, even of new highways, controlled by conditions outside the domain of engineering science? And even though there may be room for a science or an art of highway location, to what extent would this agree with railroad practice, and to what extent must wholly new or modified principles be developed? Everyone knows that in highway *construction* many lessons are to be learned from railroad practice. Cross-sections, drainage and earthwork all involve similar principles and to some extent similar practice in both; but the question now before the house concerns *location.* What can the "old-time locaters" and the "newly-born highway engineers" contribute on that score?

Motor Killings and the Engineer

IN the year 1921, the Bureau of the Census announces, 10,168 deaths from accidents caused by four-wheeled motor vehicles occurred within the registration area of the United States, which contains about 82 per cent of the population. This is a death rate of 11.5 per 100,000, an increase of 28 per cent over 1917. Further than that, the increase in rate is itself increasing from year to year, and the rate in the sixty-five largest cities averages about 15 per 100,000. These are alarming statistics. Couple with them the statement just made by Chief Magistrate McAdoo of New York City, that before long all of Manhattan below 14th St. will have to be one-way streets barred to pleasure vehicles, and that there are 2,000 unprotected crossings in the city where policemen are needed, and the seriousness of the motor traffic problem will be realized. Part of the trouble is due to the laxity of the driver license requirements, part to the carelesssness of drivers and their common assumption of superior right-of-way over the pedestrian at crossings, but mostly it is the inevitable result of an increase of motor use far beyond the capacity of a city street system laid out for slow moving traffic in small volume. There is little chance of this motor use decreasing or even of remaining stable. Driver and traffic regulations can only remove a part of the difficulty. The obvious solution, then, lies only in a radical revision of our conception of what a city street is for, and this reduces to a problem for the engineer. Motor boulevards, second-story streets, under or over crossings for pedestrians, all are probabilities of the near future in our congested centers and engineers responsible for our city developments must take account of such things as actualities and not as dreams.

Doubtful Distinction

ONE item in the census statistics of motor deaths stands out as a confirmation in figures of what any one may observe in person. It is the common opinion of all visitors to Los Angeles that that busy city is the worst congested in America, and that there is an unsurpassed disregard there of the accepted rules of traffic. Residents of the city rather resent this criticism; they possibly consider the cause of it only another evidence of the live qualities of the town.

What reckless driving in crowded streets means they may see when they read that in Los Angeles in 1921 the death rate from automobiles per 100,000 was 27.9; in 1920, 27.1, and in 1919, 24.1, as against an average in 1921 of 11.5 for the United States, 20.3 in Chicago, 18.8 in Manhattan, and about 15 for an average of all the large cities. Los Angeles has the doubtful distinction of killing more of its citizens and visitors with automobiles than any other city in the country. A walk or ride through its streets would lead one to expect just this, but now the figures are here to confirm it possibly the city authorities will take some drastic action to supplement the efforts the city engineer is taking to guide traffic on to safer routes.

A New Point of View

A DISTINCT step forward has been made in the study of fire prevention in wooden bridge floors which is reported in this issue. It represents a further element in the steady fight to wipe out our all-too-great fire waste. And, what is perhaps more important, it tends in the direction of improving bridge design and maintenance—the latter a much neglected subject. The subject of bridge fire prevention may appear strange; but the facts show quite clearly that a real fire danger exists, and that it is growing. If we read between the lines of the report we may judge that the danger exists for no better reason than that we have shut our eyes to it hitherto. It can be eliminated by proper care, and the committee outlines how this care is to be applied. The danger does not arise from the use of wood, but from the unskillful use of wood and from careless maintenance. In the same sense, the wooden dwelling house and the timber-frame mill building are not inherently dangerous but may be made dangerous by faulty construction and neglect. Insurance records prove that the wooden mill building is one of the safest types of structure in the world, by virtue of the fact that the points in which it formerly was dangerous were searched out by patient study. The wooden dwelling house has been made safe by the same kind of study, and we have great faith that with further development of the process it will ultimately be made fully as safe as the brick, concrete, or steel-frame house. In both cases the results are due to the point of view—to the recognition of the danger, primarily, with resulting study of how to eliminate it. Similarly the present committee report represents a new point of view of the subject of bridge floor construction. The same assurance of success attends it.

Commercial Flight

ALTHOUGH the flight of Lieutenants Macready and Kelly from San Diego to Indianapolis—more than 2,100 miles in about twenty-six hours—is a noteworthy achievement in long distance non-stop flying, it is scarcely so material a contribution toward commercial flight as was the recent demonstration at Detroit that a speed of more than 200 miles per hour is attainable. Until night flying is more practicable than it now is, we must be able to maintain a speed that will take us from New York to Chicago in a few hours and to San Francisco in not more than fifteen hours of continuous flying. Such an achievement will enable us to realize a saving in daylight time sufficient to create a demand for the service despite its high cost.

Study of Typhoid Causes Needed

ALLOCATION by causes of the steady fall in the typhoid death rate deserves searching study. This is more than a matter of giving credit where credit is due. More exact knowledge is needed for the wise direction of future work.

To what extent is typhoid reduction due to safer water supplies, to better raw milk and milk pasteurization, to the sanitary control of other drinks and foods, to anti-typhoid inoculation, to contact prevention, including the supervision of typhoid carriers, to more and better medical and nursing care of typhoid patients, to a possible increase in general health and thus in resistance to infection, and to increased appreciation by the people of the dangers of contracting typhoid and how typhoid may be avoided? A great reduction of foci of infection—infectious persons and infected and therefore possibly infectious things, such as water, milk, foods, utensils—deserves attention, particularly the immense reduction in the typhoid case rate and in associated contact risks and in the number of dangerous water supplies—such heavy and constant typhoid breeders as for years were the water supplies of Chicago, Pittsburgh, Philadelphia and many other cities.

By the aid of semi-log paper for plotting curves—a method deserving wider use—Professor Whipple shows, elsewhere in this issue, two marked decline periods and an apparent third one in the typhoid death rate, besides minor drops. The major declines he associates with (1) water filtration, beginning about 1890 and (2) dating from about 1910, milk control and pasteurization and water chlorination. Professor Whipple suggests that the sanitary engineer has claimed too much credit for the second marked stage of typhoid reduction, that of the last decade.

Intensive-extensive study of the decline of typhoid, with the full co-operation of water and health officials in individual cities seems to be needed before the decline can be sufficiently well allocated by causes to give proper credit for the notable achievements of the past or to guide the endeavors and expenditures of the future. Agreement on water fiiltration, the sanitary protection of water supplies and the adoption of improved sources of supply as the cause of the heavy typhoid decline from 1890 to 1910 seems to be general. Other causes contributed largely—doubtless relatively more largely since 1910—owing in large part to the fact that by 1910 many communities had so improved their water supplies as to leave little typhoid but what was once classed as residual.

A country-wide canvas would probably show that new filtration plants and changes to less polluted sources of supply have continued to be large factors in the reduction of typhoid in the past decade, and that a new factor, chlorination, has played a notable part. Milk control and pasteurization, while having advanced rapidly and while being of great value as health-protective measures, need to be studied carefully to find (1) their quantitative and qualitative values and (2) their reaction upon typhoid. Our impression is that whereas an improved water supply generally benefits the entire or at least a major part of the population of a city, the benefits of a new milk ordinance or a new system of milk inspection come slowly, and that pasteurization is rarely applied to the entire milk supply of a city, or even the worst portion of it, within a single year, and

in whatever degree applied is less certain in efficiency than water filtration and perhaps less efficient than water chlorination. Back of this, however, is the question, what part of the typhoid rate of a city, under various conditions, is due to the milk supply? Are there any data on the subject? Typhoid outbreaks, due to milk, are, or once were, numerous, but did even these often materially increase the average typhoid rate for five or ten years? And had not mild outbreaks of typhoid become rare by 1910, especially in the larger cities?

The water-works engineer and superintendent need to know at what point short of a zero typhoid death rate they may stop in advising capital and operating expenditure designed to lower that part of the typhoid death or case rate attributed to public water supplies. The health officer needs to know whether and if so where he may wisely direct his energies to further typhoid reduction. City governments, taxpayers and the whole citizenship need the same information for their guidance in voting money for water-supply improvements and for refinements in water-works operation, as well as in making appropriations for health-protective work along other lines.

Who should undertake the typhoid studies we have suggested? Professor Whipple has made a start that suggests the direction if not the distance such a study should go. The work might be carried further at Harvard, and at other well-equipped schools of sanitary engineering and public health, with co-operation by city and state health departments, the United States Public Health Service and the Vital Statistics Division of the Bureau of the Census. State and local co-operation are essential in securing data as to the dates when various improvements affecting typhoid were made and particularly the quantitative and qualitative degrees of the improvements and the percentages of the population benefited in each case.

Overworking a Willing Horse

ONE of the most encouraging signs of the development of the engineering profession is its growing sense of obligation to the community, but as the public becomes accustomed to this willingness on the part of the engineer to help there seems to be growing also a tendency to abuse it. Particularly is this to be observed on the part of state or municipal authorities, who have before them in the regular routine of their duty many problems of an engineering nature to be solved. When these are obviously specific, such things as the design of a sewer system or the building of a bridge, things that every one knows to be part of the engineer's daily job, they hire or retain an engineer for them and pay him as being worthy of his hire. But every so often they have to decide on questions which have only an engineering tinge or which, in their ignorance of the broad scope of modern engineering, they consider to be in quite another field. At such times they are apt to fall back on the "citizens' committee" and appoint thereto engineers on whose shoulders falls all the gratuitous work to be done.

Two such cases have just come to notice. In one state several engineers have been asked to serve on a building code committee made up otherwise of men quite unfitted to give more than perfunctory aid to the technical job of formulating a building code. If this committee succeeds in writing a satisfactory code it will be because the engineers have put in, without compensation, their time and the professional services which are their livelihood. But they will be classed along with the passive members of the committee and will take their reward in such honor as they can find in being named along with vaudeville managers and state labor department employees.

In another state a board composed entirely of laymen and with no technical staff is investigating drainage and backwater problems. In an effort to make some progress in its study the board sent letters to a number of engineers detailing the problem and asking specific advice. The board is now complaining because this questionnaire method has brought only evasive and indefinite replies, not recognizing that engineers rarely have sufficient income to permit much unrewarded professional service and second that no engineer can give a satisfactory opinion without study of facts.

What is the complaint in both these instances? It is not that the engineer is unwilling to bear an equal burden with his fellow citizens in this business of government, nor that he is unwilling to give freely of the fruits of his engineering experience in illuminating the dark corners of subjects outside the strict field of engineering. He does believe, however, that he should not be asked by the state to give that by which he makes a living any more than the butcher should be asked to give beef to public hospitals or a contractor to lay for nothing a stretch of city pavement. Individually he may want to offer his services gratis just as the butcher may want to send meat to the hospital but the former should be considered charity just as surely as the latter is so considered. It should not be a form of public service taken as a matter of course.

Such an attitude on the part of the individual engineer need not interfere with the desirable public activities of the engineering society in the study of public problems nor with the engineer's personal activities in the broader phases of public life. Much good can come both to the profession and to the community by such reports as the New Orleans engineers have just made on the Mississippi flood situation and those made by Washington chapter of the A. A. E. on the Knickerbocker failure. Those reports informed the public on important engineering situations with the authority that group action gives and in a way that would probably not have resulted from retained engineers. So also the various engineers whose brief biographies have graced our "Engineer in Public Life" column these past months are doing work which honors themselves and their profession.

The situation, then, reduces to this. Engineers believe that their habit of work and of thought and the materials with which they work entitle them to a certain respect in matters of public interest. They believe that the business of government would be helped by the consideration of views which they may have to advance on certain of its specific phases. They are anxious that their fellow citizens have the benefit of those views. They are willing freely to contribute of their time and services to the study and promotion of such activities as can not be carried on by an engineer engaged in the pursuit of his profession. For professional activities, however, they resent the solicitation of free service as unbecoming the state and unfair to the profession of engineering.

Lackawanna Continues Grade Crossing Elimination

Suburban Tracks Elevated Through East Orange, N. J.—Depression vs. Elevation Compared—Flat-Slab Elevated Structure Developed—Diverted Line Carries Traffic—Station Layout Described

TRACK elevation while continuing a heavy suburban traffic is being successfully accomplished at East Orange, N. J., by the Delaware, Lackawanna & Western R.R., by diverting the old line largely to an adjacent parallel right-of-way partly purchased and partly borrowed from city streets. With the restoration of traffic to the old alignment on the new elevated structure the right-of-way now temporarily occupied will be restored to the city in the shape of improved and partly new streets. It is in the general plan of street pre-emption, improvement and restoration that the East Orange grade elimination has interest as a construction operation. The plants for and the methods of fabricating the elevated structure are not out of the ordinary.


FIG. 1—LOOKING EAST ALONG THE MAIN ST. ELEVATION AT EAST ORANGE

The line under reconstruction is on the Morris & Essex branch of the railroad, one of the most heavily traveled of the suburban lines outside of New York. Some twenty years ago this line was depressed and three-tracked through Newark and in 1911 a start was made on the removal of grade crossings and incidental thereto the addition of a third track from the end of the Roseville cut at Newark to Mount Tabor, 27 miles beyond. The western end of this work including third tracking from Millburn east through Orange was completed as an elevation just before the beginning of the war but the extension through East Orange was held up partly by the war and partly by the inability of the railroad and the city to agree on the type of grade elimination. The railroad, for reasons noted below, held out for a continuation of the elevation; the city demanded depression. Finally, however, the city accepted the railroad viewpoint and the work now nearing completion was started.

When completed the railroad will have a three-track line—with the exception of two double-track drawbridges over the Hackensack and Passaic Rivers—from Hoboken to Millburn (17 mi.) and will have completely cleared of grade crossings both the main line as far as Mt. Tabor and the Montclair branch.

As shown in the map and profile, the new main line rises out of the Newark cut—a depression 60 ft. wide between concrete retaining walls—on a grade of 1.5 per cent, and continues with a maximum grade of 1.5 per cent to the connection with the Orange elevation, the maximum elevation of the new grade above the old being around 30 ft. In the revision are three new stations; that at Grove St., where the grade is only 10 ft. above the old, being made by raising the old station and the ones at East Orange (Main St.) and at Brick Church being new structures.

In respect to design, the grade crossing elimination assumed somewhat complex characteristics. Besides the necessity of changing a double track to three tracks and devising a station-platform arrangement which would care for a reversal each day in the direction of the loaded-train traffic and for one track of the three to return the empty trains from the two loaded-train tracks, there were required a number of unusual structures. Such in particular were the steel bridge on a 65 deg. skew at Main St., the construction of

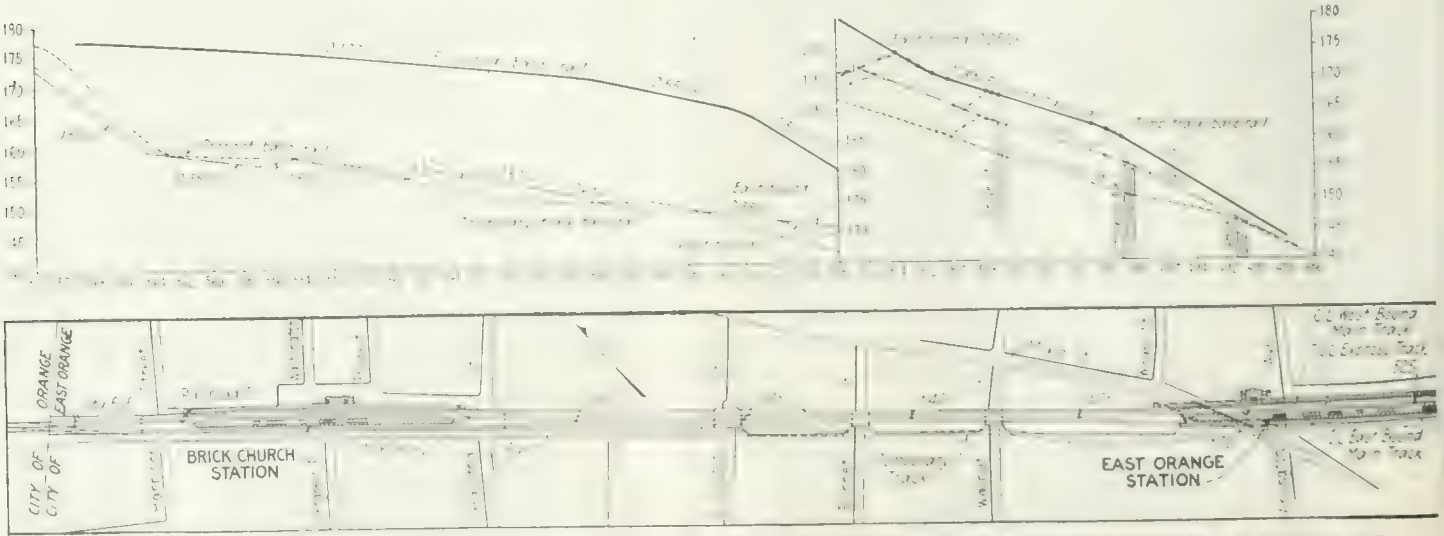


FIG. 2—PROFILE AND WEST END OF EAST ORANGE ELEVATION OF DELAWARE, LACKAWANNA & WESTERN R R

an 11-ft. concrete superstructure on an existing three-span stone arch at the Parkway and, finally, a most extensive use of flat-slab concrete structure for elevated station tracks and adjacent street crossings. The detailed design of some of the structures will be described in later articles.

Preceding all was the important question whether the elimination of grade crossings should take the form of track depression or track elevation, with respect to the streets.

FIG. 3—AT MAIN ST., ON THE EAST ORANGE ELEVATION LOOKING WEST TOWARD THE ORANGE MOUNTAIN
Main St. crossing from left to right under steel girders carrying new elevated line.
Temporary track running at left on streets and purchased land.

Elevation vs. Depression—As indicated, track elevation was decided upon, the reasoning, epitomized, being as follows: Street grades and locations are more disturbed and there are more alterations in sewers, watermains and street underground structures generally when depression is adopted. A depressed track is more likely to be obstructed by articles thrown or fallen over the edges; it is a catch-all for litter and so more difficult to keep clean; its drainage is apt to be complicated. The light is poorer and the ventilation is not so good. Crossing bridges must have a 22-ft. clearance compared with 14-ft. clearance required for streets under elevated tracks. City bridges across tracks are as a rule poorly maintained and an element of danger; with streets close together, signaling is more difficult; industrial sidings ascend from the main track level and introduce the danger of cars on the siding breaking away and coasting down onto the main track.

With all these objections avoided, largely, by elevation the fundamental reason for its adoption was the lower cost and the better service to passengers. While the physical task of handling passengers can be accomplished quite as well perhaps from depressed tracks the requirements of light, ventilation, and vision are better satisfied by an elevated line. The passenger feels more free if he can "look out of the window" and in developing suburban traffic the satisfaction of this feeling has

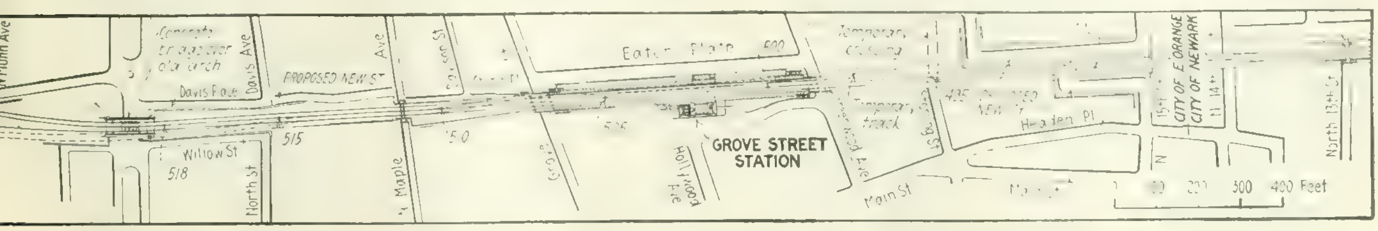
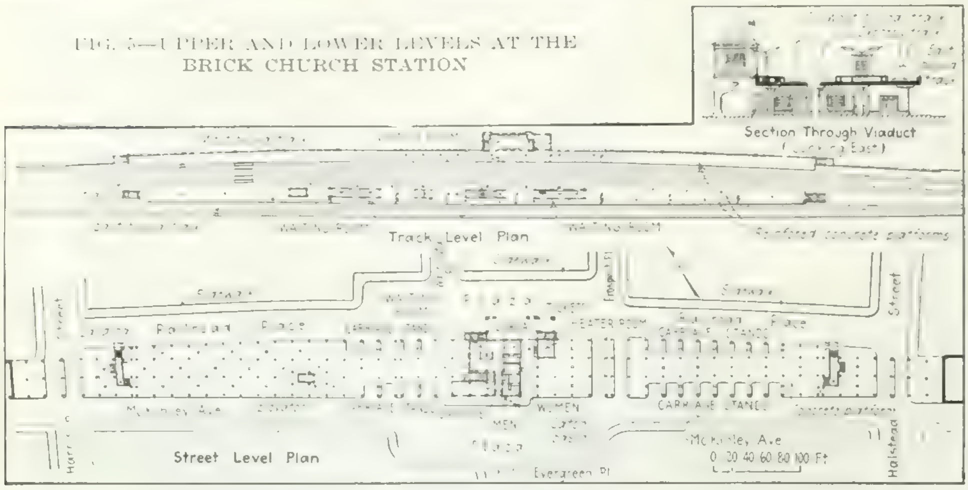


FIG. 4—EAST END OF EAST ORANGE ELEVATION OF DELAWARE, LACKAWANNA & WESTERN R R

FIG. 5—UPPER AND LOWER LEVELS AT THE BRICK CHURCH STATION



been found to be a factor worth consideration. It is also a business advantage to the town to have its streets and structures and its business signs and activities visible to passing travelers.

However, the decisive reason against track depression was its greater cost and the fact that future enlargement would be more difficult. By elevation, somewhat steeper grades were required, but with a traffic largely of suburban passenger trains, this was not a serious drawback. As the plans worked out no grades exceeding 1½ per cent had to be employed. As electrification is contemplated at some early date—provisions being made therefor in the new structures—this grade was acceptable.

Outline of Structure—From the Newark line through East Orange to the Orange line there are 1½ miles of grade crossing elimination. Except at crossings over streets and at stations, the elevated structure is embankment or fill between retaining walls some of which ran 30 ft. high. The view, Fig. 7, shows a typical parallel wall structure for a fill and Fig. 10 shows typical wall sections. All walls are capped with a parapet and railing of either the concrete post and slab panel type doweled by projecting rods to the wall top, or of the steel angle and picket type, with posts securely anchored to the wall top. Both the wall design and the methods of constructing the walls were entirely ordinary.

Two of the street crossings called for special structures, one the skew bridge at Main St., and the other the masonry arch elevation at the Parkway. Ordinarily the street crossings are beam and girder structures on abutments and piers or flat slabs on columns. Structurally the flat-slab, reinforced-concrete elevated structure is the uncommon item. There are nearly 1,700 ft. of structure of this type at the two principal stations and adjacent street crossings.

At the Parkway crossing the original structure was a three-arch stone bridge. With the rather flat arches it seemed doubtful wisdom to raise the parapet walls and deepen the fill and thus greatly increase the load on the rings. To meet this condition and the obvious necessity of a presentable appearance, a concrete pier-and-girder superstructure, with a cloistered arch façade was built across the old masonry bridge.

The crossing at Main St., Fig. 1, was a steel bridge problem. It is on a skew of 65 deg. and the street carried double street railway tracks and a heavy vehicular traffic. The main girders and floorbeams are carried on three lines of pier columns and the floor is a system of I-beams carried by the girders and piers. A very thin and economical floor was thus secured.

On the Main St. bridge and extending east from it are the platforms and other structures of the East Orange station. At the Brick Church station farther west a similar elevated structure of a flat slab on columns is employed. Fig. 8 shows the Brick Church station platform in various stages of construction. Round columns, with the reinforcement and the caps mushroomed out into the slab, are used at both stations and neither in form or design is there anything which is unusual to structures of this type. At Main St. the elevated structure averages about 75 ft. wide and is 850 ft. long, and at Brick Church the structure is about 1,065x75 ft. The columns are spaced about 20 ft. on centers. For these situations, elevated passenger stations, the flat-slab, reinforced-concrete structure was found to offer the combined advantages of economy and good appearance and usable room underneath for parking vehicles and for merchandising and storage.

At street crossings the columned structure gives particularly good visibility for motor car traffic. In the East Orange elevated structure generally, even where it is a fill between walls running square up to the crossing streets, attention was carefully given to get clear vision both in approaching and in emerging from under-track street crossings. The use of columns helped in this object as also did beveling off the corners where retaining walls and abutments met.

FIG. 7—LOOKING EAST ALONG THE ELEVATION AT WESTERN END OF WORK
Temporary tracks leave main right-of-way to the right

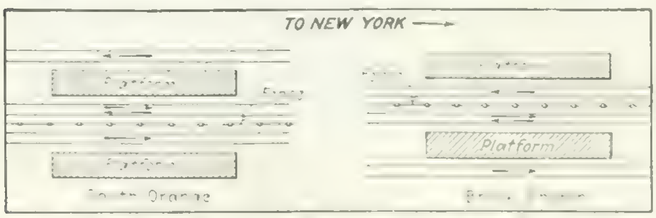


FIG. 6—COMPARATIVE PLATFORM LAYOUTS AT SOUTH ORANGE AND BRICK CHURCH

Stations and Track Layout—In accordance with the practice of the Lackawanna the stations are exceptionally pleasing in appearance and convenient in layout. The Brick Church station, shown in plan in Fig. 5, illustrates the layout. Here the elevated structure is a flat slab 1,065 ft. long on columns spaced approximately 22 ft. c. to c. On either side of this for its full length runs a marginal street which widens out into a small plaza opposite the station entrance. In the middle of the structure is located the station proper, with the baggage, waiting, ticket, etc., rooms at the street grade beneath the track slab and with waiting rooms and umbrella sheds on the two platforms above. Extending out from the station at the street grade are paved platforms for indented carriage stands, one through passageway and, on one side, space which may well be utilized for store purposes.

At Main St., the general idea of the plan is the same, but is modified because of variation in street conditions, particularly because of the sharp skew with which Main St. crosses the railroad right-of-way. Grove St. is a local station with no approach to the center track.

FIG. 8—STAGES OF CONSTRUCTION AT THE BRICK CHURCH FLAT-SLAB STRUCTURE

Track layout at the stations was designed best to accommodate the commuting traffic which moves toward New York in large numbers in the morning and from New York at night. Exigencies of schedule require that trains move variously on the right outside or the center track, though of course as a rule local trains use the outside tracks and express trains the center. The layout at Brick Church, followed also at Main St., is designed for stations which handle both express and local traffic. As is noted in Fig. 6, New York bound platform is between the express and east bound tracks so that the morning commuter knows that his train, no matter which track it is running on, may be reached from this platform. The home-coming commuter, however, may be discharged on either platform.

At South Orange, in the earlier elevation, a different layout is used, as shown also in Fig. 6. Here the governing idea was to provide easy transfer from outbound local to express trains, South Orange being the end of the local division for many of the evening trains as scheduled.

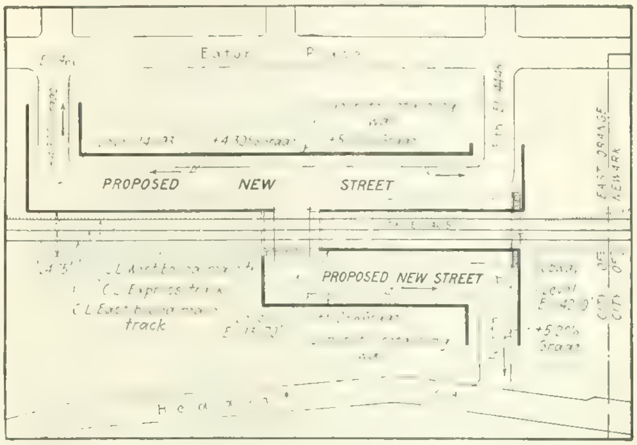


FIG. 9—SPLIT UNDERCROSSING AT N. 15TH ST.

Street Changes and Additions—Except in changing the grades of streets in dipping under the elevated structure, street changes and additions were planned largely either to provide for temporary tracks to carry traffic during construction or to eliminate crossings as at N. 15th St. (Fig. 9). Here where the line begins to rise onto elevated structure from the Newark cut, railway grade is only about 5 ft. above street grade and it required too great a dip in the street to pass it under the tracks. The new street arrangement illustrated was adopted. It will be noted that the footwalk is carried under the tracks on the line of the street but that the roadway approaching from the south turns west and runs parallel to the track until clearance can be provided, when it dips under the tracks and comes out on the north side to split into two roadways running east and west to the nearest cross-street.

Ordinarily parallel streets could be taken over for the temporary tracks, as shown in the view in Fig. 7, but in other stretches of the work right-of-way had to be bought. By swinging the temporary tracks clear of the old right-of-way for most of the length of the elevation a clear site was left for the new construction, although in places side clearance was so small that the new structure had to be built for two tracks only and these tracks put in service first.

Construction was divided into three sections each with its separate contractor. The contractors are: F. M. Talbott Co., Hyde-McFarlin-Burke Co., and H. F. Curtis, Inc., all of New York, N. Y. George J. Ray is chief engineer and O. H. Kellog is engineer in charge, Delaware, Lackawanna & Western R.R.

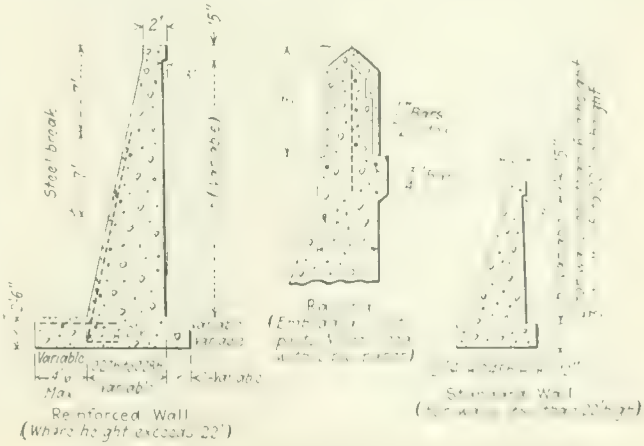


FIG. 10—TYPICAL RETAINING WALL SECTIONS

British Vehicle Tax Change Under Consideration

Proposed Return from Road Tax to Petrol Tax Is Receiving Much Support in Answer to Questionnaire

(London Correspondence)

AGITATION in Britain for a return from the road tax on vehicles to the petrol tax is based chiefly on the unfairness of the tax of £1 per horse power on vehicles fitted with pneumatic tires. The agitators in favor of the return have emphasized that pneumatic tires do practically no damage to well-made roads and have quoted with effect the evidence available both from tests carried out in the United States by the Bureau of Public Roads, and also by tests carried out in France under the direction of the Ministry of Public Works. These tests show that pneumatic tire deflections are proportional to the load applied and that the cushioning properties are retained at the end of a blow. Solid tires show an increased density of rubber and unit intensity of loading under increasing weights, and cushioning is decreased accordingly The curve of rear wheel impact relative to speed shows a rapid increase with a solid rubber tire and practically no increase in the case of the pneumatic tire.

In response to this agitation the Automobile Association and Motor Union, the all-powerful body in Britain, sent a questionnaire to its members with a view to ascertaining to what extent the desire for a return to the petrol tax was general The result of this questionnaire indicated that less than 1 per cent were opposed to a return. (The membership of the A. A. and M. U. is now about 160,000.)

Transport Ministry to Act—Various interested bodies are meeting in endeavors to arrive at a common policy in view of the inquiry to be made by the Ministry of Transport into the whole question of vehicle taxation. Among the matters on which a common policy has yet to be formulated are the appointments of the total burden of taxation as between privately-owned passenger vehicles and utility and public vehicles of various sorts. A point still requiring solution is: With the increasing burden on motorists owing to heavy taxes, cannot more revenue be brought in by adopting a policy which will insure an increase in the number of motor vehicles to be used by reducing the scale of taxes per vehicle?

Various alternative schemes of vehicle taxation are being investigated by the Ministry of Transport, and the most important of these is the one submitted by E. L. Leeming, Council Surveyor of Barton. The objects of this scheme are threefold:

(1) To retain as far as possible the present methods of licensing and registration, and not to exceed the cost of collecting, which is estimated at £350,000.

(2) To endeavor as far as possible to tax vehicles more nearly in accordance with the relative damage caused to the road surface by the various types.

(3) To apply, if practicable, a small petrol tax which will operate in the direction of taxing vehicles according to mileage on the one hand and weight and horsepower on the other.

Elements of Plan—This scheme, therefore, provides for a reduction of the horsepower tax on cars, or on commercial vehicles fitted with pneumatic tires, of 50 per cent, which rate will then be, in the majority of cases, 10s. per horsepower; in the case of motorcycles with or without sidecars, or three-wheeled vehicles, the same rate would be applied. Thus, for an 8-hp. motorcycle the charge would be £4 per annum, whereas for a 2½-hp. "lightweight" the charge would be 25s., all subject, of course, to a minimum tax of £1 per annum.

In the case of commercial goods vehicles, motor-omnibuses, char-a-bancs, etc., where these are fitted with solid rubber tires the tax should be at the rate of 30s. per horsepower, i.e., three times the rate charged for pneumatic tires and 50 per cent above the present tax. The object of this tax (which would be applied equally to petrol, electric, or steam vehicles) is to place, within limits, the burden of cost of road maintenance upon the traffic which is responsible for such damage, and, at the same time, to offer a direct inducement to owners of vehicles to convert their solid tires into pneumatic equipment. It is understood that rear wheels are to be considered, and not merely front wheel conversions, because it is the rear wheels mainly which destroy the roads and cause corrugation.

With regard to cushion types, of which certain types have the effect of reducing the impact on the road surface, it is suggested that the committee should offer certain rebates on the 30s. horsepower tax on production of a certificate issued by the makers of those tires approved by the committee, much in the same manner as the 25-per cent rebates on motorcars of 1913 date and earlier which obtains at the present time.

The estimated total sum raised by this process is less than that likely to be received this year by present taxation, and it is proposed to levy a small tax on petrol on importation, which, however, may be varied slightly from time to time to produce a sum equal to approximately 2 or 2½ millions, thus making the gross receipts equal to 10 millions or thereabouts. It is not intended, however, that the petrol tax should exceed, say 3d. per gallon, nor is it proposed to tax benzole, kerosene or other fuels. The tax, being small, may be levied as a flat rate for either refined or crude spirit.

Vehicles driven by steam or electricity will, therefore, only escape the small petrol tax—an advantage which is certainly deserved, since these vehicles are propelled by home fuel. Where petrol is used for purposes other

ESTIMATED REVENUE WHICH WOULD ACCRUE FROM THE PROPOSED TAXATION OF BRITISH MOTOR VEHICLES.

Class	Est. licenses for 12 Months Ending Dec. 31, 1923	Est. receipts for Licenses for 1923	Licenses to May 31, 1922	Receipts for licenses To May 31, 1922
		£		£
1—Motorcars fitted with pneumatic tires, taxed at 10s per hp.	290,000	2,200,000	276,221	4,188,629
2—Motorcycles, etc., taxed at 10s per hp ...	350,000	420,000	335,796	784,556
3—Invalid vehicles (no change)	313	78	313	78
4—Commercial goods vehicles fitted with solid tires, taxed at 30s. per hp..... ..	150,000	4,400,000	144,674	2,790,120
5—Road locomotives (no change)	2,400	47,000	2,314	44,810
6—Motor ploughs (no change)....	15,000	3,800	14,549	3,637
7—Motor tractors, etc (no change).................	1,500	19,500	1,399	18,280
8—Motor hackneys taxed mainly at 10s. per hp. as pneumatic tires vehicles.......	80,000	700,000	74,839	1,305,938
9—Tramcars (no change)	13,600	10,200	13,559	10,172
10—General identification licences (no change)..... ..	10,000	72,000	9,460	68,841
	912,813	£7,872,578	873,174	£9,215,061

Note The comparison of this table with that issued by the Finance Department of the Ministry of Transport, showing the receipts to May 31, 1922, shows a reduction of approximately 4 [illegible] 2 [illegible] motorcars and pneumatic-tires vehicles and an increase of 50 per cent [illegible] commercial goods vehicles.

than road transport, and rebate is desired, permits or certificates for such rebate could be issued to those consumers purchasing the fuel in bulk, say, 50 gallons or over. Those purchasing petrol in small quantities would be unable to obtain this rebate, which would not justify the expense in making such allowances, nor, on the other hand, impose any great hardship on small consumers. The estimated cost of collection will, therefore, be approximately the same as that of the present year.

The present method of carrying disk licenses in a prominent position on vehicles may be retained, except that a change of shape of license could be instituted to distinguish between the pneumatic tire license and the solid tire license. For instance, the solid tire license might be oval or rectangular shape, and the pneumatic tire circular. This would render the detection of any attempt to defraud the authorities comparatively easy.

The taxation of motor omnibuses, it is maintained, should not be reduced, but, rather, should be increased, unless the vehicles are fitted with pneumatic tires. It is well known that similar types of vehicles plying on the same route, repeating the journeys day by day, have a far more destructive effect than the same number of different types of vehicles performing the same journeys.

An increased tax of 33 or 50 per cent should be imposed for trailers, and iron tires should be prohibited.

A minimum thickness or depth of rubber for worn solid tires should be formulated in all cases.

The scheme outlined above would have the effect of encouraging owners to dispense with solid tires and adopt pneumatics, which might, in the first instance, cause some reduction in the amount received for licenses of this class of vehicle. This, however, should be looked upon favorably, because, in a very short time, the reduced damage to roads would make itself felt, together with a corresponding reduced cost of maintenance which would obviously necessitate a less sum of money for grants to the various road authorities; also, it would give a distinct fillip to the motor trade generally.

Gage of Light Railways in South Africa

The question of building pioneer and agricultural development lines on the 24-in. gage instead of the 42-in. standard gage of the South African Government Railways is under discussion in regard to twenty-two lines aggregating 850 miles which are now projected by the Railway Department. Although cheap construction is proposed for the standard-gage lines, by the use of light track and a minimum amount of station buildings and other facilities, the cost per mile is estimated at \$22,000 for these lines as compared with \$8,800 for two narrow-gage lines which are included in the program, the latter estimate making no allowance for possible future widening. The narrow-gage advocates point out that the lower cost would enable a greater mileage to be built and freight rates reduced. On the other hand, the standard-gage advocates consider that the cost for this gage could be reduced materially by using rails lighter than the 60-lb. weight proposed, and using ties 5½ ft. instead of 6½ ft. long, with 1,760 ties per mile. The farmers are said to prefer standard-gage lines. Another suggestion is to follow a practice used extensively in continental Europe by building narrow-gage lines along the highways, thus largely eliminating the cost of right-of-way and grading. The train crews would handle freight and perform the work now done by the station agents and their assistants.

An Experience with Air-Binding of Rapid Filters

Water Supersaturated at Leaking Pump Glands Gave up 2,600 Gallons of Air in Filters at Highland Park, Mich.

By William D. Hatfield
Superintendent of Filtration, Highland Park, Mich.

TROUBLES with accumulations of air in the sand and gravel beds of rapid sand filters are usually attributed to a rather high concentration of algae growth in the water which clogs up the sand beds and also causes a supersaturation of dissolved oxygen; to washing the filters at too great a loss of head, or to leaks in the sides or bottom of the filters through which air is drawn into the bed after a negative head is reached. The respective remedies for such troubles are copper sulphate to kill the algae, a wash at a less loss of head and calking the leaks in the filter walls or floor.

Since the filtration plant at Highland Park, Mich., was put into use in November, 1920, periodic troubles with air accumulations in the sand beds have been experienced. This accumulation of air cut the period of service of the filters from 20 to 50 per cent and at times when typical air-binding occurred, the filters had to be washed or "blown-out" every four to nine hours. Ultimately the source was located as a defective gland packing in the pump suction.

The advisability of "breaking" or blowing out the air by opening the wash-water valve without wasting is questionable, but it is often necessary in order to get enough water through the filters to supply the demand. At such times reliance for sanitary safety must be placed on chlorination.

The Highland Park plant is a modern 12-m.g.d. rapid sand filter plant and in a general way differs from the average only in that it is situated 11½ miles from Lake St. Claire, the source of the raw water, and that the raw water is pumped to the plant by the Detroit Edison Power Co. instead of by the city. The raw-water pumps consist of three centrifugal pumps operating at 1,800 r.p.m. under a head of 140 feet. The raw water as it enters the mixing chamber is treated with from 0.4 to 1.0 gr. per gallon of alum, and after 20 min. mixing remains in the coagulation basin from four to six hours. The head of water on the sand beds is 5 ft., the depth of the sand and gravel bed is 4 ft. and the average level of the water in the clear well is 2 ft. below the level of the underdrain system, thus making the total available head for operation 12 ft. Under normal operation the filters are washed with a 23-in. rise per minute of the wash water when the loss of head has reached 10 ft. Experimentally the filters have been washed at from 4 to 12 ft. loss of head and at various rises per minute of the wash water. The rate of filtration has varied from 75 to 155 m.g.d. per acre.

During the first month of operation of the plant the length of service between washings of the filters was from 12 to 20 hours, and on washing a considerable amount of air was always found in the beds. From December, 1920, until May, 1921, very little trouble was experienced from this accumulation, though occasionally on opening the wash-water valve large quantities of air would blow out of the sand, resembling a regular air wash. During this time the period of filter service was about 25 hours. Beginning May 15, 1921,

serious air-binding of the filters occurred and the runs of the filters lasted only from four to nine hours. At such times it became necessary to "blow out" the filters as soon as the loss-of-head indicators took a sudden drop, but the filters were not washed until the normal period of 24 hours was reached.

Weekly microscopical analyses were started in March, 1921, before the serious air troubles began. The total number of micro-organisms varied from month to month from 50 to 125 per c.c. and consisted of a miscellaneous collection of Tabellaria, Asterionella, Fragilaria and other Diatomaceae. It was felt that these organisms in such small numbers could not be causing the trouble. Scraping the fine sand from the surface of the bed seemed to solve the problem, for from May 25 to June 5 the air troubles were abated and the length of filter service was from 30 to 40 hours. However, the trouble returned on June 6 and lasted until the latter part of July. During August typical air-binding did not occur but at the end of 20 hours' service the loss of head gradually fell to 10 ft. On washing the air fairly blew the sand off the gravel so that great care was needed in opening the wash-water valve.

Since the trouble could not be traced to algae or fine sand, attention was turned to a different method of operation. Variations in the alum dose and in the volume and velocity of wash water had no effect. When air-binding was not serious it was often possible to wash the beds at a loss of head of from 4 to 6 ft. without finding an accumulation of air, but during periods of air-binding the air started accumulating at a loss of head of 2 ft. an hour after the filter was put in service, and small air bubbles would rise from the surface of the sand through the 5 ft. of treated water on the beds. At these times air could be found in the filters at any loss of head after the first hour of service. During the latter part of August air did not accumulate in the beds until a loss of head of more than 8 ft. was reached. It was therefore possible to wash the filters at an 8-ft. loss of head without finding air in the beds. From September, 1921, until February, 1922, no air was found in the filter beds even though they were washed at a 10- or 12-ft. loss of head.

Dissolved Air—Analyses of the influent water for dissolved oxygen during periods of air-binding showed that it was from 115 to 135 per cent saturated with oxygen, while analyses of the combined filter effluent often showed a reduction of the supersaturation to 105 per cent. There was no reduction of carbon dioxide. Before the cause of this supersaturation was located the saturation dropped to less than 100 per cent and no more trouble was experienced. A crude analysis of gases given off from the filters when washed indicated that it contained about 30 per cent oxygen and 70 per cent nitrogen. The influent was therefore not only supersaturated with oxygen but also with more than twice as much nitrogen. In other words the water was often 135 per cent saturated with both oxygen and nitrogen or air. From the relative solubilities of oxygen and nitrogen in water when under their partial pressures of the atmospheric air, from the temperatures and from the parts per million of dissolved oxygen, it is possible to calculate the number of cubic centimeters of air that are dissolved in a gallon of the water. The following table gives results of a typical analysis made during air-binding troubles. From these data it is easily seen that a filter which had passed 1 m.g. would have removed approximately 2,600 gal. of air from the water. Is it any wonder that the sand beds fairly blew up when they were washed?

RESULTS OF ANALYSES ON APRIL 4, 1922

Source	Temperature Deg. C.	Dissolved Oxygen P.P.M.	Air per Gallon, c.c.	Saturation, Per Cent
Influent	4	15.8	120	120
Effluent ...	4	14.5	110	110

Note: It happens at this temperature that the cubic centimeters of air per gallon and the per cent saturation are identical, but as the temperature increases the cubic centimeters of air per liter are lower than the per cent saturation.

When the air troubles began again in February, 1922, an analysis of the lake water showed it to be 98 per cent saturated with dissolved oxygen (or air) while the water entering the filter plant was 127 per cent saturated. An investigation showed that air was being drawn into the pumps around the packing glands and under the high pressure was dissolved in the water. The water arriving at the filter plant was again at normal pressure and highly supersaturated. On passing through the coagulation basin the supersaturation was not reduced, but as soon as the water entered the sand the air was given off even though no negative head existed.

The raw-water pumps are designed with a water seal so that if the packing is loose water should leak out instead of air leaking into the pump. The water-seal pipes were found to be plugged with packing and other material, so that the water seal was not functioning Also a defective connection was found where a water line was tapped into the suction line of the pumps. After cleaning the water-seal piping of obstruction and repairing the defective connection with the suction line, no more supersaturation of the raw water occurred and no air has been found in the beds on washing. The raw-water pumps are now operated with the packing glands of such tightness that a little water leaks out all the time. The amount of wash water has been cut to less than 1 per cent and the average run of the filters varies from 40 to 70 hours, depending on the rate of flow.

Carbon and Manganese and the Strength of Steel

New experiments made at the Bureau of Standards, and reported in a scientific paper by R. P. Neville and J. R. Cain, just issued, define the effects of carbon and manganese on the mechanical properties of iron quite precisely. The experiments were made by testing annealed specimens from 3-lb. ingots made from electrolytic iron in a pure magnesia crucible in an electric vacuum furnace. It was found that carbon increases the ultimate strength at an average rate of about 1,000 lb. per square inch per 0.01 per cent of carbon up to a content of 85 to 100; the rate of increase was the greater for the higher manganese ratios. Carbon increased the Brinell hardness in about the same ratio as the ultimate strength, but the elastic limit was less affected than the ultimate strength. On the other hand, elongation and reduction of area decreased rapidly. Manganese had but little effect on the properties of the iron, in the absence of carbon. With the addition of carbon its effect increased proportionately with the carbon content. The ultimate strength of the metal was raised by 90 to 250 lb. per square inch for each point of manganese, and the Brinell hardness in about the same ratio. The proportional limit was increased more than the ultimate strength, while on the other hand the ductility was changed but slightly.

Making Separator and Diffuser Container Blocks

Manufacture for Aeration Units of Milwaukee Sewage Works Carried Out by Force Account—Cost Data Given

By R. R. Lundahl
Division Engineer, Milwaukee Sewerage Commission, Milwaukee, Wis.

A TOTAL of 24,400 precast concrete containers and separator blocks for the air-diffuser plates for the Milwaukee activated-sludge plant are being built by day labor forces under the direction of the engineering staff of the Milwaukee Sewerage Commission. Tentative designs of the blocks and containers were submitted to the makers of forms, subsequently to be changed in minor details to suit the conditions arising from the preliminary castings. A casting plant was laid out for a production of from 40 to 80 castings per day, including a mixing plant, a steam curing room, assembly tracks and storage space of about four acres for the 24,400 separate pieces. The plant was started in February, 1921, and the work will probably be completed by the end of 1922. Aside from the design of the castings, forms and plant, this article will deal with shop routine, difficulties encountered, costs, and handling of the crews to obtain speed and efficiency.

Except in special cases each container accommodates nine filtros plates. As designed, the container is 10 ft. 2 in. long, 18 in. wide, and 6⅝ in. deep. The extra depth provides an air reservoir under the plates after they are set in the container. Fig. 1 is reproduced from a working drawing of a nine-plate container block. The other blocks vary in length, depending upon the number of plates to be accommodated. The plates will be cemented in place after the containers are set in position.

The entire floor area of the aeration tanks, raw sewage feed channels, mixed liquor channels and the return sludge channels are to be covered with container and separator blocks. In fact every portion of the plant floor area, except where the velocities are great enough to prevent deposits and in the sedimentation tanks, is to be covered by such blocks and containers. The blocks and plate containers are set alternately over the entire area mentioned, forming a hoppered or saw-tooth bottom.

About 9,000 containers are required for the entire plant. The blocks are to be set alternately with the plate containers, approximately 7,600 separator blocks being required. The separators are much easier handled if in two pieces, so the several blocks are made one half the length of the containers. This makes 15,200 separator blocks or a grand total of 24,400 separate pieces to be cast. After investigation it was found that it was cheaper to precast the separator blocks than to cast them in place.

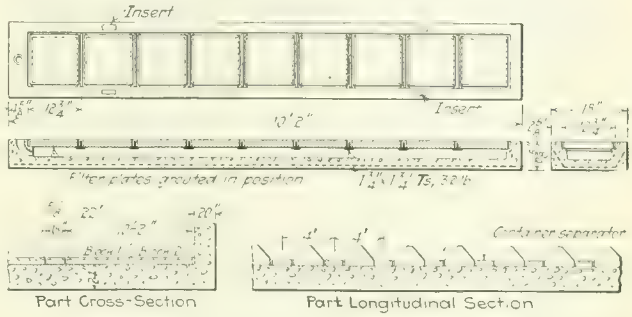


FIG. 1. NINE-PLATE CONTAINER BLOCK AND LOCATION WITH REFERENCE TO SEPARATOR BLOCKS

The inserts are for use in handling the container. The elbow at the left end is for the air-pipe connection.

Plant—The manufacture of these separator blocks and plate containers could have been included in the general contract for the sewage-works but this proved to be impracticable because it would require more time to do this work than to complete the disposal plant ready for the installation of the blocks and containers, unless a very large plant for the manufacture was established, which would necessarily entail an excessive overhead cost for each casting. A report was prepared by our engineers comparing the advantages, costs, etc., of the manufacture of the castings by day labor and under the direction of the Sewerage Commission and by contract. After reviewing the report, the commissioners authorized the manufacture of these castings by day labor, in a plant to be erected on Jones Island.

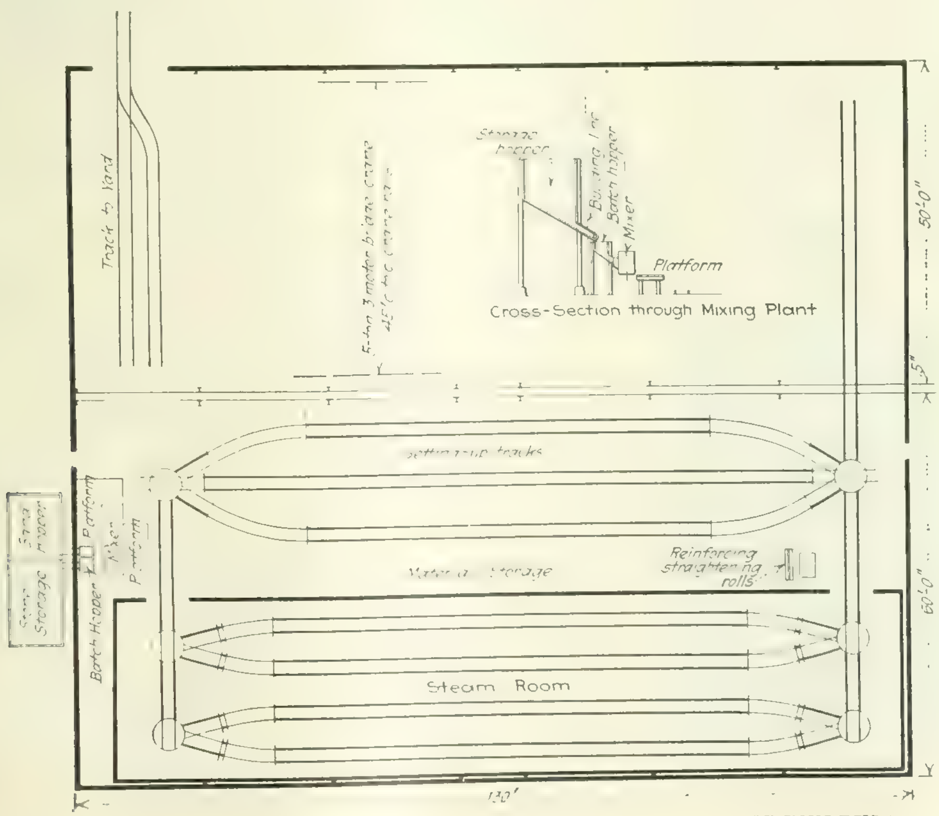


FIG. 2. HOPPER MIXER AND TRACK LAY OUT IN BLOCK CASTING BUILDING

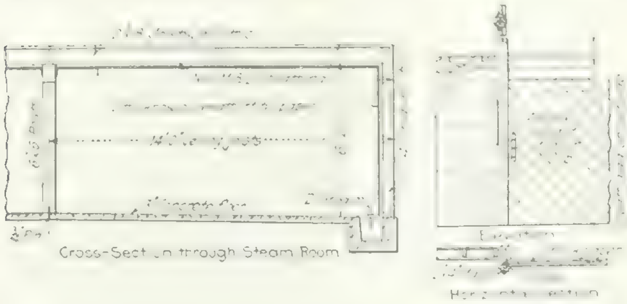


FIG. 3. HEATING METHODS AND DOOR SEALS IN STEAM ROOM

The ground area required was 130 x 110 ft. and as the work was to be carried on at all seasons the area was covered with a steel frame, sheet-iron covered building. Fig. 2 shows a floor plan of the building. The mixing plant is fed from the storage hoppers located outside the building and these in turn are charged by a locomotive crane operating a clam-shell bucket. The cement is handled manually and is stored in a shed just south of the storage-hoppers and convenient to the mixing plant. The steam curing room is of particular interest. Fig. 3 shows the construction, method of heating, method of handling and sealing the doors. The general arrangement of the tracks within the rooms and a ventilating fan are not shown. This room will accommodate 80 castings at a time. It can be heated to a temperature of 115 deg. F. shortly after the doors are sealed. The live steam is discharged into gutters containing water, thus producing highly saturated steam which was necessary to prevent the concrete from baking rather than curing.

It was not deemed necessary to make forms for all the six types of separator blocks since by a few changes the forms for blocks 1 and 2 could be used for the other types.

It was estimated that 60 forms each of the three types—the container form, and the form for separator blocks 1 and 2—would be required to maintain the estimated capacity of the casting plant and take care of renewals and repairs. This number was delivered early in May, 1921. The actual work of making castings was started the latter part of May.

Sequence—The sequence of operations in the manufacture is as follows: The forms are assembled on industrial cars equipped with special frames made to accommodate the forms, two forms to each car, the triangle mesh reinforcing for the casting being placed in the form as it is assembled. The assembling floor is equipped with three tracks, accommodating 80 forms, although this number is seldom on the floor at one time. The north bay of the casting plant is shown in Fig. 6, in which the assembling tracks and cars are plainly seen. As the forms are assembled the cars pass in front of the concrete mixer, shown at the far end of the bay where they receive the concrete from a specially constructed bucket handled by a small electric hoist operating on a trolley. As the concrete is placed in the forms it is thoroughly spaded by four men, two on either side of the form. After receiving the concrete, the cars pass into the steam curing room shown on the left of Fig. 6. This steam room will accommodate 160 castings at a time. At the end of a day's run the doors of this room are closed and sealed. The steam is then turned on and maintained until 6 a.m. the following day, when the doors are opened and the ventilating fan started. This cools the room in time for the workmen to enter at 8 a.m. the same morning. The cars with the castings are then run out of the steam room and placed under a bridge crane which picks up the frame of the car from the trucks, placing the same with the two forms and castings in the storage bay of the plant, shown in Fig. 7. The crane now places a new frame on the car, with two dis-assembled forms, and the car returns to the assembling floor. Here the forms are thoroughly cleaned and oiled before being assembled again. By noon the correct complement of cars and castings has been removed from the curing room and placed in the storage bay.

Stripping Forms—In the afternoon of the same day that the castings are removed from the curing room the forms are stripped. In the original design it was intended that the whole outside form would have to be taken apart, this, however, was found to be unnecessary.

The operations in removing the container form (in which the container is cast upside down, see Fig. 5) are as follows: The tie angles P-17 are removed by taking out the key wedges while the forms are yet on the car frame. The form is then picked up by the bridge crane by means of a special shackle that hooks into the end of the form in holes provided for that purpose. The load being eccentric the form immediately turns over. The wires holding the adjustable inserts to the bottom plate P-18 are now cut by a cold chisel and the bolts holding the inside form to the bottom are removed. The inside form is collapsed by means of the turnbuckles, the wedges holding the end forms to the sides are loosened and the entire outside form lifted off by the crane. The inside form is next lifted out and

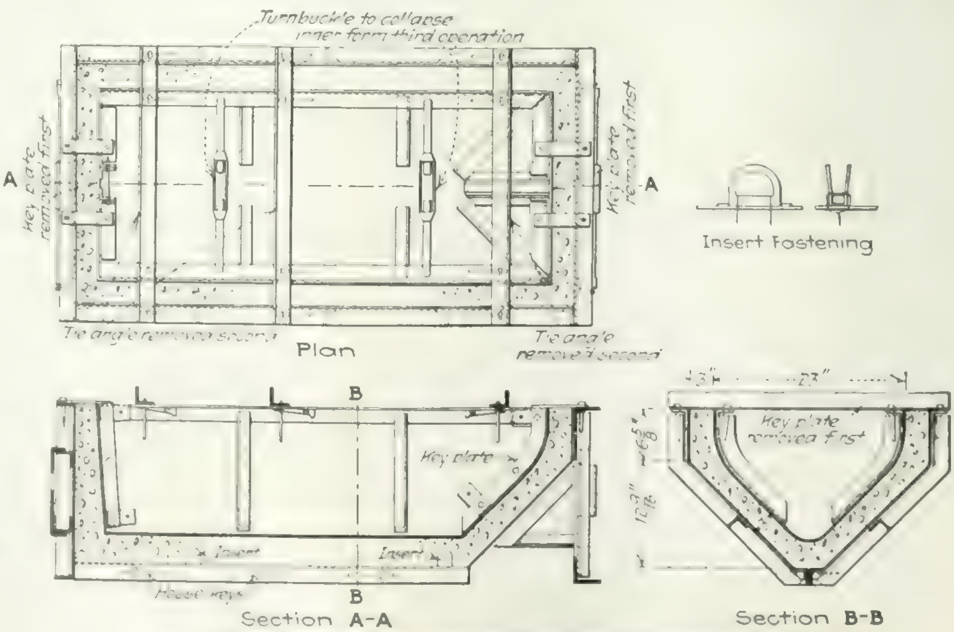


FIG. 4. STEEL FORMS FOR PRECAST CONCRETE SEPARATOR BLOCKS

placed in the outside form and the entire form goes back to the assembling floor.

In removing the forms for separator block 1, the key plates P7 and P12 (Fig. 4) of the inside form are first removed, then the tie angles P11 and the form is then collapsed by means of the turnbuckle and lifted out by the crane. The form and casting are then turned over, the insert wires cut and two sets of wedges in each end loosened, which permits the outside form to be lifted off. In the case of block 2 where both ends are straight the same process is followed but in attempting to remove the inside form, as designed, considerable trouble was experienced. In the design of block 2, a bevel of 1 in. in the ends of the forms was allowed to permit withdrawing. Experience showed that the least projection on the form prevented its removal, the result being that we finally had to remodel the inside form and make it the same as used for block 1. After this was done we experienced no further trouble. The amount of concrete in each No. 2 block was increased slightly but not enough to increase the cost materially. Trouble with this form greatly reduced the output of the plant in its first few weeks of operation but at the present time the forms are all operating satisfactorily, for which due credit should be given to the Blaw Knox Co. and to our engineer, Mr. Trenkamp.

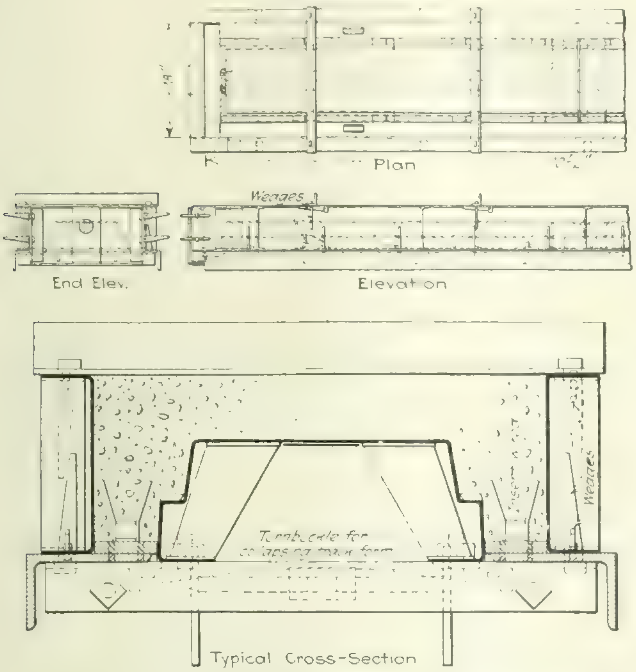


FIG. 5. STEEL FORMS FOR FILTROS PLATE CONTAINERS

After a few weeks' use it became evident that the turnbuckles furnished with the container forms were not satisfactory. For collapsing the forms they served the purpose admirably, but in spreading or strutting out the forms they were found to be too weak. Instead of acting as a strut they would bend up, and as a result the forms were not held to shape. This trouble resulted in a new type of turnbuckle designed by Mr. Trenkamp, constructed as follows: To the head of a $\frac{3}{4}$ x 1-in. machine bolt a $\frac{3}{4}$-in. nut was welded, placed on edge, the thread in the nut being at right angles to the bolt. The nuts for each turnbuckle were right- and left-hand threads respectively. The hexagon hand nuts were then removed from the old turnbuckles and new rods with right- and left-hand threads were welded into these nuts. These new rods were then threaded into the nuts, which were welded to the bolts and the bolts inserted in the old holes in the forms formerly used for the hooks on the old turnbuckles, and held securely in place by a nut. These new turnbuckles act truly as struts and have the advantage of always being held securely in the form with no chance to drop out, which happened with the old type with the hooks.


FIG. 6. NORTH BAY OF THE CASTING ROOM SHOWING ASSEMBLY FLOOR AND STEAM ROOM AT LEFT

After the forms have been removed the finished castings are placed on small industrial cars by the crane and carried to the storage yard, where they are removed from the cars and piled four high by means of a hand derrick. As the space fills up, the industrial and derrick track is shifted to make further room.

Output—The operation of the plant was started late in May, 1921. During June a regular daily output was maintained, but at a rate far below the expected capacity, with a unit labor cost of \$3.65 per casting. Starting in July the rate was increased to 34 castings per day; in August, to 55; September, 62; October, 65; since which time (for about a year) the average has been maintained above 65 per day, reaching a maximum of 82, with an average labor cost of \$1.75 per casting. This increase of nearly 100 per cent was procured without any expansion of the facilities, but by their more intelligent use, better arrangement of the


FIG. 7. REMOVAL SPACE AND STORAGE BAY FOR BLOCKS AFTER STEAM CURED

work and increased efficiency of the men doing the work.

In the original plan of organization the men were placed in groups so as to become proficient in their particular work. This grouping did not prove to be satisfactory because a man's absence disrupted the entire organization. It is now the practice to rotate the several crews every week or two, which prevents them from becoming "stale" and also familiarizes each man with every operation of the plant so that he is ready to take any position to which he may be assigned. This arrangement does not include the crane or concrete mixer operators, but we have relief operators for these positions.

FIG. 8. BLOCKS IN STORAGE YARD WILL FINALLY COVER FOUR ACRES

The mixture of concrete used in the castings is 1:1½:3, the aggregate being washed materials. The crushed gravel is a special size ranging from ¼ to 1 in. which makes a very good concrete and one easy to spade in the narrow forms. The sand is a well-graded washed torpedo sand.

The original estimated cost of these castings was $10 each, including the cost of material. The cost to date has averaged less than $7 each, which includes the cost of buildings, equipment, repairs, forms, etc., amounting to approximately $50,000. The total cost will be about $175,000.

The cost of production is much lower than was anticipated and is certainly much lower than any contractor would have bid to manufacture them, as it was new work of a special character on which basic information for bidding was not available.

Up to Oct. 1, 1922, the plant had produced 23,781 castings out of a total of 24,400. The number of rejects or culls in this entire number was only 29. It is expected that the whole number will be completed by November, 1922, reducing the estimated time by six months.

There are 30 men employed in the casting plant and 4 men in the storage yard. The work is in direct charge of Frank Trenkamp, division engineer of the Sewerage Commission, and it is due to his work and supervision that the efficiency of the plant has been so materially increased.

Walter Genrich, senior engineer, is in charge as foreman of the plant. This work is being done by the Sewerage Commission of the City of Milwaukee, of which T. Chalkley Hatton is chief engineer and James L. Ferebee is principal assistant engineer. A Laurie Kurtz, division engineer of design, rendered material assistance in designing the plant and equipment.

Lateral Strength of Columns Subject to Flexure

Serious Errors Arise from Disregard of Tendency to Buckle in Direction Normal to Plane of Bending

By C. R. Young
Associate Professor of Structural Engineering,
University of Toronto

Examination of the literature of structural design shows a frequent disregard of the tendency of steel columns subjected to flexure to fail in a direction at right angles to the plane of bending. Apparently, the view held by some writers and designers is that the state of flexure in a column somehow manages to restrain the column perfectly against lateral buckling transverse to the plane of bending, in some such manner as the tension flange of a beam assists the compression flange and helps to prevent it from crippling sidewise. Whatever the restraining effect of flexure may be, obviously it cannot be complete. Even considering the column as a vertical beam subjected to an axial load, the permissible stress on the most highly compressed flange should be arrived at by the application of a formula for the safe stress on the compression flanges of beams or girders. A characteristic formula of this type is that of the American Bridge Co. specifications for steel structures, namely $p = 19{,}000 - 300\ l/b$.

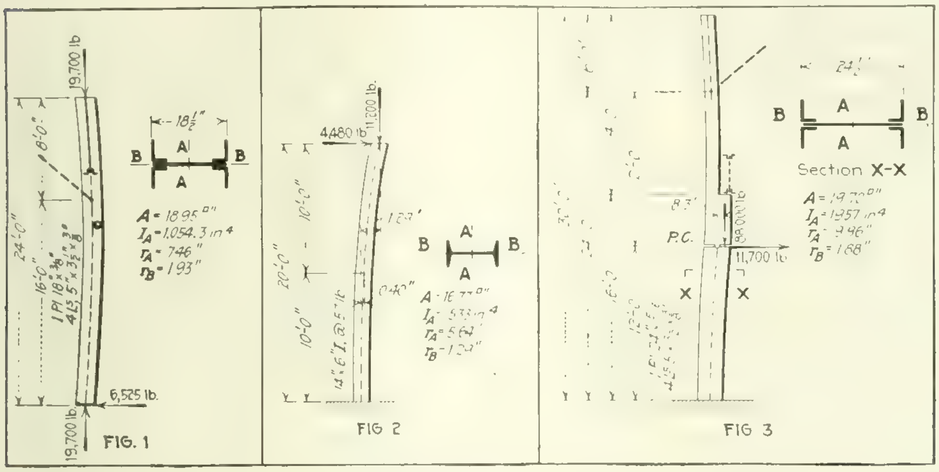
The situation with a column, however, is quite different from that existing in a beam. The tensile stress on one side of a beam tends to hold the tension flange as nearly as possible in a straight line, and to a lesser extent exerts this kind of influence on the compression flange; but with a member subjected to compressive stresses entirely across the section, as is normally the case for a column, there is not this restraining effect. Both flanges of a column, if subjected to compression, will tend to buckle laterally, the one most highly stressed naturally tending to buckle more than the other. It is therefore evident that a column subjected to compressive stress across its entire cross-section should be proportioned in a direction normal to the plane of flexure as a column than as a beam, and consequently that formulas applied to such a case should be of the column type rather than of the type applicable to the lateral buckling of compression flanges of beams.

A characteristic instance of the neglect of the flexural tendency in the weak direction of a column is contained in an example in one of the best-known American textbooks on structures. This case is that of a side column for a mill building, shown in Fig. 1. The columns are 24 ft. high, are considered as pin-ended at the base, and have a kneebrace connected to them 8 ft. down from the top. A truss 6 ft. deep runs from column to column along the sides of the building, but the author disregards the stiffening effect both of this truss and of the girts on the column, and assumes that the columns transversely to the plane of bending should have a limiting slenderness ratio of 150. Nevertheless, in the investigation of the assumed section the maximum stress at the kneebrace connection, amounting to a total of 12,090 lb. per sq.in., is compared with a permissible stress of 19,950 lb. per sq.in., based on the radius of gyration in the direction of the plane of bending. Had the radius of gyration at right angles to the plane of bending been taken, the permissible stress (after allow-

ing for an increase of 50 per cent applicable to this case of combined stress) would amount to 8,355 lb. per sq.in., or much less than the calculated existing stress.

Protest against this criticism might be made on the ground that if the maximum combined stress is calculated at the kneebrace connection the permissible stress should not be based on the situation at mid-height of the column, where the lateral buckling tendency is greatest. If, however, the maximum stress be calculated at mid-height of the column, it is found to be 9,340 lb. per sq.in., or substantially more than the stress allowed by the formula.

In a well-known English text-book on structures, the design of a column to meet the conditions shown in Fig. 2 is discussed. The actual combined stress at the base of the column, assuming that the section used is a British standard beam section 14 x 6 in. at 57 lb., is 14,300 lb. per sq.in., or less than the safe allowable flexural stress on mild steel. If, however, the state of affairs existing at mid-height of the column be investigated, it is found that the maximum combined



THREE CASES OF COLUMNS WEAKEST IN PLANE TRANSVERSE TO PLANE OF BENDING

stress at this level is 7,850 lb. per sq.in. Applying any characteristic column formula applicable to a slenderness ratio such as this, that is 186, it is found that the maximum allowable stress at right angles to the plane of bending is less than 4,000 lb. per sq.in., although in the example under consideration the author passed the design as sufficient.

A case of lateral buckling transverse to the plane of bending that is very likely to be overlooked is that of a mill building column fixed at the base and subjected to flexure. The column shown in Fig. 3 is sufficiently heavy to withstand the maximum combined stress at the base, assuming 20,000 lb. per sq.in. to be a safe unit for the mixed loading, but it does not meet the requirements at a section, for example, midway between the base and the crane-girder seat. At this mid-section the maximum combined stress is 12,560 lb. per sq.in., allowing for the effect of deflection of the vertical cantilever below the plane of contraflexure. Assuming the permissible stress to be on the basis of $p = 16{,}000 - 70\ l/r$ plus 25 per cent for the combination of dead, snow, wind and crane loading, the safe stress is only 11,060 lb. per sq.in. Evidently, therefore, such columns should be investigated at this mid-point, unless they are adequately supported at right angles to their webs by girts or special struts.

By no means all the text-books on structures are misleading or silent in this regard. A considerable number examined by the writer indicate an appreciation of the inherent weakness of a column transverse to the plane of bending and make adequate provision for it. It is felt, however, that attention should be drawn to the erroneous treatment of this subject in a number of textbooks, so that junior designers may be on their guard.

Rubber Seal Rings Solve Hydraulic Turbine Problem

THE rapid increase in the size of hydraulic turbines within recent years, as well as the increase in the heads for which units of this type have been built, have brought the designer of such units many new problems. One of the most important of these has been the design of seal rings suitable for such units, particularly where the water contains silt or abrasive particles and where, on account of high heads, the water leakage around the turbine runner is more than ordinarily serious.

About a year ago, Ely C. Hutchinson, general manager and chief engineer, Pelton Water Wheel Co., began experimenting with rubber seal rings. The results have been so successful that the seal ring problem has been solved, thus removing this barrier to the further development of high speed, high capacity, hydraulic turbines.

In the experiment and study directed toward finding something better in the construction of turbine seal rings, the ideal sought was a design and construction which would avoid (1) leakage between stationary and rotating parts, (2) wear between parts, (3) danger of seizure between rotating and stationary parts or danger that a shutdown might be caused by the assembly of the turbine runner slightly out of the exact center, or even having a slight eccentric movement on account of the necessary clearance within the main steady bearings.

After the use of rubber seal rings had been found to show encouraging results, experiment was made in hardness, quality and clearances of rubber rings. Rings now being made are of a thickness that leaves no free clearance between the moving and stationary parts and the hardness used is about equal to that of automobile tire casing. The results are: no danger of seizure, no leakage and negligible wear after almost a year's operation under adverse conditions; and no damage to the interior of the turbine from rubbing between rotating and stationary seal rings.

At the Kaweah No. 2 power house of the Southern California Edison Co. rubber seal rings have enabled the plant to develop more power under the same hydraulic conditions and with better operating characteristics.

In announcing the success of experiments with rubber rings, Mr. Hutchinson acknowledges the co-operation of H. W. Dennis and H. L. Doolittle of the Southern California Edison Co. and C. O. Poole and F. O. Dolson of the Southern Sierras Power Co.

Design Features of the University of Kansas Stadium

Structure Is Part of Memorial to Students Who Died in War Service — Study of Existing Stadiums Made as Preliminary to Decision on Type

BY CLEMENT C. WILLIAMS
Lately Professor of Civil Engineering, University of Kansas; Professor of Civil Engineering, University of Illinois

THE stadium at the University of Kansas is being built as one part of a memorial to students and alumni who sacrificed their lives in the World War. From a variety of ideas as to what would constitute a satisfactory memorial, opinion finally crystallized about two structures—an athletic stadium and a University union building. The former is completed and plans for the latter are being prepared. The campaign for funds, contributed by university alumni and friends, is about ended.

Before beginning the design of the stadium the writer visited all of the large college stadiums in the country, in order to secure information and points of view on the general type of structure and the character of facilities to be provided. In this connection, he wishes to acknowledge the ready responses to inquiries and helpful suggestions from directors of athletics and designers of stadiums in the various institutions.

The four outstanding types of stadiums are (1) the bowl, (2) the natural basin type, (3) the side-hill type and (4) the grandstand or elevated structure. The Yale Bowl, which is the only example of the first class, was formed by excavating a huge pit with sloping sides in a level field, piling the spoil around the rim as an embankment, and then placing the seats on the slope of the excavation and embankment, the playing field being at bottom of the pit. The structure forms a complete and enclosed oval in plan and it is intended to accommodate football contests only.

In the second class, advantage is taken of an existing recess in the topography to lay the structure on the natural slopes of an open basin, in the bottom of which may be placed the athletic field. More or less grading of the slopes and the bed of the basin or valley to accommodate the structure and the field is usually necessary and in some cases a portion of the structure rests entirely upon artificial supports, as in the Syracuse stadium. This type is further illustrated by the stadiums at Tacoma, San Diego, the University of Washington, and others.

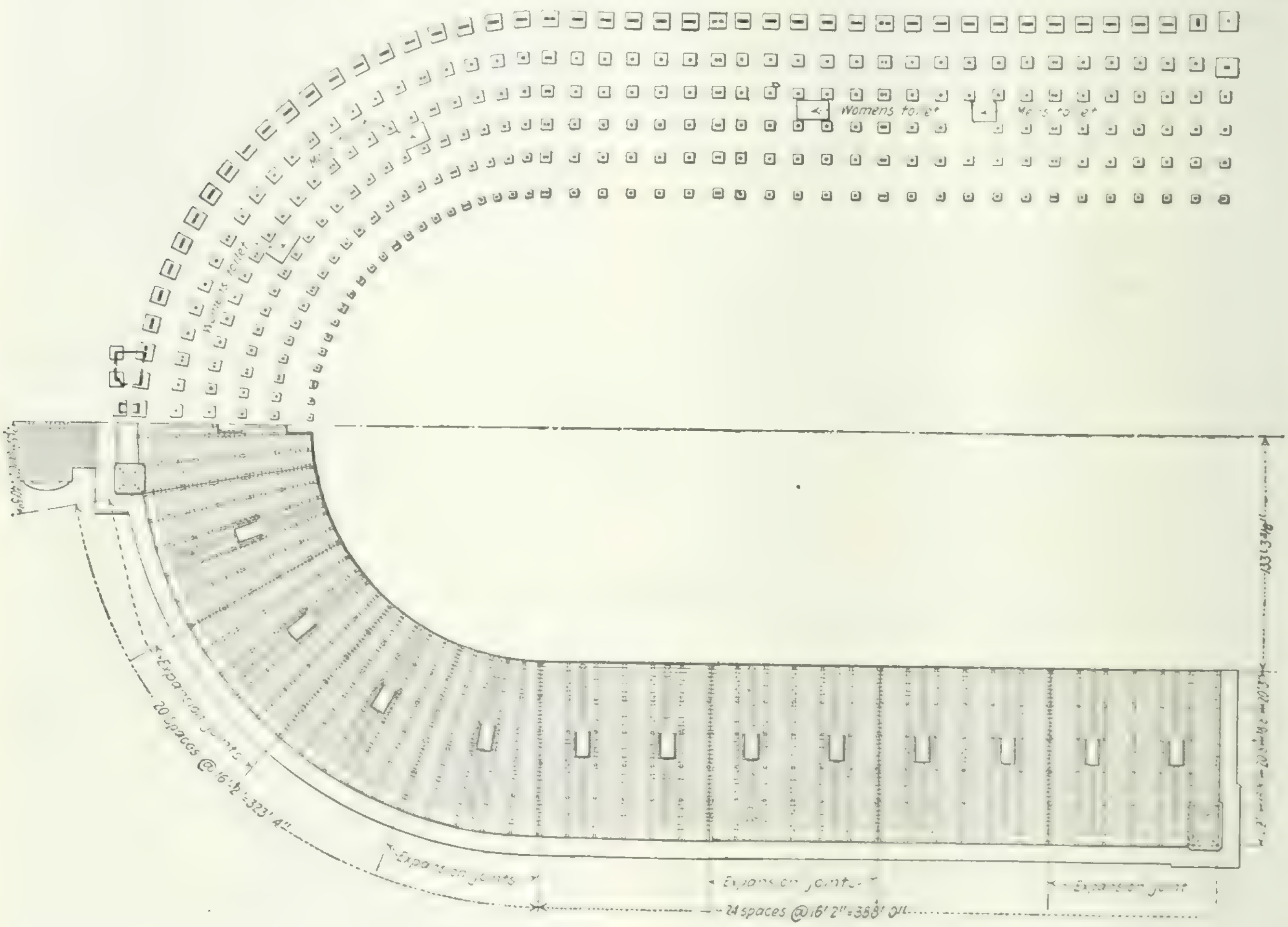


FIG. 1—PLAN OF KANSAS STADIUM

As examples of the third, or side-hill type, may be mentioned the stadiums at Cornell, Washington University (St. Louis), and College of the City of New York. In these cases, the structure is laid on the natural slope

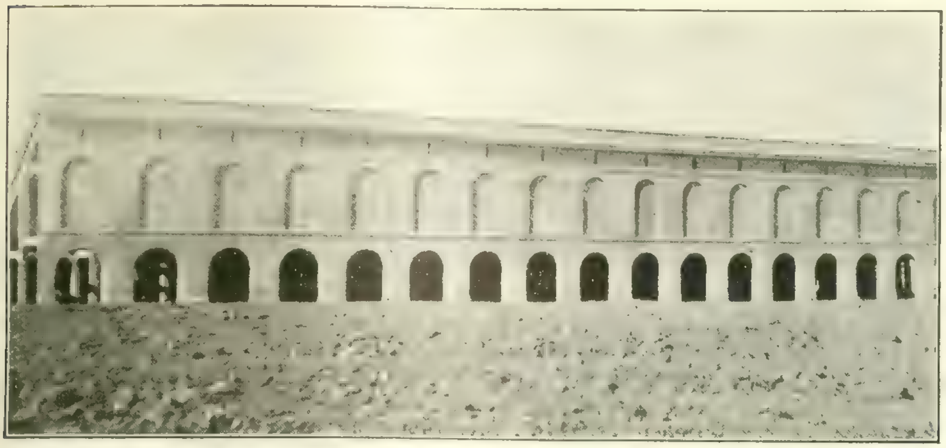


FIG. 2—ARCHITECTURAL FEATURES OF KANSAS STADIUM

of a hill side with a certain necessary amount of modification by grading, and the athletic field is placed at the foot of the hill, the seats being on one side of the field only.

The fourth class includes those structures erected entirely above the ground level and resting on artificial supports entirely. It is illustrated in the stadiums at Harvard, Princeton, Chicago, and Ohio, the one proposed at Illinois, the proposed municipal stadium in Chicago, and the Pershing stadium in France, the open air theater at Milan and several at baseball grounds. The prototype of this class is the Coliseum at Rome.

Choice of Type—In the Kansas stadium, it was essential that as many sports as possible should be accommodated, hence a closed bowl was not feasible on account of the requirements for track. Moreover, the stagnation of air in a sunken bowl with the consequent ratardation in the drying of the field after a rain and other attendant difficulties, inclined the decision away from the bowl type. Furthermore, no site near the university was peculiarly adapted to the sunken bowl or to the side-hill type of structure, and our observation had been that in the matter of maintenance and the variety of facilities provided for, the advantages lay with the Harvard or Princeton type. Therefore this type was selected.

One important consideration which affected the choice was the space under the stand which becomes available for sheltered track events. A few institutions have utilized this space to a great extent and the possibilities of its use counted heavily in the choice at Kansas. In fact, a considerable expenditure was incurred in additional grading and drainage to make this space utilizable. The accessibility of this space for shelter in the case of showers was an important consideration.

From these and other factors, the type of stadium chosen was a U-shaped structure consisting of two straight sides enclosed at one end by a half circle. The advantages of improved vision (which are more psychological than real) claimed for curved sides did not appear to compensate for the added expense of construction involved. The entrance to the stand is from the rear up stairways which lead to the center of gravity of the seating sections. While this arrangement is somewhat more expensive than one allowing entrance from the front, the added convenience in seating, the minimizing of walking in front of seated spectators, and the rapidity of exit after a game seemed to justify the increased outlay. It was estimated that the width of stairways would permit the emptying of the stands in six minutes and the results at the last game accorded with this estimate.

Small stairs are provided at the bottom of the stand to permit egress of spectators to the field should occasion warrant. A side doorway was provided at the main entrance at the middle of the closed end to permit a parade led by the band to march directly on the field.

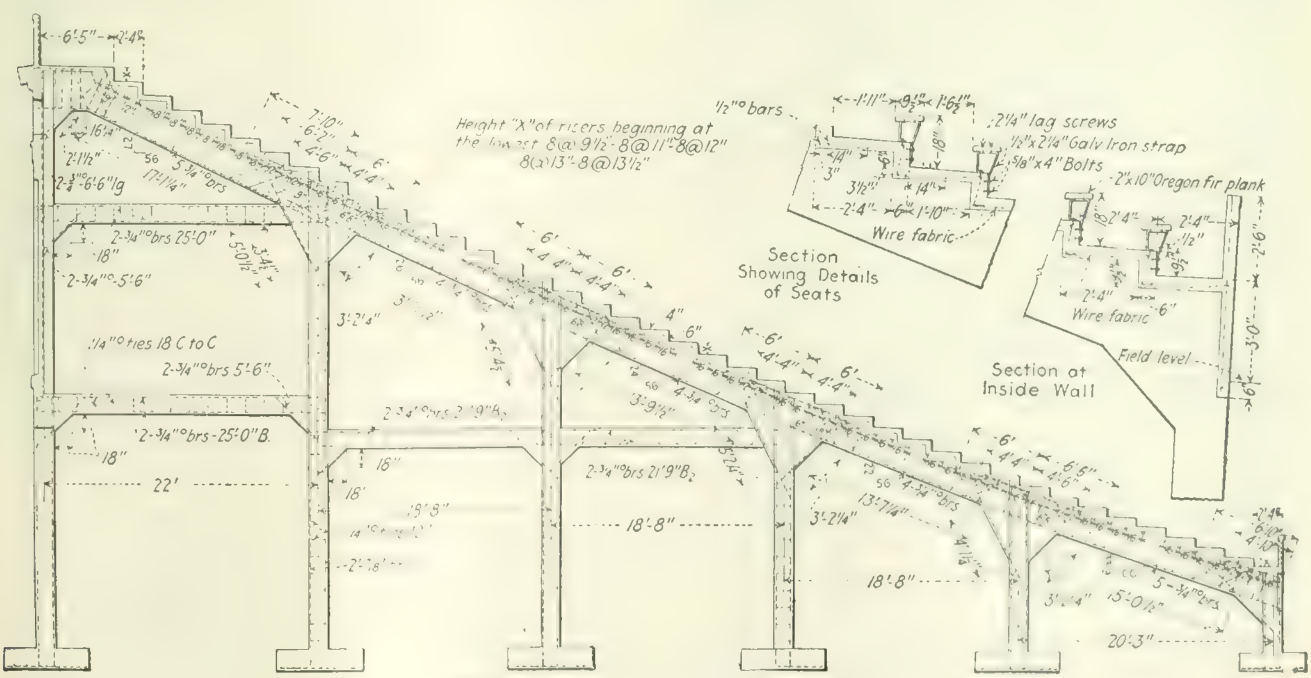


FIG. 3—TYPICAL FRAMING DETAILS

Location and Accessibility—A number of considerations influenced the choice of old McCook field as the site of the new stadium. Among these may be mentioned, (1) accessibility, (2) nearness to the campus, enhancing the availability, (3) lack of ready funds to purchase an extensive site, and (4) sentiment in preserving the traditions of McCook field.

The university lies outside the city limits at the southwest corner, hence by placing the stadium at the north side of the campus it was at the point nearest to the center of the city and, therefore, became readily accessible from the three railway stations and from the hard surfaced highways that are being constructed through Lawrence. The street car line to the university passes on one side of the tract.

In selecting the location the matter of stable foundations and freedom from excessive ground water also constituted important factors. In some places in Lawrence, the slipping of strata has caused serious difficulty, hence, an effort was made to avoid difficulty from this source.

Some effort was made to orient the stadium so that the rays of the sun at the middle of the football season would be at right angles to the field, but too much in the way of appearance and accessibility would have been sacrificed to accomplish this, so the structure was made to lie on a north-and-south axis, which is essentially the axis of the topography and of the campus. The stadium opens directly towards the central administration group of buildings, this placement affording the spectator a panoramic view of practically the entire university.

The stadium is slightly less than two city blocks wide, and as it is centered on Alabama St., it is approachable from two other well-paved streets leading directly to the parking spaces at either side. In addition, direct approach may be made from a side street by McCook Ave. which leads from the street car line and connects to one of the main approaches to the campus.

Data on Design—The first question to be determined in the design was the probable future seating capacity. The attendance at the University is over 4,000 and with the present rate of increase the attendance will probably reach 8,000 in the near future. Data were obtained on the attendance at games at other institutions similarly situated when their student bodies numbered about 4,000, and now, when they number 8,000 to 10,000. Important games at Michigan, Illinois, and Wisconsin draw crowds of from 20,000 to 26,000, whereas twenty years ago they drew crowds of about 10,000. The record attendance at Kansas previous to building the stadium was somewhat less than 12,500. Owing to the proximity of Kansas City, Topeka, Leavenworth, and Atchison, to which hard roads will soon be completed, it was decided that provision for two and one-half times the previous record crowd would be justifiable. The capacity, then, adopted was 32,000. It is of interest to note that at one game after the portion of the stadium was complete, the attendance was over 20,000. It is perhaps futile and even undesirable to attempt to provide for the maximum crowd that may seek entrance to a famous football game, for the stadium should perhaps accommodate only the alumni, students, and friends of the university and of its rivals.

Style of Architecture—Inasmuch as the stadium was to be a memorial to soldiers and sailors the memorial type of architecture was adopted throughout, with straight lines and tablets overlying the towers at the entrance and ends. This architecture constitutes the only memorial feature of the construction since no name tablets or other memorial inscription will appear on the structure.

The arrangement of arches at the outer wall resembles the Coliseum and the Harvard stadium except that the upper arches are blanked, in order to hide the reinforced-concrete framework of struts and columns beneath. Special care was taken also to place all these skeleton structural members in such positions that they would not be visible from the outside, the only ones being the stairways leading to the entrances to the stand.

The two towers which stand at either side of the main entrance rise but slightly above the skyline of the structure and are of simple straight-line design. Each tower carries two tablets surmounted by a flag pole. Inasmuch as it was obviously impossible to make these towers sufficiently large and imposing to dominate the structure, as primary masses, they were subdued to less conspicuous features and the stadium was treated as one mass.

FIG. 4—ARCHES GIVE PLEASING EFFECT

Design of the Structure.—The structure was designed following the specifications of the Joint Committee on Concrete and Reinforced Concrete; the foundations were proportioned by means of Schneider's formula: $A = \frac{D}{Br}$, where A is the area required to support the given load, D the dead-load, B the allowable soil pressure and r the ratio of dead-load to total load coming on the foundation where the ratio of live- to dead-load is the greatest. The foundation bed is a clay stratum on which $1\frac{1}{2}$ tons was used as the proper bearing capacity. The live-load including impact was taken as 100 lb. per square foot of horizontal projection. The details of the framing of a typical section are shown in Fig. 3. In addition to steel rods, the seat slab was reinforced with a wire fabric. Expansion joints were provided between the sections 97.5 ft. apart.

There are 40 regular seat spaces, and two rows of movable seats may be placed in the promenade at the top. In order that the vision might be equally good throughout, seats do not rise on a uniform gradient but on a curve that is essentially a parabola. The exact curve was determined graphically by assuming the eye of the spectator 2 ft. 8 in. above the seat and having

a clearance of about 4 to 8 in. over the eye of the spectator in the seat in front. Beginning at the lowest the heights of the risers are as follows: 8 to 9½ in.; 8 to 11 in.; 8 to 12 in.; 8 to 13 in., and 8 to 13½ in. The exact amount of this clearance varies as shown in the table below where the clearance in the Kansas stadium is compared with that used at other institutions.

	To Side Line, Clearance in Inches			To Center, Clearance in Inches		
	2nd Row	Halfway	Top	2nd Row	Halfway	Top
Chicago	3	2	3	4	8	8
Harvard		4½	4	14	10½	10
Yale	4¼	3	4			
Michigan	4¾	4¼	3⅝	7½	7¼	7
Kansas	5⅜	5⅛	4¼	7⅞	8⅜	7⅞

Design of the Field—The proper design of the field was fully as important as the stadium itself, for unless the field should be successful, the entire project would be a failure. In fact, approximately 25 per cent of the total cost was involved in the grading, draining and otherwise preparing the field and site. The facilities provided on the field are the football gridiron, a standard quarter-mile track 21 ft. wide with a 220-yd. straight-away at one side, and temporary accommodation of the baseball diamond. A layer of the top soil of the field was removed, and 6-in. tile drains laid approximately on 50-ft. centers. Above these drains a 6-in. layer of cinders was laid over the entire field, and above this 10 in. of sandy loam. The surface was then sodded with blue grass sod. The top of the field as well as the drains slope from the center of the field to the edge on an approximately 0.5 per cent grade.

FIG. 5—OPEN END SECTION OF STANDS
Though flat the parabolic curve of the seating area is clearly noticeable at the end wall.

The track is 21 ft. wide and lies around an oval with straight sides 330 ft. long and semicircular ends with 104.4 ft. radius. It slopes 2 in. to the inner edge and is underdrained at 50-ft. intervals. It consists of a layer of 12 in. of screened cinders with a 4-in. top layer of one part clay and three parts cinders screened through a ¼-in. screen. On top was a ½-in. dressing of cinders of ¼-in. size.

It was important to secure adequate drainage and yet to retain sufficient moisture in the ground above the drains to prevent the grass dying, during the drought periods characteristic of Kansas summers. By using cinders instead of crushed rock, which has been employed in humid regions, it is believed that this problem has been met fairly well.

Acoustics—Practically no information could be obtained on the acoustics of stadiums, hence, no definite consideration could be given this factor in the design. For most satisfactory cheering effects, the volume of sound from one side should go directly to the opposite side without serious dissipation. A stadium with overhanging balconies may have some advantage in this respect. In the single slope type of structure, 100 ft. or more wide, obviously the cheers from the back rows reach the opposite stand some 300 ft. away a fraction of a second later than from the front rows. A curious phenomenon is observable from the portion of the structure completed, namely that certain low tones of the yells are affected differently from the higher tones. No trouble has been experienced from echo effects.

Accessory Facilities—One of the details which was given considerable thought was the seats. It was desirable to devise comfortable, durable seats without undue expense. For comfort and to prevent certain pathological consequences, it was desirable to have seats at about the height of a standard chair. Backs were removed from consideration because of the direct cost and the indirect expense resulting from the space which they occupy causing a wider spacing of seats and hence a wider stadium. Oregon fir planks, 2 in. x 10 in., supported on galvanized strap-iron frames were adopted as seats and have been found entirely satisfactory. The galvanized iron frame was chosen to harmonize with the concrete and to prevent rust stains. The seats project 4½ in. beyond the face of the concrete benches on which they rest so that rain water flowing over the benches will not injure clothing and also that the feet may be drawn under the seats when necessary. Rather liberal public toilet space has been provided, because observation at certain other university stadiums showed the urgent necessity of such provision.

An office, team room, locker room, shower room, and storeroom are provided under each end section of the structure, one side being intended for the 'varsity and the other for the freshman team and visitors, the two layouts being alike. An inclosed passage from the team room leads directly to the field.

In the completed arrangement tickets will be sold from movable cages through openings in the iron fence which will surround the stadium, and will be taken up at turnstiles which admit to the inclosure.

The first and third bays under the seats are available for sheltered track events during winter, and the second, which is partly occupied by structural members and stairs may be used for storage. The outer bay has ample headroom for the principal field events.

Provision for Extension—So indefinite were the data on the attendance used in determining the stadium capacity that possible future extension necessarily had to be taken into consideration. The scheme for extension considered most feasible consists of extending the straight sides outward and cantilevering a balcony over the portion already built. The foundations of the present structure were not designed to carry such a balcony, hence added width would have to carry this added load.

Construction—The contract for the portion of the stadium completed was signed July 9, 1921, and the 15,000 seats were ready for use Nov. 24, the completed portion constituting three of the four sections of the straight sides, in both legs of the U.

The stadium was designed under the direction of the writer as consulting engineer. F. L. Brown, assistant professor of mechanics; Laforce Bailey, assistant professor of architecture; and L. H. Dodd did the detailed designing. Much of the architectural treatment is due to Professor Bailey. The Unit Construction Co. of St. Louis were the contractors, with E. H. Hartman as superintendent of construction. L. H. Dodd served as resident engineer on construction.

Cause of Decrease in Typhoid Rate in the United States

Curves Plotted on Semi-Log Paper Accentuate Drop After Water and Milk Supplies Improved—Two States and Six Cities Figured

By George C. Whipple
Professor of Sanitary Engineering, Harvard University, Cambridge, Mass.

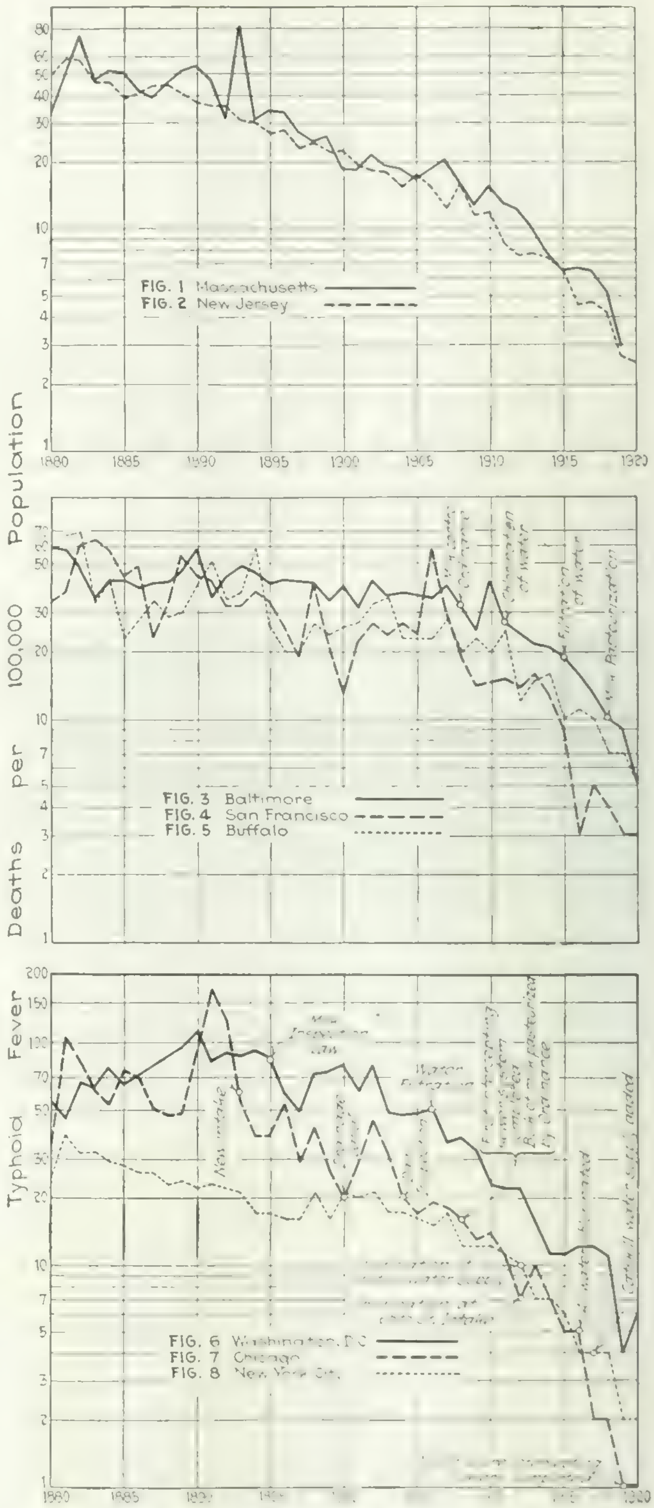
During the last thirty years the typhoid fever rates of the United States have been decreasing. Sanitary engineers have naturally claimed credit for this decrease, as water purification was the factor which gave these rates their first down-hill push. Perhaps they are inclined to assume too much of the credit for the typhoid fever decline. If so, this may be attributed in great measure to the way in which the data have been studied.

The annual typhoid fever death-rates of such a state as Massachusetts, if plotted on ordinary cross-section paper, show a continuously falling curve. Few of the water supplies of this state are filtered or chlorinated, and the other changes certainly have not been enough to account for the decrease. One studies the curve in vain, because the eye is not keen enough to detect differences in the curvature at different times. If, however, the same data are plotted on semi-log paper, as shown in Fig. 1, it will be noticed that twice since 1880 there have been changes in the general slope. The first change occurred about 1888 and followed closely after the improvements in water supplies made under the inspiration of the early work of the Massachusetts State Board of Health. The second occurred about the year 1909 and coincided with the period (1908-10) when improvements in milk supplies were being actively pushed, when pasteurization was being put into practice. A curve (Fig. 2) similarly plotted for New Jersey shows the same break in 1910 as that for Massachusetts; in fact, the two curves are surprisingly alike throughout, showing the direct relation of improvements in the water and milk supply to the typhoid situation.

If similar plottings are made for large cities, it will almost invariably be found that the downward slopes of the plotted typhoid rates began to accelerate somewhere between 1908 and 1910 (see Fig. 3 to 8). The change of rate about this time was so marked, was so general over the country, and applied to so many cities where the water supply did not change in character during those years, that the cumulative evidence makes it seem almost certain that the great decline in typhoid fever in the United States during the past decade was due very largely to the pasteurization of milk supplies. In some instances there are evidences of another change of slope about 1918, which may possibly be related in some way to the typhoid vaccination practiced so completely in the army during the war. Sufficient time has not elapsed to prove this.

But it must not be forgotten that the chlorination of water, which began about the same time as milk pasteurization, has also been an important factor in the decline of typhoid. The effect of filtration is too well known, indeed, to need more than bare mention.

It is hoped that sanitary engineers and epidemiologists will use the method of semi-log plotting for analyzing the changes which are gradually occurring not only in the death-rates for typhoid fever, but for other diseases. Miss A. D. Hamblen, statistician of the Massachusetts State Department of Public Health, has recently made many such plots for the various causes of death in Massachusetts, sometimes with surprising results (see U. S. Public Health Reports, Aug. 18, 1922). The writer wishes to acknowledge her work as a pioneer in this field, although the method itself is not a new one.



FIGS. 1 TO 8—TYPHOID FEVER CURVES FOR TWO STATES AND SIX CITIES

Plotted on semi-log paper to accentuate breaks in curves. Changes affecting curves indicated where known.

Hogged Fuel Used Instead of Oil In Portland Dredges

Despite Greater Convenience of Fuel Oil, Four Dredges on Columbia River Find It More Economical to Burn Mill Refuse

THE PORT of Portland, Ore., operates four dredges on the Columbia and Willamette rivers, all of which are now burning hogged fuel, the ground-up refuse from lumber mills. Two of these dredges are equipped to burn either hogged fuel or fuel oil. The question of which fuel is the more economical has been studied in the light of changing prices and local conditions with the conclusion thus far in favor of the fuel from the local mills. However, the price of fuel oil at Portland has dropped materially in recent months and on Aug. 25 was about $1.25 per bbl. If this decreases to $1 per bbl. it is believed that because of the convenience and the reduction in labor and equipment necessary to use hogged fuel, it would be preferable to burn oil if the hogged fuel cost remained $1 per unit at the mill. However, as oil prices decline the price of hogged fuel per unit—that is, 200 cu.ft.—should do likewise.

LOADING HOGGED FUEL ONTO DREDGE AT PORTLAND, ORE.

The fuel is brought alongside the dredges in the barges which are tied up close to the boiler room side hatch. Extending out from the dredge is a boom carrying an endless chain bucket conveyor which feeds from the barge into the dredge storage room.

Some of the factors that affect this problem follow:

Reasons cited by the Port of Portland for favoring hogged fuel are (1) its comparative economy, (2) its local origin which eliminates danger of interruption due to transportation difficulties and (3) the desire to encourage mill operations that might not be feasible without a market for hogged fuel.

Difficulties or objections to the use of hogged fuel are (1) the cost of equipment and labor problems involved in handling so bulky a commodity, (2) variation in fuel values with the grade of timber being cut, moisture content, etc., (3) losses and delays due to the necessity of taking and paying for the entire output of mills when dredges are not operating continuously; also the shortage of fuel that results when the mills shut down, (4) B.t.u. losses suffered by hogged fuel when stored, which may amount to as much as 40 per cent with fine material when stored five to six months.

Up to 1906 the Port of Portland dredges burned slab wood. Since that time hogged fuel has been used with the occasional supplemental use of oil. The use of both fuels simultaneously is advantageous when moisture is unusually high in the mill refuse.

Of the four dredges, one requires for its operation a total of about 400 hp., two require about 1,500 hp. each, and the fourth about 2,000 hp. When all four are in continuous operation their total requirement is about 5,800 units of hogged fuel per month. In order to be certain of having a continuous supply of this amount it has been considered necessary to make contracts with the mills. The Port of Portland has been taking, under a contract price of $1 per unit, the entire hogged fuel output from five sawmills. After adding delivery and handling charges, the cost of the fuel on barges alongside the dredge has been $2 per unit.

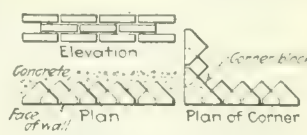
Tests conducted on the dredge Willamette, which develops a total of about 1,500 hp., showed that with the average hogged fuel then in use containing 37.76 per cent moisture and yielding 4,774 B.t.u. per lb., the dredge used an average of 9,390 lb. of fuel per hour. This fuel averaged 3,600 lb. per unit, giving a consumption of about 2.7 units per hour.

The need for making contracts for the entire hogged fuel output of mills was particularly urgent a few years ago when fuel oil went up to $2.25 per bbl., and many industries converted power plants for the use of hogged fuel, thus creating a strong demand for it. Now that oil prices have declined, hogged fuel costs may reflect the downward trend and two-year contracts of the Port of Portland, expiring next spring, will probably be renewed. The mills are on the river so that transportation is by water. The longest haul has been about 75 miles, but in summer, May to August, when water is high, the current in the river adds to time and cost of the upstream trip.

While fuel oil can be handled effectively by one small barge per dredge, it requires three to four barges for each dredge to maintain an adequate supply of hogged fuel. Seventeen barges are now used by the Port of Portland to serve the four dredges. Six of these were built within the past year at a cost of $15,000 each. The new barges have a capacity of about 240 units each, some of the older barges as low as 140 units.

Pressed Concrete Blocks for Canal Locks

TO REDUCE the cost of lock construction on the new canal between the Meuse and Wahl rivers in Holland, a facing of special concrete blocks was devised for the lock walls as a substitute for the usual basalt or vitrified brick lining, since the latter is expensive and does not bond well with the mass concrete. These concrete blocks, shown in the accompanying drawing, are about 4 in. thick and 20 in. long; they are of 1:3 gravel concrete ($\frac{3}{8}$-in. gravel) and are made in forms subjected to a pressure of about 100 tons. The blocks are laid with $\frac{3}{8}$-in. mortar joints and are so stable that they serve largely as forms for the mass concrete. At corners likely to be struck by vessels a granite block facing is used. In a paper in *The Engineer*, London, it is stated by Mr. Wentholt, engineer in charge of construction, that this block lining has the advantages of hardness, cheapness and good appearance, besides eliminating expensive formwork. Thin semicircular arch blocks of similar construction were used for the roofs of the lock culverts, so that mass concrete was placed over these culverts without the use of forms. Hexagonal concrete blocks 16 in. thick also form the floor of the lock between the gates.



CONCRETE BLOCK FACING FOR LOCK WALLS

Fire Prevention in Timber Floors of Highway Bridges

Report of Co-operative Committee Finds a Definite Fire Risk and Suggests Safeguards in Construction and Maintenance

Destruction by fire of the Thirtieth St. bridge over the Allegheny River at Pittsburgh last year focused attention on the fire danger in wooden bridge floors. Numerous other serious bridge fires of the last eight or ten years were recalled and certain questions were raised concerning the nature and magnitude of this fire danger. It was suggested that creosoting introduces a special hazard, that bad design of bridge floors favors the starting or the spread of fire, that neglect in maintenance is a factor in the fire situation, that bridges should be provided with fire-fighting means, and the like. Discussion of the subject on invitation of Engineering News-Record ultimately led to the conclusion by a number of interested authorities that the subject was so important as to call for special study by a competent committee. This conclusion was warmly supported by the Wood Preservers' Association, and on the initiative of that body a co-operative committee was formed for engineering study of the subject.

The report of this committee, just issued, is reprinted in full in the following. It constitutes the first definite recognition of the fire risk in bridges, and indicates the joint responsibility of designing and maintaining authorities.—EDITOR.

DURING the past few years a number of serious fires have occurred on important bridges and the circumstances attending these fires have indicated the desirability of making a detailed study of the situation, in an attempt to bring out the important factors governing the fire hazard in timber bridge construction. With this purpose in mind a co-operative committee was formed representing fire protection, highway bridge construction, lumber, creosoting and the public interest, as given by the signatures hereto.

An extensive correspondence has been carried on with city, county and state bridge engineers, and with this and information collected from other available sources as a basis the committee submits the following report:

Fire Risk—The existence of a fire risk in bridges having wooden floors must be recognized. An indication of the importance of this risk is the fact that on some heavily traveled city bridges small fires are of daily occurrence during the summer months.[1]

The available evidence indicates that this risk is much less for country bridges than for city bridges and is greater on long bridges than on short ones.

Causes of Fires—On city bridges, fires are most commonly caused by the lodgment of lighted cigar or cigarette stubs in cracks or depressions where chaff and débris have collected. Decayed or splintered material in the floor adds greatly to the fire risk. In the case of country bridges the greatest risk is from forest and grass fires.

Other reported causes of fires are: Sparks from locomotives or steamboats; hot coals dropped by steam rollers, traction engines, tar kettles or other construction equipment; burning waste dropped by street cars; defective insulation of electric wiring, defective bonding of rails and lack of capacity in return feed wires of electric railways; fires in adjacent structures.

Relation of Preservative Treatment to Fire Risk—Creosoted material appears to be somewhat more difficult to ignite than untreated material, but once ignited it creates a fire which is hotter and more difficult to control and which is known by experience to be more destructive than fire in an untreated floor. However, decayed or partially decayed untreated wood is very easily ignited and has been the cause of many fires. The likelihood of fire is increased by treatment which results in excessive bleeding of oil, such as might be caused by the heavy treatment of green lumber. It should be noted that freshly creosoted material is much more inflammable than that in which the treatment is several months old. It is urgently recommended that orders for creosoted material be placed as far as possible in advance of construction and that the material be seasoned for three to six months after treatment.

Where it is practicable to do so, freshly treated timber may be rendered more fire resistant by thoroughly coating the upper surface with sand. The application of sand should be continued as long as there is any bleeding of oil.

Construction—In general it may be stated that tightly laid floors, in which cracks are eliminated to a large extent, are most fire-resistant.[2]

The relative fire risk of various types of floor may be stated as follows, beginning with the most fire-resistive:

(a) Wood blocks on concrete base. This type of floor may be said to have no fire risk.
(b) Wood blocks on plank sub-floor.
(c) Laminated floor of 4-in., 6-in. or 8-in. strips laid on edge and spiked together, with a bituminous wearing surface.
(d) Plank floor with bituminous wearing surface.
(e) Laminated floor without wearing surface.
(f) Multiple-thickness plank floor.
(g) Single-thickness plank floor.

Steel joists or stringers supporting floors of any of the above types reduce the risk of rapid spread of fire by reducing the amount of combustible material exposed. Where wood joists or stringers are used the fire risk will be reduced by using heavy timbers for these members. The massing of combustible material renders it less susceptible to ignition and the spread of fire and lessens the probability of serious structural damage before the fire can be controlled, in case fire-fighting means are at hand.

Special care should be exercised in the design of the floor and its supporting structure to avoid ledges or pockets in which trash may collect. The possibility of the accumulation of rubbish on truss members and in floor openings made for the passage of these members should be given careful consideration. In cases where such construction will not interfere with the proper disposal of floor drainage, curbs on timber floors should be constructed with ample clearance between curb and floor so that trash may have an opportunity to blow away.

To check the spread of fire lengthwise of the bridge the spaces between stringers, in cases where these rest on the floorbeams, should be filled with tightly fitting diaphragms over each floorbeam. Perhaps the most practicable method is to use wooden diaphragms at least six inches thick, which may be made up of two thicknesses of plank spiked together. Strips or battens should be placed around the edges of these diaphragms to cover cracks due to imperfect fitting or shrinkage.

The accompanying sketch indicates the recommended construction.

In cases where limitation of headroom is not a factor, fire curtains of sheet metal extending at least 5 ft. below the bottoms of the joists, and spaced at intervals of about 50 ft., will be of material assistance in preventing the spread of fire. The corrugated asbestos-covered metal as used for siding and roofing of buildings is suggested for this purpose.

Maintenance—Floors, ledges and pockets, and bridge seats should be kept free from street sweepings and other trash.

In the case of country bridges, particularly timber trestles, all underbrush, small timber, drift and débris, underneath and for some distance on both sides of the bridge should be removed. Grass and weeds should be cut in the early fall and drift should be removed after floods. Where the vegetable growth is heavy, chemical weed killers are recommended as being economical and efficient.

Frequent inspections should be made of any conductors of electricity which may exist on the bridge.

Floors should be kept free from splintered and decayed wood.

Provisions for Fire Fighting—For bridges where watchmen or bridge tenders are employed, water barrels, sand boxes or water mains may be employed to advantage for fighting fires. For bridges not under constant supervision the value of any of the above is questionable although sand boxes would probably be most likely to be ready for use when needed.

Water barrels and sand boxes should be covered and the surface of the water in the barrels should be covered with a light film of oil. In cold climates freezing of the water in barrels can be prevented by the addition of a suitable amount of calcium chloride.

When water mains are provided they should have hose connections every 50 ft. and hose reels every 200 ft. In cold climates they must either be protected against freezing or be kept empty with provisions for supplying them with water under pressure, either from hydrants direct or from fire engines.

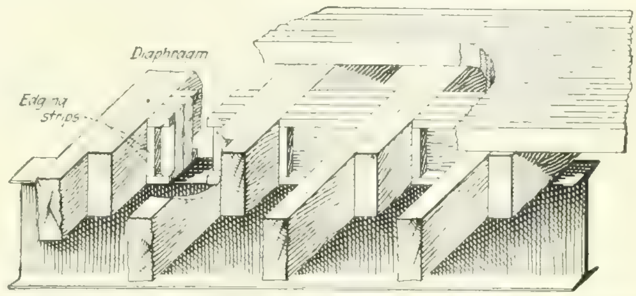
Watchmen and drawbridge tenders should be provided with at least one 2½-gal. soda-acid fire extinguisher. Where aid may be expected from a municipal fire department, there should be provided some means of transmitting alarms. If watchmen or bridge tenders are on duty, a telephone may be considered as a substitute for the more reliable and satisfactory public box on a fire alarm telegraph system.

Maintenance of the under-structure and the use of fire-fighting appliances will be facilitated by providing under the bridge floor, on each side of each pier and at intermediate points not more than 100 ft. apart, platforms constructed of fire-resistive material. Access to these platforms may be secured either by hatchways in the bridge deck or by stairs on the outside of the bridge.

In cases where fire streams from hose and nozzles are available, there should also be provided at 20-ft. intervals, both longitudinally and transversely, openings in the bridge deck to permit the use of cellar pipes, revolving nozzles or similar devices. These openings should be not less than 10 in. in diameter and should be provided with metal covers which can be easily removed but not readily displaced by accident.

Fire Retardant Paints or Treatment—The weight of the evidence, obtained from laboratories which have investigated this subject, is to the effect that, whatever may be expected from future experimentation, there is at present little that can be accomplished in the way of rendering wood fire-resistive by means of a paint coating or other treatment by chemical methods. A paint coating which is not readily combustible may, however, serve to delay slightly the time in which the lumber reaches its maximum susceptibility to ignition. The difficulty with the chemical treatment is that the chemicals will either wash out or, if waterproof, are not fire-resistive.

Conclusion—The investigation having shown that the subject of bridge fire protection is of an importance not previously recognized, the committee desires to emphasize the need for giving consideration to the fire risk in the design of highway bridges. Public officials having bridges in their charge have a clear responsibility in the matter, and the committee desires to call to the attention of such authorities the desirability of protecting bridges by due care in design and construction, by watchful maintenance, and by provision for preventing and fighting fires.



SKETCH OF FIRE-STOP DIAPHRAGMS OVER FLOORBEAMS

Chairman, Geo. W. Booth, Chief Engineer, National Board of Fire Underwriters, New York.

L. T. Ericson, Chief Engineer, The Jennison-Wright Co., Toledo.

C. M. Taylor, Past President, American Wood Preservers' Association, Port Reading, N. J.

D. F. Holtman, Construction Engineer, National Lumber Manufacturers' Association, Washington.

C. J. Hogue, Manager, West Coast Forest Products Bureau, New York.

F. E. Schmitt, Associate Editor, *Engineering News-Record*, New York.

Secy., E. F. Kelley, Senior Highway Bridge Engineer, U. S. Bureau of Public Roads, Washington.

Washington, Nov. 1, 1922.

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[1]John D. Stevenson, Assistant Chief Engineer of the Department of Public Works, city of Pittsburgh, makes the following statement: "The city has several steel bridges having wooden floors. Some of these are large structures crossing the rivers and are important arteries of traffic. During the hot, dry periods of the summer, fires on these bridges are very frequent. They are of minor importance only, because we have been successful in extinguishing them before the flames have taken much of a hold. During the last summer, on one bridge fires were a daily occurrence and not infrequently two or three fires occurred in one day."

The annual report of the fire commissioners of the city of Holyoke, Mass., for 1921 states that during the year "the Department responded to 170 fires on the various bridges. The month of June was particularly prominent in this respect, when the department responded to 64 alarms for bridge fires. This epidemic was lessened in the months to follow through the efforts of the board of public works in sending the sprinkler over the county bridges frequently during the day. While the department has been very fortunate in the past in extinguishing bridge fires at a minimum loss, there is always danger of such a blaze getting so much headway as to cause the loss of one of the bridges." In practically all cases, the cause of these fires is stated in the report of the fire commissioners to be cigarette stubs.

[2]Thomas J. Wasser, State Highway Engineer of New Jersey, states that prior to January, 1922, the old Raritan River bridge at Perth Amboy was decked with closely laid rough plank flooring and that, to his knowledge, no fires were reported during the life of that floor. The deck was replanked with heavier lumber, surfaced on two sides and one edge, and laid with ½-in. openings. Since that time there have been seven small fires on the bridge and it has been necessary for the department to put on a fire patrol to meet these conditions.

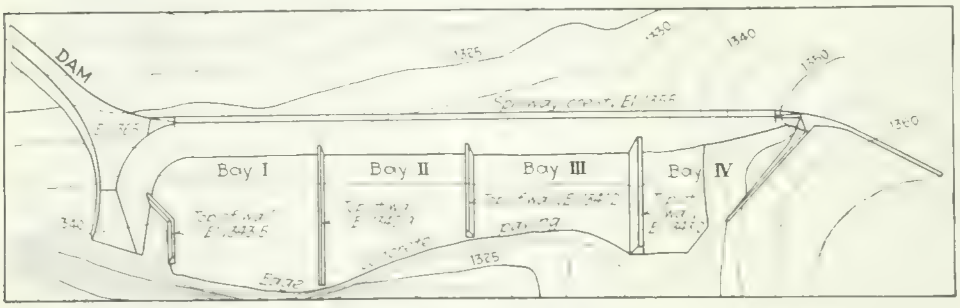
Repairing the Spillway to the Gibraltar Dam

Unexpected Floods Last Winter Tore Out Part of Concrete Spillway—Details of Repair to Water-Supply Dam for Santa Barbara, Cal.

By R. A. Hill
Quinton, Code & Hill, Consulting Engineers, Los Angeles, Cal.

During the past summer the City of Santa Barbara, Cal., has been working on the spillway at the Gibraltar Dam, repairing the damages which occurred during the last winter. Notwithstanding exaggerated reports to the contrary, there has been no real danger to the dam at any time, but the condition at the spillway was such as to render it imperative that extensive additions and repairs be effected to that part of the structure before another winter.

The Gibraltar Dam was completed in the fall of 1919, which year, as indicated by past performance, would be in the first part of a dry cycle. Long-time rainfall records also showed that it was extremely rare for two wet years to occur in succession during such a dry cycle. The normal flood stage of the Santa Ynez River is generally less than 8,000 sec.-ft. and the maximum recorded is about twice that amount. During flood years about three floods of short duration in excess of 5,000 sec.-ft. are to be expected, but the flow of the river rarely exceeds 1,000 sec.-ft. for more than 30 days in any one season.



PLAN OF GIBRALTAR SPILLWAY AFTER CONSTRUCTION, DECEMBER, 1919

Temporary Nature of First Spillway—The plans described in an article on the Gibraltar Dam and its appurtenances in *Engineering News-Record*, May 20, 1920, p. 1003, were somewhat incomplete on account of the economic exigencies. Due in a large measure to the extreme inaccessibility of the Gibraltar Dam, there has been, from the inception of the project, a certain indifference on the part of the citizens of the City of Santa Barbara. The bond issue, which was to provide funds for the construction of the dam and other units of the water system was found to be on completion of final plans somewhat less than was necessary for construction in line with the original intent. The feeling was such that it was not deemed advisable to attempt to raise an additional sum of money, and consequently, as serious floods were not to be expected for several years, it was decided to modify the spillway plans.

The original intent had been to construct an ogee weir with heavy paving to the edge of the cliff over which the water would fall 150 ft. into the gorge of the Santa Ynez River. The edge of the cliff, which is some 40 to 60 ft. distant from the spillway, is from 4 to 6 ft. higher, so that by eliminating the ogee there was formed a water cushion of approximately that depth and the concrete was reduced about 2,000 cu.yd.

The cliff near the dam is almost vertical for a considerable distance; towards the other end of the spillway, however, the slope is much less abrupt and prior to the floods was covered to a considerable depth with earth and boulders. There was such a tremendous quantity of this, that it was deemed inadvisable to excavate, as the first floods would wash away the loose material and expose the face of the cliff in far greater detail than would be possible by excavation. As it was expected that erosion would take place in several places, and particularly in a gulch which heads near the southeast end of the spillway, a sufficient quantity of cement was left on hand to allow patching to be done immediately following the first flood. Unfortunately this stock of cement was requisitioned for repair work in the Mission Tunnel and was not replaced.

Actual Effect of Flood—In spite of the fact that the storage capacity of Gibraltar Reservoir is only 16,000 acre-feet and the Santa Ynez River, above that point, drains over 200 square miles, there was no overflow during the winters of 1919-20 and 1920-21. A violent storm, however, occurred in December, 1921, which centered in Southern California and in less than a week an average of 8 in. of rain, one-half of the total mean annual, fell on the coast cities and a much greater amount on the mountains. During this storm the reservoir filled completely and overflowed the spillway with a maximum discharge of about 3,500 sec.-ft. In the month of January several small floods occurred, so that even with the waste gates open, there was water over the spillway most of the time. The temperatures during this month were quite low, and snow accumulated to a considerable depth on the mountains, with the result that, following a warm rain in February, a flood of 6,500 sec.-ft. maximum poured over the already damaged spillway apron. Since that date the rains have been moderate and there have been no floods of magnitude.

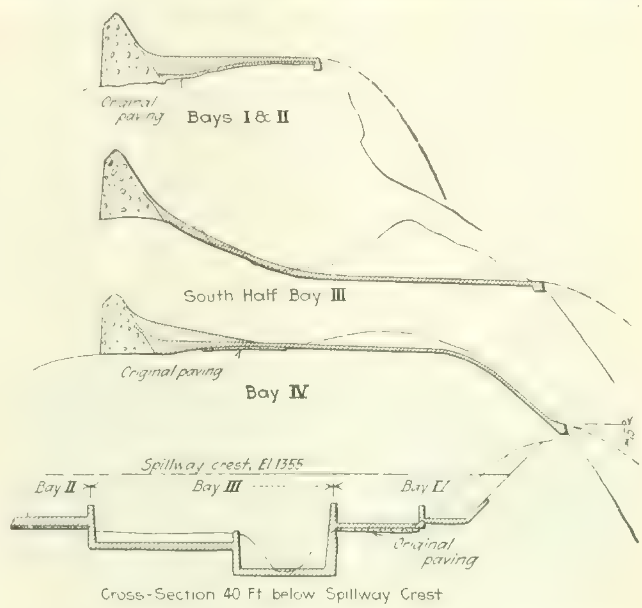
After the flood in December, it was found that the northwest half of the spillway was not damaged, and that the rock below was quite favorable, but at the end away from the dam a rather unfavorable condition was exposed. The gulch was seen to have followed approximately the line of fault, running in a generally east and west direction, which crosses the axis of the spillway about 70 ft. from the south end. As this axis is approximately northwest and southeast, it is seen that a large portion of the water discharging over the spillway naturally concentrated along this fault

line. Erosion near the head of the gulch and of the paving in the third bay from the dam had been quite severe. The abutment of the spillway was of the same type of sandstone as the abutment of the dam itself but overlying a portion of the hard rock in that part of the spillway just north of the fault plane there was found a thin stratum of material which had disintegrated somewhat under the action of water. The paving over the faulted zone at the toe of the spillway weir in the third bay had been broken and torn up by the action of the falling water, until a hole about 20 ft. in its greatest diameter and 6 ft. in depth was formed. There remained only about 10 ft. of badly shattered rocks between the edge of the hole and the face of the cliff.

The flood of February, 1922, poured over the spillway $3\frac{1}{2}$ ft. in depth and plunged down upon the already damaged paving, and broke through this intervening material, cutting a notch in the face of the cliff. While the entire discharge of this bay was concentrated in a narrow chute, the greatest erosion took place beyond the end of the original paving. At that point a hole approximately 30 ft. square and 20 ft. in depth was formed by the combined action of all the water discharged over the left half of the spillway. This left a chute about 20 ft. wide sloping uniformly from the toe of the weir to the bottom of the hole some 30 ft. beyond. At some time during this flood about 20 ft. of the division wall between the third and last bays broke off and dropped into this hole. With the exception of a small piece of paving in the last bay, all of the damage was restricted to this one locality.

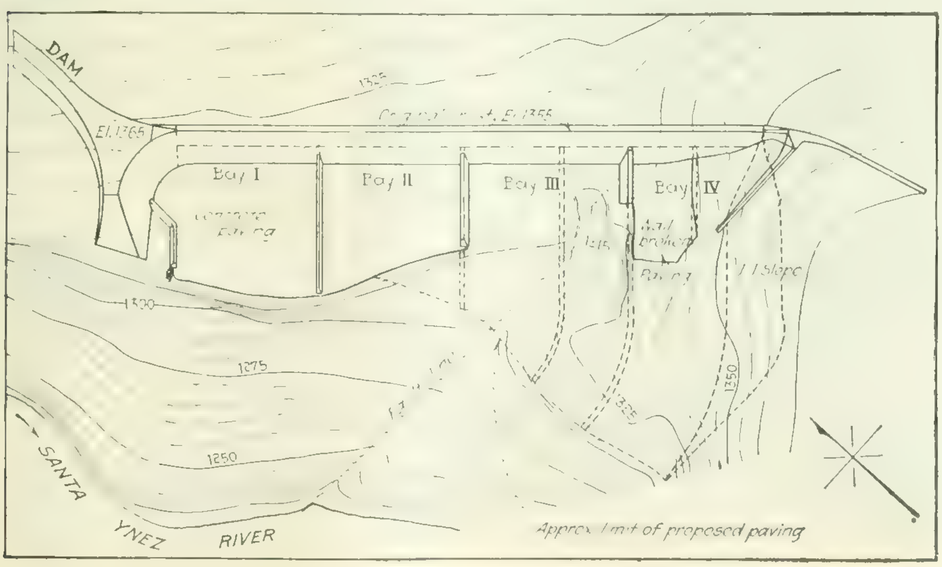
Had this serious break not occurred in the paving between the spillway weir and the edge of the cliff, the effect of these floods would have been advantageous as all the earth and boulders were washed off and the geologic conditions completely exposed. On the other hand if there had been no damage, it is doubtful whether sufficient interest could have been aroused in Santa Barbara to have made it possible to finance the completion of the spillway.

Probable Cause of Damage—There were, apparently, several contributing and dependent causes, some of which might have been avoided, and some, under the economic restrictions, unavoidable. At some stage of overflow the water cushion apparently did not function, a standing wave was formed, and the full force of the impact of the falling sheet came on the paving along the weir. This condition is known to have prevailed at 3 ft. overflow where the water cushion was approximately 6 ft. in depth. This factor alone was not sufficient to have caused material damage, for otherwise the paving would have been torn up along a greater length of the spillway, and erosion of the rock beneath would have taken place.



TYPICAL CROSS-SECTIONS OF REPAIRED SPILLWAY

The modified plans for the spillway called for paving 1 ft. in thickness to be laid directly on solid rock, with the exception that in the case of knobs which projected above the general plane of bedrock, a minimum thickness of 6 in. was allowed. The paving was poured last, and at the point where damage has occurred some of the contractor's plant had to be moved to allow for its completion. At this particular spot, in spite of the fact that the balance of the construction is uniformly of excellent character, the visible condition showed that the construction was faulty, and inherently weak. The paving was in few places more than 6 in. in thickness and knobs of rock actually protruded at many points. There was positive evidence that the paving was laid on a loose rock backfill along the toe of the weir in the damaged portion. The heavy impact of the water dropping twenty or more feet, together with the blows delivered by floating debris quite naturally broke this thin layer of concrete and exposed the loose material. This backfill probably washed out almost immediately, following which great slabs of the floor were lifted up by the force of the sheet of water driving beneath it. The division wall between the last two bays was not carried as far out as intended, with the result



TOPOGRAPHY AFTER 1922 FLOOD, SHOWING REPAIRS

that a greater part of the flow of the last bay concentrated in the gulch which is immediately in front of the third bay.

Even these conditions would not have resulted in serious damage had it not been for the unfortunate fact that the location of the only poor construction coincided exactly with that of the shattered fault zone. The rock on both sides of the plane of the fault is badly cracked so that after erosion was started this rock came out in blocks. The large hole described above is a result of this action rather than a product of scour, as indicated by the jagged character of the rock exposed on its almost vertical sides.

It was this combination of circumstances, first, the failure of the water cushion to act as such; second, the faulty construction work at this point; and third, the shattered strata along the hitherto unknown fault line, which together have brought about a condition demanding immediate and comprehensive repairs and additions to the temporary spillway at the Gibraltar Dam.

Reconstruction Work—The plans being executed are similar to the original, except that the erosion near the end away from the dam has necessitated certain modifications and additions. The two bays comprising the north half of the spillway are practically undamaged by the floods and such work as is done here will be largely substitution of permanent for temporary construction. The edge of the cliff is from 5 to 6 ft. higher than the toe of the weir and from 50 to 60 ft. distant. This wedge will be solidly filled with concrete and joined by a smooth curve to the downstream slope of the weir.

The third bay, that is the damaged one, was 70 ft. in width but now must be divided into two parts in order to avoid an excessive amount of either concrete or excavation. The 45-ft. closest to the dam is not eroded materially, but the paving is broken up entirely and the underlying rocks to a depth of about 4 ft. are of poor character, so that both of these must be removed. The ogee form will be used here, as in the case of the two north bays, but owing to the excavation the level of the paving will he from 4 to 6 ft. lower, the paving in this bay will be extended on down the slope of the cliff for a distance of some 70 ft. to prevent erosion at the head of the fault crevasse. This slope paving will be continued to the north, but gradually reduced in width to taper out finally opposite the center of the second bay from the dam.

CLOSE VIEW OF DAMAGED SPILLWAY

The other 25 ft. of the third bay has been eroded below the level of the soft upper layers so that the chute now formed will be paved and joined by a curve to the spillway weir. The opposite wall of the hole torn out by the February flood will be shot away and this chute will be carried beyond so that water discharging through it will not concentrate along the fault.

In the bay next to the mountain the new construction follows closely the original intent. Some of the paving near the toe of the weir has been torn out but the general character of the material beneath was such that but little erosion occurred. The outlet channel of this bay is being carried out approximately 140 ft. from the weir and will be considerably widened by excavation into the side of the mountain. The paving will be joined to the weir in a smooth curve and sufficient slope will be given to it, as in all other cases, to maintain the velocity of the falling water.

The water discharging over the right half of the spillway will leave the paving approximately 60 ft. away and on top of the cliff, but that over the left half will be carried from 100 to 140 ft. from the weir and will be at an elevation of 40 to 50 ft. below the crest when released. In all cases the angle

LOOKING AT DAM FROM CLIFF ACROSS RIVER

of discharge will cause the water to jump 50 to 100 ft. beyond the paving before it strikes the face of the cliff. Because free discharge into air cannot be secured, the work will be constructed so as to prevent the formation of a standing wave on the paving. In addition training walls are provided between channels of different elevation.

Summary.—It is estimated that there will be required about 3,200 cu.yd. of concrete and 3,500 cu.yd. of rock excavation. Their cost is estimated at $90,000.

Danger to the major structure, the dam, does not exist, nor could any possible failure of the spillway cause the catastrophe feared by some people unfamiliar with the conditions. In all fairness it should be stated that had the fault zone been visible, it is probable that a heavier type of construction would have been insisted upon and would have been allowed.

GIBRALTAR SPILLWAY FROM CLIFF ACROSS RIVER

(A) Material under overhang not washed out. (B) Hard cap, same as abutment of dam. (C) Thin stratum of soft material. (D) Portion of paving which failed in December, 1921. (E) Location of notch cut in face of cliff by February, 1922, flood. (F) Location of hole formed by February flood. (G) Fault line exposed by floods. (H) Approximate end of proposed chute in Bay 4.

Quinton, Code and Hill of Los Angeles were consulting engineers to the City of Santa Barbara during the period of construction and are now retained as consulting and supervising engineers in all matters pertaining to the repair of the Gibraltar spillway. All construction work at the dam and on the various units of the aqueduct was under the supervision of E. E. Haskell. The Gibraltar Dam and its appurtenances was contracted to W. A. Kraner of San Francisco, associated with Bent Brothers of Los Angeles.

Rock-and-Wire Deflectors Protect Banks Against Floods

THE California highway commission last winter constructed about 2,000 lin.ft. of diversion walls made of rock laid in wire mesh casings. These structures, known to engineers of the highway commission, as "sausages," are found to afford the desired bank protection at a comparatively low cost. All the work was done near Los Angeles where stream beds which are dry for most of the year, occasionally carry capacity floods that rapidly cut their banks, endangering highways and even carrying away improved land.

"SAUSAGES" READY FOR SERVICE ON BIG TEJUNGA CHANNEL

Rich orchard land at the right was rapidly being cut away by flood currents that undermined the toe of the steep banks.

The "sausages" are made by unrolling side by side where the structure is to be built two widths of No. 6 gage, 6-in., electrically welded wire mesh, and firmly lacing the adjoining edges together with No. 12 galvanized wire. Rock of any size over 6 in. in diameter that can be conveniently handled are then brought on horse-drawn sleds and piled by hand along the center of the wire mesh. When the pile has reached a suitable height the outer edges of the strips are brought together on top and laced with No. 12 galvanized wire.

Two sizes of "sausages" have thus far been built in about equal quantities, the smaller about 10 ft. and the larger 14 ft. in circumference at a cost of about $1.50 per lin.ft. for the smaller and $2 for the larger. The former are made with two 5-ft. strips and the latter with two 7-ft. strips of the wire mesh.

Wing walls made in this way are anchored only by their own weight. They begin at the bank to be protected and extend downstream and out into the channel. In times of flood they tend to collect debris that further increases their current deflecting effect.

LAST CONSTRUCTION STAGE—LACING THE WIRE MESH

Rocks are hauled to the pile on sleds from both sides. Very large rocks are used on the bottom of the pile where possible.

FROM JOB AND OFFICE

Hints That Cut Costs and Time *For the Contractor and the Engineer*

Massive Construction in Anchorages and Towers Features Columbus Bridge

By R. C. Cheney

Assistant City Engineer, Columbus, Ohio

THE CITY of Columbus, Ohio, has but recently completed a short span suspension footbridge connecting two park areas, which is unusual in foundation work for towers and in the construction of its cable anchorages. High water a year ago took out a light cable span which was the only means of crossing Alum Creek in the eastern part of the city for a distance of about three-quarters of a mile. Replacement of this bridge was necessary, so the type herein described and illustrated was constructed.

TOWER AND APPROACH RAMP

Massive towers formed one of the features of the suspension footbridge connecting two park areas in Columbus, Ohio. The total height of towers including foundations is 43 ft., only 17 ft. of which is above floor grade.

The stream at the bridge site normally flows about 8 ft. above low water, but often overflows several times a year flooding the flat ground on the west bank, the east bank being protected by a 6-ft. levee. A bridge floor grade of about 12 ft. above the general park grade was established, necessitating construction of embankment approaches at each end which were graded and seeded. A 6-ft. limestone walk was also built winding down these ramps.

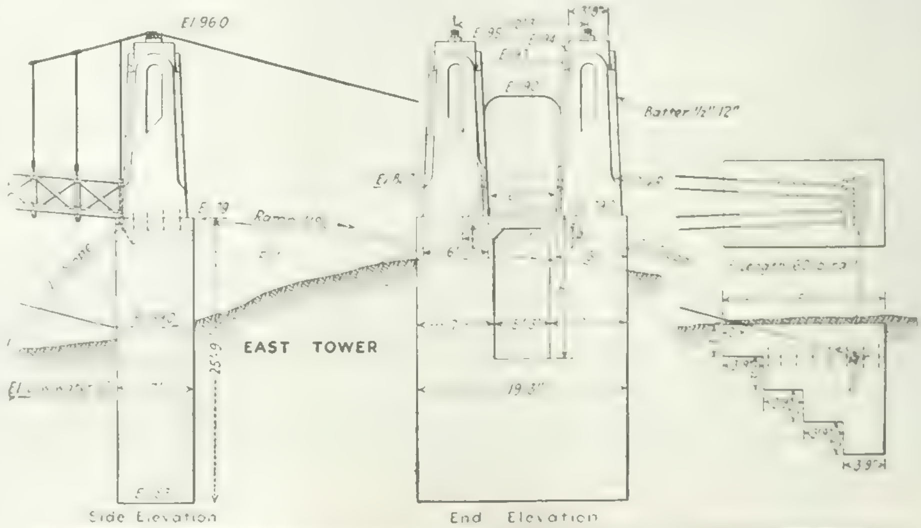
At first it was believed that foundation soil would be of low bearing power and the plans contemplated wood piles under the towers. Upon excavation, however, gravel was found. Though satisfactory for bearing power alone, it was feared this gravel might be scoured because of the location of the towers with respect to the stream. Sufficient penetration with wood piles was impossible. Test piles and steel rods in each hole indicated rock or a firm resistance at 8 to 9 ft. below the planned bottom.

Encasing the footing with steel sheet piling was considered, but this was disregarded in favor of carrying the concrete footing down. The excavation was therefore continued and about 5 ft. below the planned grade a bed of blue clay was encountered, which was very firm and difficult to excavate. The towers were therefore concreted in pockets 3 ft. deep into this material, making the total height of the towers including the foundations 43 ft. Of this distance 17 ft. only was above floor grade.

DETAIL OF HANGER AND TIGHTENING TIE

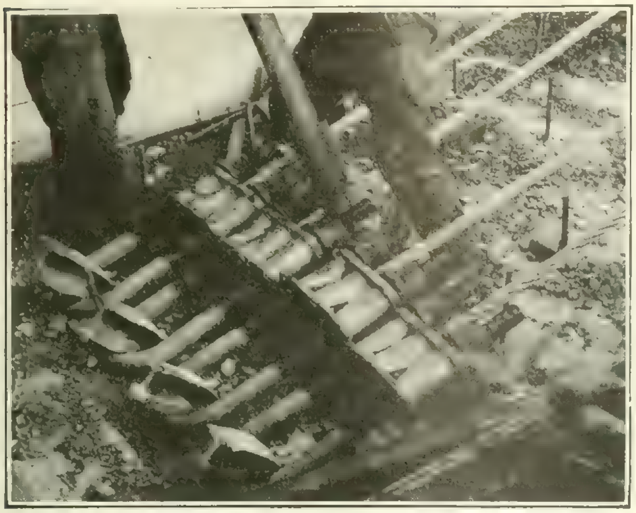
The lower rod used as a tightening tie for the rail system projects far enough up to connect through a small block with the hanger rod. The block allows tho upper rod to be screwed up or down for local vertical adjustment.

The anchorages were constructed early so that the concrete after having set sufficiently was able to carry the cable load during the bridge erection. In constructing these anchorages the concrete was first brought up to a plane within 3 ft. of the finished grade. The rails were embedded for attaching the closed bridge socket, and the cables were hooked at the ends to these rails and elevated to the tower saddles. When the bridge floor was assembled and adjusted to grade the upper lift of the anchorage was concreted, encasing permanently the attachment of the cables. As the top grade of the anchorages was about the general ground elevation, a thin covering of earth was spread over and seeded with the other surface. Concrete in the tower footings and anchorages was 1:3:6 and all other concrete 1:2:4.



TOWER ELEVATIONS AND ANCHORAGE DETAILS

Anchorages were constructed early enough to support the cable load during the erection of the bridge.



CABLE ANCHORAGES FOR COLUMBUS BRIDGE

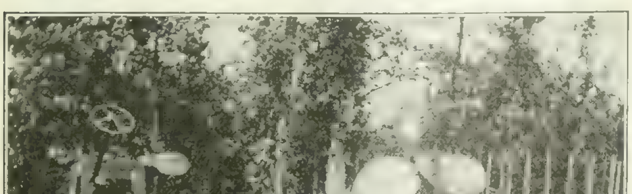
Concrete was poured to within 3 ft. of the finished grade, the cables hooked to the rails and elevated to the tower saddles. When the bridge floor was adjusted to grade, the upper lift of the anchcrage concrete was poured.

The bridge was built by the city of Columbus, R. H. Simpson city engineer. The construction was under the direction of the division which handles bridges and other structures, of which the writer is engineer in charge, and J. F. Evans resident engineer. The Capital Construction Co. of Columbus, the contractor, handled the superstructure, and the Grant-Boulton Co., subcontracted the substructure.

Dismantled Touring Car Supplies Motive Power to Drive Mixer

THE photograph below shows a concrete mixer driven by a gasoline engine taken from a Ford touring car. The mixer was usually driven by an electric motor but in some emergency development work no motive power seemed at hand. A Ford touring car was temporarily dismantled and the engine, hood, instrument board, and storage battery were attached to two channel irons. A short shaft, mounted on bearings between the channel iron frame and carrying a pulley, was attached to the engine propellor shaft beyond the clutch. The speed of the small drive pulley was 1,025 r.p.m. when the touring car was rated at 15 miles per hour.

Over 200 cu.yd. of concrete were mixed with this machine which worked quite as well as when driven by an electric motor.

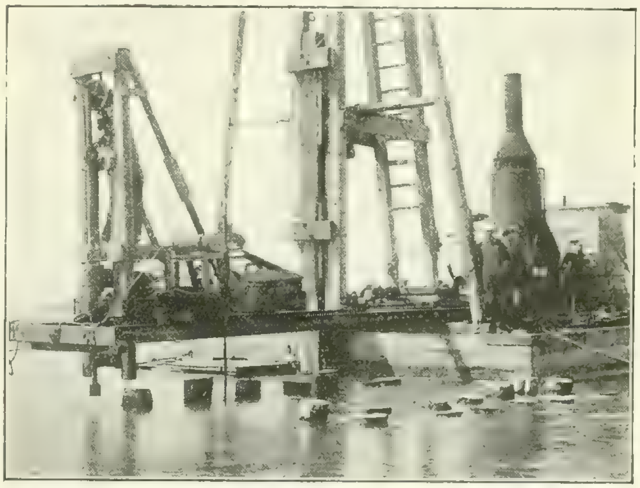


FORD ENGINE REPLACES ELECTRIC MOTOR ON MIXER

Pile Cutoff Saw Is Mounted on Carriage Extending from Piledriver Scow

IN THE construction of Section 1 of the Jersey—Maryland Street dock wall in the harbor at Buffalo N. Y. a method for cutting off piles under water was designed by the contractor which has rather unusual features. The total length of this section of the dock was 546 ft. and consists of wood piling driven to rock and surmounted by rows of premolded concrete blocks with a reinforced-concrete slab 20 ft. wide on top of and between the blocks. There are 49 bents, each bent having two rows of piles spaced 2 ft. 6 in. on centers and each row consisting of seven piles, making a total of 686 piles. The method of procedure in cutting off piles was as follows:

A track consisting of two 8-in. I-beams was extended out from the piledriver, one end being bolted in place on the deck of the driver and the other end being held in place by two guy cables attached to the piledriver leads. A constant check was kept by means of a carpenter's hand level on the track. A carriage with four small flanged wheels and an A-frame supported the shafts for the saw and a gasoline motor and was operated back and forth on the track by means of a small cable and hand winch. The shaft was held in place in the A-frame by two sets of guys and was raised or lowered with a chain block which was fastened on top of the A-frame. The saw was belt-driven by the gasoline motor. The piledriver was held stationary by means of a 12 x 12-in. spud placed in the leads. This spud leveled the track of the saw carriage by leveling the boat itself.



PILE CUTOFF SAW USED IN BUFFALO HARBOR WORK

The track on which the cutoff saw carriage operates is kept level by adjusting the spud in the piledriver leads. The device is controlled from the piledriver by a hand winch. Cutoff elevation is established by raising or lowering the saw by means of a chain block, the proper elevation being secured by sighting on a target in the A-frame shaft.

A target was placed on the guy supporting the shaft in the A-frame at a given distance from the bottom of the saw. This target was then set by an observer on shore with a level and raised or lowered by means of the chain block. At a given signal the saw was set in motion.

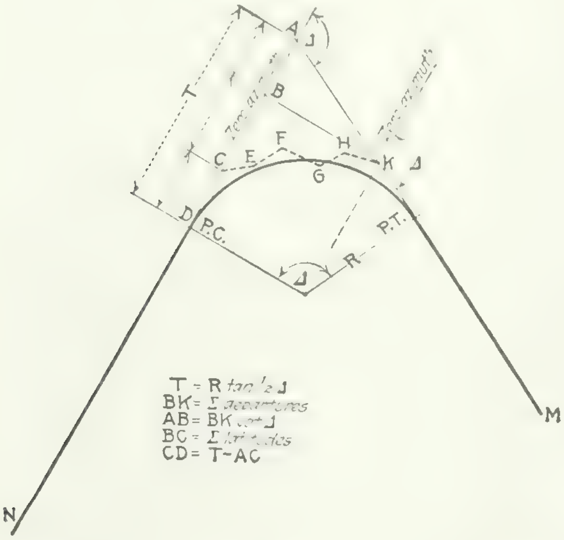
The work was done under the direction of George H. Norton, city engineer, and John T. Mockler, assistant engineer. George Parks Sons Co., Inc., Buffalo, N. Y., was the contractor.

Locating a Curve With an Inaccessible P.I. In Thorn-Brush Country

By W. W. Armstrong
Cadiz, Ohio

In locating a curve recently the point of intersection was in a deep gorge and the ground where the curve was to be located was covered with thorn brush, so the following method was used:

In the accompanying sketch, *DA* was assumed to have a zero azimuth. With a transit having a full circle limb in a clockwise direction a traverse by the back angle method was picked out through the openings in the brush along the line *CEFGHK*. With the instrument set at *K*, oriented and the telescope directed toward *M*, the vernier reading or azimuth of the line *KM* is equal to the central angle of the curve. For convenience the direction *DA* was called north. Then the algebraic sum of the latitudes is equal to the line *BK*, and the departures the line *BC*. *AB* is equal to *BK* cot Δ. We then measured back to *D* from *C* and located the P.C., from which the curve was run. It was much easier then to clear the brush ahead of the chainmen.



CURVE RUN IN FROM PRELIMINARY TRAVERSE

With an inaccessible point of intersection the above curve was located as shown, so that little thorn brush, which covered the site, had to be cut out of the way to allow instrument work to proceed.

Simple Method of Making Prints

By Frederic I. Winslow
Consulting Engineer, Framingham, Mass.

I venture to suggest a trivial, yet convenient method of securing a clear blue or black print from a typewritten sheet; which I have never seen published. The copy is written on a thin sheet of white paper inserted in the typewriting machine, but the paper is backed with a carbon sheet with the carbon side against the back of the white paper, and not placed as is done when a number of carbon copies are made. The keys are struck as hard as is practicable, making an impression of each letter on the back of the paper. If done thus, a clear print is secured at an inexpensive figure and with a minimum of effort.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Steel Shield Pulled by Excavator Keeps Trench from Caving

By P. H. Knight
City Engineer, Frankfort, Ind.

A shield has been used in the construction of a district sanitary sewer 7,500 ft. long and 18 in. in diameter at Frankfort, Ind.

An Austin trench excavator was digging the trench and as the soil was sandy loam much trouble was caused by the banks caving to the outside line of the tractions. The sides of the trench held to a depth of about 4 ft., but owing to the boom and bucket it was impossible to prevent caving from there down to the pipe. This made a dangerous situation for the bottom men and the shield was designed to protect them. The depth of the trench where the shield was erected was 17 ft.

The shield is simply a ½-in. steel plate about 18 ft. long set up on edge at each side of the bottom of the trench to a height of 12 ft. A channel iron frame was built at the front end, and another frame 3 ft. from the rear end. Vertical strips of wood were bolted to the steel sheets at 5 and 10 ft. from the front end.

A wire screen was fastened to the front end of the shield to prevent the stones (which sometimes roll down on the boom and buckets) from hitting the men.

The front end of the shield at the channel iron frame was hooked near the top to two ¾-in. steel cables. These cables were carried up and crossed before hooking them to a steel beam spreader at the top of the trench. Other cables, spaced wider apart, then carried the strain ahead to the excavator. The spreader was on wheels. The shield moves ahead at the same rate as the excavator.

SHIELD KEEPS TRENCH SIDES FROM CAVING

FROM JOB AND OFFICE

For Contractor and Engineer

Wrongly Devised Details That Cut the Contractor's Profit

BY FRANK B. LEE

Philadelphia, Pa.

IN INSPECTING certain construction jobs in Philadelphia my attention has been directed to a number of badly-devised details both in plant layout and in the operation and use of equipment. In the following paragraphs several examples are cited wherein money was lost or work complicated through more or less bunglesome methods.

In a certain cellar excavation the runway for trucks handling excavated material was started diagonally across the site to be excavated in order that the trucks might turn in a narrow alley. If the runway had been placed in the center of the work and the runway flared at the top all excavation could have been done by mechanical means and the trucks would have been given room enough at least in which to start the turn into the alley. By the method used a corner of the site was left which had to be excavated by hand. (Fig. 1.)

On another job excavation that could have been done entirely with mechanical means had to be done by hand because sheeting was not driven in advance of the excavation. Then, too, the method of driving the sheeting was rude. This job was on an excavation for the basement of an office building. Three-inch by 10-in. sheeting was driven with wooden hand mauls. The mauls even lacked iron reinforcement bands. When the men were driving the sheeting the shovelers below stopped work, and everyone stopped when the teams hauling dump wagons were being unhitched from empties and hitched to loaded wagons.

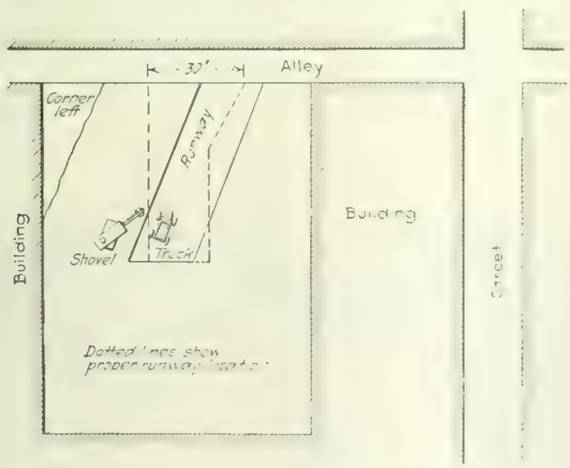


FIG. 1—LOCATING A RUNWAY POORLY AND WELL

Another bad feature of this job was the method in which teams and load were hauled up the runway. (See Fig. 2). They were hauled up by a hoist but with the hoist line attached to the side of the wagon at the front. When the wagon was pulled up the incline the hoist line interfered with the teams to such an extent that the driver had difficulty in guiding the wagon. Why not hitch at the rear of the wagon with an offset brace hung in front so that the hoist line would clear the team? (See Fig. 2,B.)

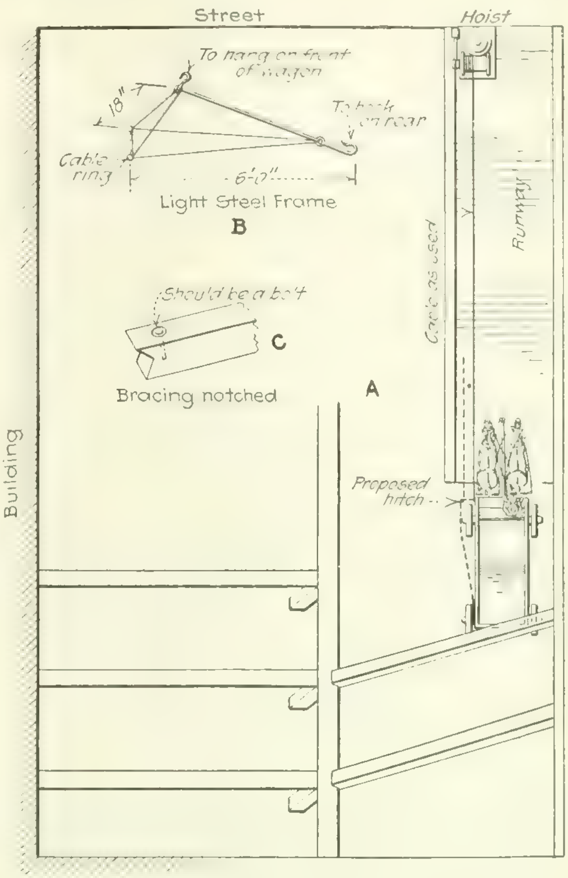


FIG. 2—TWO ERRORS IN BASEMENT EXCAVATING

Still another piece of rough work on this same job was noticed in the manner in which the timbering supporting the excavation was framed. As is shown in Fig. 2 the diagonal timbers were notched, but no safeguard was provided against their splitting. Bolts should have been run through the timbers. (Fig. 2,C.)

A certain road job should have shown a profit to the contractor who had it but through improper and inadequate use of equipment and through improper material handling, it was built at a loss. Stone was taken from a quarry near the job and on a direct line from the job to the railroad siding where other concreting materials were received. In actual work the material was all dumped on boards ahead of the mixer and then transported to the mixer in dump carts. Considerable saving would have been effected, in my belief, if all materials had been concentrated at the stone bin and then loaded into batch boxes to be dumped directly into the mixer skip with no costly rehandling.

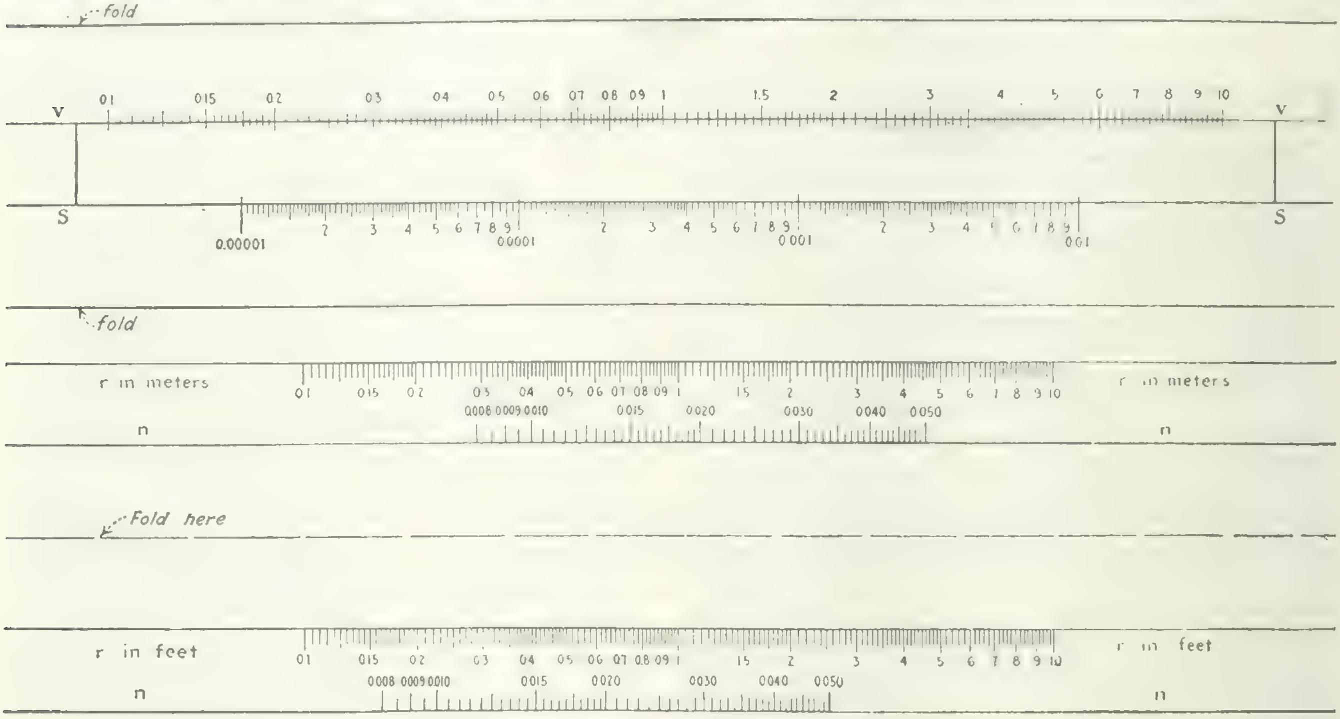
Another cellar excavation job which attracted my attention was one on which material was excavated by hand from pier foundation sites, then rehandled into dump wagons and hauled 70 ft. to be dumped onto a fill. One fresno scraper would have done the trick with all costly handling and loading charges eliminated.

The things I mention here are small but they are costly. They seem due not to a lack of knowledge but to indifference where refinements in methods are concerned. It is easy to keep in touch with the latest uses to which machinery can be put. There is no excuse for such rough construction work.

Slide Rule for Solving Manning Formula

By T. Kiang
Assistant Engineer, Chihli River Commission, Tientsin, China

MANNING'S formula for the calculation of flow in open channels is generally regarded as the simplest of its kind in common use. Diagrams for solving



SLIDE RULE FOR SOLVING MANNING FORMULA

formula with a view to avoid laborious computations have been devised. The writer finds a still quicker method that is a special slide rule. The annexed figure shows such a slide rule in two parts. Part A, when folded along the heavier lines and pasted with the shaded portion between those two scales cut out, will form an envelope which corresponds to the fixed part of a common slide rule. Part B, when folded along the middle line and pasted, forms a slide which will fit and slide in the envelope formed from Part A. With the scale of r on the slide opposite that of v on the envelope they will work together like a common slide rule.

Example: Given $n = 0.020$; $r = 1$ ft.; and $S = 1 \div 5{,}000$ or 0.0002. To find value of v.

Solution: Using the English units side, move the slide until the line of 0.020 on the n scale coincides with the line of 0.0002 on the S scale. Opposite the line of 1.0 on the r scale is found the line of 1.05 on the v scale which represents the value of v required; i.e., $v = 1.05$ sec.-feet.

With any three quantities given the problem can thus be solved. When the dimensions are in metric units, use the other side of the slide to find v.

All graduations are in their logarithmic values and can be made to cover any given range so far as the lengths of base of their logarithms bear a certain relation to each other as is necessary to satisfy the original equation. This relation can be expressed as follows:

Combination A: With length of base of logarithms of scale r equal to $\frac{2}{3}$ of that of scale v and that of scale S equal to $\frac{1}{2}$ of that of scale n.

Combination B: With length of base of logarithms of scale S equal to $\frac{1}{2}$ of that of scale v and that of scale r equal to $\frac{2}{3}$ of that of scale n. Note that lengths of base of logarithms of scales n and r are not necessarily equal.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Use Circus Safety Net in Tank Erection

ATTACHED to the brackets holding up the scaffolds used by riveters in erecting the steel tank shown here is a safety net like those under circus trapeze performers. If a workman falls or absent-mindedly steps off the narrow scaffold he is caught by the net. The idea was developed by C. W. Penrod, foreman in the Chicago Bridge and Iron Works. The picture is taken from the bottom of a standpipe at Carthage, N. Y.

SAFETY NET TO SAVE TANK RIVETERS

FROM JOB AND OFFICE

For Contractor and Engineer

Truck Outfit for Painting Pavement Center Lines

BY EDWARD N. HINES
Chairman, Wayne County Road Commission, Detroit, Mich.

A TRUCK-MOUNTED outfit for marking the center lines of concrete pavements has greatly reduced the labor cost, in Wayne County, Michigan, of this very important safety measure. When the practice was first begun it took four painters a day to stencil a mile of road, making the labor cost alone about $25. With the painting machine, two men are marking from 6 to 7 miles of pavement every day.

TRAILING WHEEL ON TRUCK MARKS PAVEMENT
An iron frame, following the truck, supports a wooden wheel having a 1-in. felt covering. Paint, played upon the felt tread by compressed air, is transmitted to the pavement by the trailing wheel.

In the outfit illustrated a DeVilbiss compressed-air painting machine has been mounted upon a Ford truck. Following the Ford truck is an iron frame upon which has been mounted a wooden wheel about 2 ft. in diameter and 4 in. wide. This wooden wheel follows in the track of the left-hand wheels of the truck. Around it is tacked about 1 in. of felt. As the truck is driven down the road the trailing wheel revolves upon the pavement. A spray of paint is played directly on the felt tread about 1 ft. above the pavement. This paint is immediately transferred to the pavement by the felt. When it is desired to run without painting, the iron frame and wheel can be raised and laid over on the back end of the truck.

To guide the driver in centering the line, the center of the road is marked about every 50 ft. in front of the truck with a piece of chalk. In case it is desired to re-mark a line, which has grown faint, the driver follows directly with his left-hand wheel over the old line.

A white paint line is being used instead of a black tar line because much of the old concrete mileage has become so darkened from oil drippings that a black line cannot be easily followed at night.

Water Level in Deep Well Discovered by Simple Electrical Device

BY JENT G. THORNE
Consulting Engineer, Clinton, Iowa

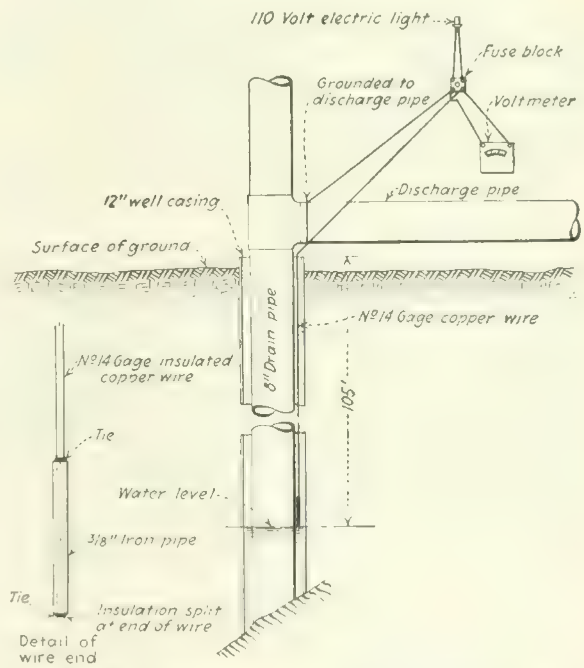
DURING the testing of a new deep well recently drilled in De Witt, Iowa, the height of the water in the well, both before pumping and while pumping, was measured by means of an electric current.

To a 14-gage, rubber-insulated copper wire was attached securely a $\frac{3}{8}$-in. iron pipe 2 ft. long, to act as a weight. The wire was cut off about an inch below the end of this pipe and the insulation allowed to extend slightly below the end of the copper wire. The other end of this wire was connected to one terminal of a fuse block, and a second wire was run from the second terminal on the fuse block, and grounded on the iron drop pipe. From the third and fourth terminals of the fuse block a connection was made to the 110-v. city electric current. A voltmeter was connected to the first two terminals of the fuse block to indicate when the circuit was made.

While the wire was being lowered into the well the hand on the voltmeter stood at zero until the water was reached, when it would move up four or five points. By working the wire up and down several times the exact point was indicated where the hand on the voltmeter would commence to move. In this way the exact height of the water in the well was measured very quickly.

A string with a wooden float was used but was not successful on account of the lack of space between the drop pipe and the well casing. An electric bulb was tried instead of the voltmeter but did not give results.

The whole apparatus is very simple and easy to install and gives the results accurately.



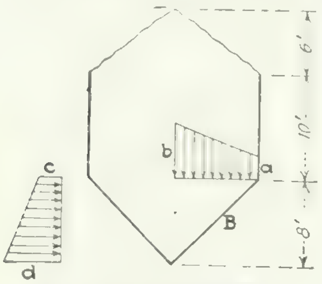
DEVICE FOR ASCERTAINING WATER LEVEL IN WELL
One wire extended from a terminal on a fuse block into the well, and a second wire was grounded on the iron drop pipe. Completion of the circuit (when the wire in the well touched water) was shown on a voltmeter. By measuring the wire length at that point where a completion of the circuit was recorded, the water level was ascertained.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Coal Bin Pressures

Sir—In the communication by Jacob Feld, Oct. 19, 1922, p. 669, on coal-bin pressures, the categorical rejection of the equivalent fluid pressure method is not convincing. To say that a method of designing for lateral pressure of coal is theoretically unsound does not convey anything, and to say that it has been experimentally proved incorrect is equally devoid of meaning, particularly when the reader is given no hint as to who made the experiments, and when and how.



COAL BIN ANALYSIS BY LIQUID PRESSURE METHOD

Small diagrams *ab* and *cd* give the vertical and horizontal components of load on inclined beam *B*

If there is one thing that experiments and experience have proved to be impossible it is to find even the approximate pressure of a granular mass such as coal. Coal can be made to stand against a vertical surface by setting up a few slender boards propped with clothes props; if the boards be taken away it may stand alone and it may come down like an avalanche. Everyone will admit that the avalanche possibility is the one that should be provided against in design. Sound theory may account for these three conditions, but it has only academic and school-room interest. The facts are these:

1. Coal may exert a lateral pressure equal to that which a liquid would exert, and designs must be made for this contingency.

2. For horizontal top surface the lateral pressure exerted, as determined by the ordinary theory of pressures of granular materials, can be found with very much less work by using the equivalent liquid pressure method, and the results are identical.

When a theory tells us that a pressure is many tons and when a test proves that it may be zero, there is no occasion to burn incense to that theory. However, if it furnishes a rough rule for safe designing, use it, and simplify it in every way possible.

For a condition of surcharge the added head of the "liquid" can be taken as half the amount of the surcharge in the bin. Designs made on this basis, the vertical pressure of the coal being taken as though it were a liquid equal in unit weight to the coal and the lateral pressure or lateral component being taken as a fraction of the vertical pressure, are entirely safe, and an enormous amount of work is saved by the method. To determine the fraction for the horizontal pressure, take any of the lateral pressure theories, find the total horizontal pressure on a vertical surface, no surcharge, and compare this with full liquid pressure.

Given an inclined beam B on the bottom of a bin as per sketch: If the coal weighs 50 lb. per cu.ft. and the lateral-pressure fraction is found to be 0.3, the load intensities are

Vertical component

$$a = 50 \times 10$$
$$b = 50 \times 24$$

Horizontal component

$$c = 0.3 \times 50 \times 13$$
$$d = 0.3 \times 50 \times 21$$

The bending moment on beam B is very simply determined from these data.

EDWARD GODFREY.

Pittsburgh, Oct. 21.

Steep Street Grades in San Francisco

Sir—The article "Brick Used in Paving 34 per cent Grade" in *Engineering News-Record*, Aug. 17, 1922, p. 267 concludes by saying, "The writer has seen and heard of several paved streets with grades as high as 30 per cent, but to his knowledge this street is the steepest one of which there is any knowledge."

We have in San Francisco a short stretch of cobble pavement laid on a 50.1 per cent grade on Duncan St., between Noe and Sanchez streets. Although this street may not be known to eastern engineers, it is well known on the Pacific Coast, especially to automobile dealers, who have frequently sent their cars over the grade to test their stamina. This particular pavement is 40 ft. wide. Granite curbs and 2.17-ft. basalt block gutters, cement grouted. laid on a concrete base, adjoin the cobblestone pavement. This street was paved to the existing grade, which the property owners did not want changed. The pavement protects the hillside from undue erosion, and has no other practical value.

On Jan. 18, 1896, Baker St. from Valley St. to Broadway was paved with cobbles. The roadway of this street is 38.75 ft. in width. The block is 275 ft. long, and is paved for its entire length. The grade is 35.6 per cent. There are other examples of pavements having steep gradients in San Francisco, but the above will establish a record of pavements on steep streets. In passing I might say that such streets as the above would now be treated in an entirely different manner. under what we call our special treatment plan. JAMES M. OWENS, Highway Engineer.

San Francisco, Calif., Sept. 12, 1922.

Is Locating a Lost Art?

Sir—The article by C. K. Conard in *Engineering News-Record* for Sept. 28, 1922, p. 515, on reverse studies in railroad location brings to my mind the fact that locating is in the main a lost art. The old-time locaters under whom I worked when a younger man are nearly all gone and the wonderful art that these old masters developed has to a large extent passed away with them, for theirs was a knowledge not written in books and not easily explained.

All of the old-time experts located in both directions, not merely to run alignment that way but also to select the zones by inspection in both directions. In fixing the zone of operations by reconnaissance it is necessary to go forward, backward, sideways, and up and down, viewing the situation from every angle with the aid of such maps as can be secured. One or two preliminary surveys will usually suffice to limit the bounds of the prospective line, which, of course, is then worked out carefully on paper from contour maps. Being able to see in both directions on the map, it is of no concern in which direction the line is run, staked, and stationed. In the final revision, work is confined to detecting betterments in short stretches which can be viewed on the ground in both directions.

Any one who attempts, however, to locate in one direction without a careful map location closely studied from the grade contour will get a poor line, especially if the angle is large, the curve long, and the whole curve not visible from the P. I.

Balancing quantities from level-cutting tables after the map location has been made and the projected profile worked out usually is sufficient, but some engineers prefer to calculate quantities from projected cross-sections. As rock will swell and earth will shrink, too great a refinement is useless and all the preliminary borings available will not make cuts and fills exactly balance due to the ordinary mishaps of grading. The time spent in engineering help will cost more than the extended refinements can save in quantities.

Today, especially in highway work, too little money is spent for competent locaters and too much on office refinement in minute calculations, overlooking the fact that there may be thousands of dollars difference between a poor location and a good one. I have noticed this in mountain country. The reason is that, while nearly all of our chief engineers of railroads were once locaters, I doubt if 10 per cent

of our state highway engineers ever located a railroad.

Even now I see articles from time to time by highway engineers who write apparently as though they had discovered some new method of slope staking with a prepared tape and rod, or a new method of graphical computation of overhaul. These devices all were worked out long ago by railroad men along with many others not yet discovered by the newly-born highway engineers.

The fact is that all the methods of locating railroads are applicable at the outset in locating highways and unless the highway locater assimilates these principles through actual practice in railroad locating, we will continue to have poor highway locations. In our American Railway Engineering Association bulletins and occasionally through important suggestions such as that of Mr. Conard, the principles of locating can be presented and preserved. I should be glad to have the technical magazines give us more facts on so important a subject.

R. S. Blinn,
Locating Engineer.

Sparta, N. C., Oct. 3.

Abrasion Tests of Concrete Aggregates

Sir—Your issue of Aug. 17, 1922, p. 287, contained a letter by F. H. Jackson, Bureau of Public Roads, under the title of "Questioning Abrasion Tests," which offered certain criticisms of tests made in this laboratory. The tests referred to were contained in my paper before the American Road Builders' Association on "Selection of Aggregates for Concrete Roads," which has since been published in their 1922 "Proceedings."

The conclusions stated in that paper with reference to the value of abrasion tests were not reached solely on the basis of abrasion tests of aggregate, but included also many thousand compression and wear tests of concrete made from about 150 different coarse aggregates.

Mr. Jackson states that the "Rea method was not designed for and is never used for testing crushed stone aggregates." He overlooks the fact that this test was so used in our investigations.

The principal point of my discussion of the present standard wear test is that if the acceptance or rejection of crushed rock depends on minor details of the tests, otherwise similar, then the test method is not satisfactory.

TABLE I—METHODS OF MAKING ABRASION TESTS OF COARSE AGGREGATES

All tests were made in the Deval Abrasion Machine.

Method	Weight and Grading of Sample (Square-Mesh Sieves)	Abrasive Charge 1⅞-in. Cast-Iron Balls	Total Revolutions	Remarks
A.S.T.M.[1]	5,000 gm —2½ to 3 in.		10,000	50 pieces
Mattimore[2]	5,000 gm —2½ to 3 in.		10,000	Same as A.S.T.M. except cylinders provided with 1/16-in. slots which allow fine material to escape as produced
Rea[3]	2,500 gm.—⅜ to ¾ in. 2,500 gm.—¾ to 1½ in.	6	10,000	Use volume of 0.11 cu.ft. in case of materials of unusual weight.
Abrams	2,000 gm —⅜ to ¾ in. 2,000 gm ¾ to 1½ in.	10	2,000	Use volume of 0.09 cu.ft. in case of materials of unusual weight.

[1] Standard Method of Test for Abrasion of Road Materials, A.S.T.M. Standards, 1921, p. 710

[2] Use of Slotted Cylinder for Abrasion Tests of Rocks; Report New York Commissioner of Highways, 1917, p. 62. Also Proc. A.S.T.M. Part II, 1918, p. 426. See results of tests made by this method by F. H. Jackson, Proc. A.S.T.M. Part II, 1920, p. 278.

[3] Abrasion Tests for Gravel Aggregate; General Specifications for Materials Ohio State Highway Department, Columbus; also Concrete Highway Magazine, June, 1918. Mr. Rea used screens with circular openings ½, 1 and 2 in. The wire cloth sieves with square openings used in our tests give approximately the same separation sizes as the circular screens.

The various types of abrasion tests are given in Table I and the results of such tests on a large number of aggregate in Table II. Compression and wear tests of concrete are given in Table III. The tests in Tables II and III are not exactly parallel, since Table II includes only the aggregates on which all the different types of abrasion tests were made.

Many thousand other tests were made in studying the performance of the Deval machine in tests of crushed rocks and pebbles in studying the effect of the following:

(1) Grading of aggregates on wear,
(2) Size of sample,
(3) Number of revolutions,
(4) Number and size of shot used,
(5) Shape of particles.

TABLE II—ABRASION TESTS OF COARSE AGGREGATES

Machine operated at 30 to 33 r.p.m.

See Table I for details of methods of making tests.

The per cent of wear was based on the weight of material finer than a No. 16 sieve, or which escaped through the 1/16-in. slots in Mattimore's method.

	Per Cent of Wear						
Method	Limestone (17)*	Trap (4)*	Granite (3)*	Sandstone (5)*	Slag (3)*	Pebbles (18)*	Grand Av.**
A.S.T.M.	4.8	2.2	1.9	5.0	8.7	0.9	3.9
Mattimore	12.6	4.7	3.8	6.9	17.8	2.6	8.1
Rea	21.0	7.4	18.3	29.5	13.7	10.0	16.6
Abrams	10.5	3.8	8.0	17.1	5.7	4.9	8.3
Average	12.2	4.5	6.0	14.6	11.5	4.6	9.2

* Number of different samples.
** Averages not weighted.

No report has been published on these tests. However, we believe the results given in the tables justify our conclusion that the Deval abrasion test gives little or no information as to the quality of aggregates for concrete road construction. The durability of a concrete road depends primarily on the *quality of the concrete*, and only to a slight degree on the quality of the aggregate. A very excellent concrete road may be built of inferior aggregate, if proper mixtures and methods are used; on the other hand, a very poor concrete road may result from a high-grade aggregate, if careless methods are employed. After examining a great many miles of concrete roads in different sections of the country, I have come to the conclusion that if more attention is given to restricting the quantity of mixing water used and to proper methods of curing, a great deal more latitude may be allowed in the quality of aggregate used. The above conclusions are borne out both by the very exhaustive laboratory investigations which we have carried out and by experience of many sections of the country in using aggregates which are generally considered inferior.

TABLE III—WEAR AND COMPRESSION TESTS OF CONCRETE MADE FROM MISCELLANEOUS COARSE AGGREGATES

Wear tests of 8 x 8 x 5-in. concrete blocks made in Talbot-Jones rattler.
Compression tests of 6 x 12-in. cylinders.
Mix 1:4 by volume of mixed aggregate; approximately same as 1:2:3 mix.
Relative consistency 1.10; about the same as should be used in the construction of concrete roads to be finished by hand.
Hand-mixed concrete; one specimen to a batch
Cement; a mixture of five brands of portland cement purchased in Chicago.
Sand from Elgin, Ill., graded 0-No. 4, used as fine aggregate in all tests.
Each coarse aggregate was screened and recombined to the following grading: No. 4 to ⅜-in., 25%, ⅜ to ¾-in., 50%, ¾ to 1½-in. 25% by volume.
For each aggregate sample, the value for wear was the average of 10 tests and for strength, 5 tests, made on 5 different days.
Specimens stored in damp condition 14 days, then in air until tested at age of 3 months

	Coarse Aggregate				Concrete Tests* (3 Months)	
Kind	Number of Samples Tested	Unit Weight Lb. per Cu Ft	Apparent Specific Gravity	Absorption at 3hr Per Cent by Weight	Compressive Strength, Lb. Per Sq In	Depth of Wear, In.
Pebbles	24	102	2.56	1.17	4,330	0.51
Crushed Limestone	26	91	2.59	1.14	4,560	0.44
Crushed Granite	12	92	2.59	0.32	4,350	0.34
Crushed Trap	6	95	2.85	0.12	4,210	0.40
Crushed Sandstone	7	86	2.34	3.94	4,470	0.45
Crushed Slag	13	88	2.34	2.20	4,240	0.48
Crushed Flint	2	83	2.43		4,850	0.46
Crushed Marble	1	96	2.69	0.39	4,620	0.42
Crushed Lava Rock	1	90	2.62	2.50	5,350	0.40
Crushed Tufa	1	47	1.27	27.50	1,960	0.66
Crushed Fire Brick	1	70	1.92	4.55	5,390	0.43
Cement Clinker	2	88	2.22	8.20	5,160	0.37
Boiler Cinders	1	40	1.51	8.70	3,000	0.85

* Strength tests were also made at ages of 7 and 28 days, and 1 year on many of the aggregates.

Duff A. Abrams,
Professor in Charge, Structural Materials
Research Laboratory, Lewis Institute.

Chicago, Ill., Oct. 9.

NEWS OF THE WEEK

New York, November 9, 1922

Coal Commission Confronted by Many Questions

Staff Counts on Co-Operation From Trade Bodies—Far-Reaching Problems Involved

(Washington Correspondence)

The fact-finding machinery being set up, the President's coal commission is now taking definite form. While the commissioners expect to secure much of their information from the broad conclusions of outstanding men engaged in coal production, distribution, wholesaling and retailing, a vast amount of data must be collected by a technical staff. That portion of the work which deals with costs of production will be under the immediate direction of David L. Wing, whose title is to be expert investigator. C. E. Lesher, editor of *Coal Age*, has been drafted to direct the engineering investigations, and coal specialists from various bureaus will be transferred to the commission. A statistical program is being worked out which it is believed will cause very little dissension, and there is every evidence that the commission will have the whole-hearted co-operation of the entire coal business.

Statistical Compilations

Where statistical and other information is furnished by one branch of the industry, arrangements are being made whereby the other branches concerned and the commission itself can check the figures as they are being compiled. In this way it is hoped to compile statistical data, the correctness of which will be admitted by each branch of the industry.

Since the government's law officers decided that Dr. George Otis Smith may not lead a double official life, it became necessary for him to resign his position as director of the U. S. Geological Survey. After having discussed the matter personally with the President, Dr. Smith presented a formal resignation, which, the President has explained, is temporary. It is planned to reappoint him when his duties with the coal commission have been completed.

One of the most important questions the commissioners will have to consider is whether they will recommend amendments to the anti-trust statute, that will permit consolidations and that will permit of a scheme of collective marketing.

While it is possible that the commissioners may avoid a flat recommendation as to the rates of wage that they may regard as fair, it is certain that they must go deeply into the wage and living cost questions. In their report, they will be expected to discuss and express opinions on such questions as a minimum wage, a guarantee of employment and unemployment insurance.

It is not unreasonable to suppose that they will consider the place of trade unions in the business of coal production, especially when the organization of coal miners exerts so important an influence on the production of two-thirds of all the coal produced in the United States, which, incidentally, is nearly half the world's output. The commission is called upon to probe deeply into the affairs of the strongest labor union in the world.

While nationalization is specified as one of the points on which the commission must report, it is regarded as probable that it will be dismissed without extended discussion. It is probable that the commission will see in the cry for nationalization a reflection of the course that the public instinctively pursues when called upon to pay unusual prices as a result of manipulations for which it is in no wise responsible. Another big question with which the commission must wrestle is that of regulation, in connection with which it will be expected to express an opinion as to whether coal falls into the category of public utilities.

State Control of Water Power Defeated in California

Early returns from California in the general election held Nov. 7 indicate the decisive defeat of a proposed amendment to that state's constitution giving the state ownership and control of water power sites and authorizing the issuance of $500,000,000 in bonds to finance development. Indications are that the bill was defeated by a two-to-one vote.

$40,000,000 Road Bond Measure Fails to Pass in New Jersey

Legislation having in mind the provision of $40,000,000 for the construction of roads and bridges in New Jersey was defeated by the voters of that state in the general election held Nov. 7. Final results on the election were not available as this issue went to press, but the indications are the bond issue was defeated by about three votes to one.

Automobile Fatalities Increase

According to an announcement of the Department of Commerce, returns compiled by the Bureau of the Census show that during the year 1921, 10,168 deaths resulted from accidents caused by automobiles and other motor vehicles (excluding motor cycles). These deaths occurred within the death registration area, which contains 82 per cent of the total population. This number represents a rate of 11.5 per 100,000 population as against 10.4 in 1920; 9.4 in 1919; 9.3 in 1918 and 9 in 1917. Between 1917 and 1921, therefore, the death rate per 100,000 population increased about 28 per cent. In the 27 states for which data for 1917 are available, the actual number of these deaths increased 41.2 per cent. The rate per 100,000 population was highest in Los Angeles, with Chicago second, in a list of 66 cities.

Honor Dr. Hunt on Return From Netherlands Convention

To celebrate his return from Europe where he had attended the 75th anniversary of the foundation of the Koninklijk Instituut van Ingenieurs of the Netherlands, Dr. Charles Warren Hunt, secretary emeritus of the American Society of Civil Engineers, was the guest at an informal dinner held in the Engineers Club, New York City, on Nov. 3. Dr. Hunt attended the anniversary celebration as official delegate from the American Society of Civil Engineers and also in his personal capacity to receive the diploma of honorary membership which had been accorded to him by the Dutch society.

Francis Lee Stuart, formerly director of the American Society of Civil Engineers, presided. Among the speakers were Dr. Alexander C. Humphreys, president of Stevens Institute of Technology, past president of the American Society of Mechanical Engineers, and former director of the American Society of Civil Engineers; William L. Saunders, past president of the American Institute of Mining & Metallurgical Engineers, and John F. O'Rourke, former director of the American Society of Civil Engineers.

The speakers all expressed appreciation of the compliment extended to the American Society of Civil Engineers by the Dutch society in the election of Dr. Hunt as an honorary member and paid tribute to his long service as secretary during a difficult period of its development. Dr. Hunt responded with a brief account of his trip and of the courtesies extended to him by his hosts.

New York State Engineer Joins Consulting Engineering Firm

Frank M. Williams, who is completing his fifth year as state engineer of New York, has joined the Technical Advisory Corp., a consulting engineering firm of New York City. His active connection with the corporation will begin Jan. 1, 1923. However, in the meantime he will be available by appointment for consultation on certain matters which will not conflict with his official duties.

Mr. Williams will be one of the corporation's active principals specializing in advice on matters pertaining to water-power development, canal construction, highway and pavement building, public utility valuation, and railway and marine terminal development.

The Technical Advisory Corp. was organized in 1920 and is composed of a number of prominent consulting engineers.

Illinois Society Selects Peoria as Annual Meeting Place

The Illinois Society of Engineers has decided to hold its next annual meeting at Peoria, Ill., Jan. 23 to 25, 1923. E. E. R. Tratman, Wheaton, Ill., associate editor of *Engineering News-Record*, is the secretary.

Shallow Foundation Causes Building Failure

Failure of a factory building in Richmond, Va., on Sept. 15, has been found upon investigation to be due to a peculiar condition of shallow foundation. The facts as given by Allen J. Saville, director of public works, are as follows:

The collapsed building, of mill construction and four stories high, built less than ten years ago, stood on a sidehill site. The basement of the building adjoining on the downhill side, an older building, went down some 10 ft. deeper than the wall of the building which fell. Within the last few years the older building was torn down, but its uphill wall was left standing, to the street level, and acted as a retaining wall to hold up the ground below the footings of the adjoining building, though it had never been designed to perform any such function. It finally collapsed, without warning, and the adjoining wall simply kicked out at the bottom and dropped the building.

The accident occurred at lunch hour, when the machinery was not running and few persons were in the building. Five girls were eating lunch on the third floor in the room adjoining the falling wall, but due to the nature of the collapse they simply fell or slid from floor to floor as the building went down, and suffered nothing more serious than bruises.

No evidence was found that excessive rains had damaged the old wall. Apparently it simply fell without external cause. No excavation or other work was being done near the building.

Regular Airplane Express Service in California

The Pacific States Express Co. of San Francisco is now maintaining daily express service by airplane between San Francisco and Modesto to supplement that rendered by its motor trucks and boats. The airplanes are owned and operated by the Varney Aviation Co. under contract with the express company. Motor trucks deliver freight to the aviation field, thirty miles south of San Francisco and beyond the fog belt; and the eighty-mile trip from the field to Modesto is made in 1 hr. 15 min. The only stop enroute is at Stockton. It is planned to extend the service eventually to Sacramento and south to Fresno, Bakersfield and Los Angeles.

For the purpose of advertising the service and establishing confidence in its trustworthiness the daily trips are made regularly regardless of whether there is a load of freight and care is taken to have the planes start exactly on time. Planes always circle the valley towns before alighting, thereby making their arrival at exactly the same time each day a subject for local comment. The result has been that an encouraging amount of business has been received from the very outset.

Rates are 35 cents per pound or fraction thereof, with a minimum charge of $1. The planes now used have a freight capacity of 400 lb. but machines of 800 and 1,500-lb. capacity are available if and when the business requires them. Some of the classes of goods thus far consigned by this route are pumps and motors, automobile parts, grain samples for the Grain Exchange, hospital supplies, etc.

Merchants Association to Honor Men of Science

Engineers and scientists who have contributed most to commercial progress during the last twenty-five years will be the guests of the New York Merchant's Association at a mass meeting to be held in Madison Square Garden on Nov. 17 to celebrate the industrial growth of the city. It is announced that if Mrs. Harding's health will permit his absence from Washington, the President will be the principal speaker.

The guests announced by the association are: Thomas A. Edison, pre-eminent in the field of electrical invention and other arts; Charles P. Steinmetz, among the foremost in the study and development of the principles of electrical energy; Michael F. Pupin, a leader in electro-mechanical development; Lee De Forest, one of the pioneers in the development of wireless telegraphy in America; Luther Burbank, originator of new fruits and grains; Col. William Barclay Parsons, as chief engineer planned and constructed the first passenger subways built in America; Gen. George W. Goethals, designer and builder of the Panama Canal; J. Waldo Smith, designer and chief engineer of the Catskill water-supply system; Wilbur Wright, co-operating with his brother, Orville Wright, discovered and first successfully applied the principles governing human flight in heavier-than-air machines; Glenn Curtiss, pioneer in the development of aviation in America, who developed the hydroairplane; Cass Gilbert, architect, creator of the Woolworth Building; Simon Flexner, bacteriologist.

General Contractors Nominate

In accordance with its by-laws the Executive Board of the Associated General Contractors of America recently nominated officers for the 1923-1924 term. W. E. Wood, president of the W. E. Wood Co. of Detroit, was nominated as president; H. B. Greensfelder, secretary of Fruin-Colnon Contracting Co., was nominated as vice-president at large and J. H. Ellison, vice-president of Winston Deer Co., Minneapolis, vice-president, Zone 4. Nominations for directors of the various districts were also made.

Montana Highway Department Prints New Publication

The first printed issue of the Montana Highway *News*, the official news publication of the Montana Highway Department, is being issued—this month (October). The issue is the seventh but is the first one to be printed, previous numbers having been mimeographed in the department's headquarter's office. The publication is devoted to the dissemination of knowledge of the work and problems of the Montana Highway Department and is being mailed free of charge to newspapers, county and city officials, contractors, interested citizens and others.

R. C. P. Coggeshall

R. C. P. Coggeshall, whose death on Oct. 21 was briefly noted in the issue of this journal of Oct. 26, p. 720, will be remembered by many as one of the deans of the water-works fraternity, remarkable for his genial and sympathetic manner, his wise and helpful counsel at water-works conventions, and his long and useful service to the city of New Bedford extending through some fifty years, during forty of which he was superintendent of water-works.

Mr. Coggeshall was born in New Bedford April 20, 1849. His primary education was secured at a private school and the Friends' Academy and later he became a student at the Rensselaer Polytechnic Institute, Troy, N. Y.

He gave up the life of a student the latter part of 1868 to become a clerk in the New Bedford Post Office. Five months later he accepted a clerkship at the Bay State Glass Works at East Cambridge. However, engineering still attracted him and in the May of 1872 he returned to New Bedford and became draftsman, surveyor and general assistant to the then superintendent of the Water Department. Five years later he was elected city land surveyor, an office now lost through the creation of the greater city engineering department. As that office did not require full time service, Mr. Coggeshall did some private engineering work.

Soon after he settled in work in New Bedford he became (in the fall of 1872) an instructor in mechanical drawing in the public evening drawing school and kept on with that work until 1887.

Mr. Coggeshall's life was largely devoted to the development of water supply in New Bedford. He witnessed the construction of the Acushnet water system of New Bedford, designed for a supply of 50,000 people and saw its capacity increased in different ways until finally the system was abandoned in 1899, when it was superseded by the Quittacas system, of much larger capacity.

Early in 1919 Mr. Coggeshall was relieved of some of the cares of his office by the election to the Water Board of Stephen H. Taylor, assistant superintendent, an office created by the enactment of a special ordinance.

Mr. Coggeshall was a charter member of the New England Water Works Association, which was organized June 21, 1882, being its first secretary and holding office for ten years. In 1885 he was elected president of the association and at various times filled other offices. He contributed numerous papers to its gatherings and in 1915 was made an honorary member. He was a member also of the Boston Society of Civil Engineers, of the Connecticut Society of Civil Engineers and of the American Water Works Association.

Agricultural Engineers to Meet in St. Louis

The sixteenth annual meeting of the American Society of Agricultural Engineers is to be held at the Planters' Hotel, St. Louis, Mo., Dec. 27-29. Because of the geographical position of St. Louis it is anticipated a large number of agricultural engineers from all over the country will attend.

Engineer Board to Review Dallas Water-Supply Plans

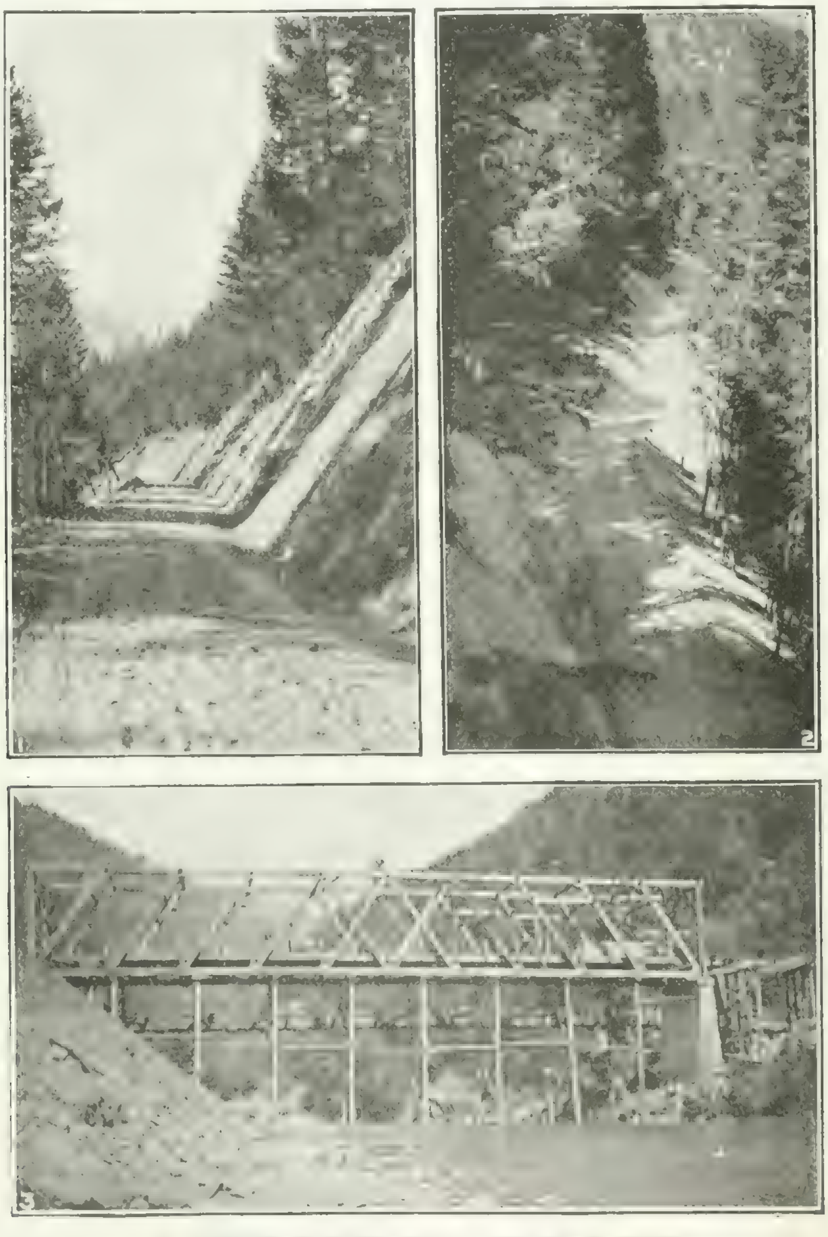
The Technical Club of Dallas, Texas, has offered the city the services of a board of engineers to review and pass upon various plans that have been submitted to the city for an additional water supply.

Dallas has a population of about 200,000 and for the past few years the City Plan Commission has studied the water situation from the point of making it adequate to serve a city of 500,000. The city has made some special surveys covering possible areas for impounding water.

The mayor and board of commissioners have accepted the offer of the Technical Club and it is expected that the personnel of the board of engineers will be announced at an early date.

Mountain Road Costing $24,000 Per Mile Soon to Be Opened

The Klamath River road which has been under construction by the federal government for the past four years, will soon be finished and opened to the public, according to official announcement. Although built by the government with the primary object of opening up the interior region of the Klamath National Park with its 28,000,000 ft. of timber, the road will have a far-reaching effect upon the development of the whole northwestern part of California. The accompanying photographs indicate the scenic beauty and picturesqueness of the country traversed by the road and the apparent extreme difficulty of constructing it. The road was constructed at a total cost of about $1,200,000, or an average of about $24,000 per mile. As the road is unsurfaced this cost went mostly for clearing and grading. The road begins at the end of the Siskiyou County road near Happy Camp and follows 50 miles down the rugged canyon of the Klamath River. The new road will open up a direct route from the Sacramento Valley to the Coast.



A 50-MILE FOREST ROAD COSTING $1,200,000
1 and 2—Views showing character of mountainous country traversed.
3—Bridge across Salmon River.

Utilities Seek Coal Priority to Build Up Winter Reserves

Washington Correspondence

Despite reassuring statements from the Department of Commerce and from the federal fuel distributor, representatives of the public utilities contend that the coal situation, so far as their plants are concerned, is getting worse instead of better. The figures of the American Railroad Association also are attacked as being inaccurate. The belief in public utility circles is that there are duplitions in the figures as to car loadings. Since the utilities are hampered by fixed incomes in bidding for coal against manufacturers, they believe that nothing short of the re-establishment of Priority 2 will enable them to build up the reserves necessary to carry them through the winter.

Eastern and middle western utilities have been asked to await the closing of the Lakes before attempting to build up storage. They contend, however, that the closing of the Lakes means that freezing weather has arrived and a tonnage far in excess of that moving up the Lakes will have to be delivered to domestic consumers. Moreover, the advent of cold weather means that the railroads are 20 per cent less efficient. Transportation disability, the public utilities contend, will be even greater this winter because of the shortage of motive power and the run-down condition of that portion of railroad plant.

The point on which the public utilities are placing most emphasis in their representations to the fuel distributor and to the President's coal commission is that deliveries on their contracts frequently are as low as 15 per cent, while in rare instances only are they exceeding 50 per cent. The high prices being paid for coal in the Middle West have unbalanced the transportation movement from eastern mines and this situation is further curtailing the chances of the public utilities to secure reserves sufficient to insure the proper margin of safety.

Duty Imposed on Cement Imports from Canada

Pursuant to the permission granted in the retaliatory clause of the current Tariff Act, the Treasury Department has issued instructions to collectors of customs to collect a duty of 8 cents per 100 lb. on Roman, portland, and other hydraulic cements imported into this country from Canada. The act puts cement on the free list, but has a further proviso "that if any country, dependency, province or other subdivision of government imposes a duty on such cement imported from the United States, an equal duty shall be imposed upon such cement coming into the United States from such country, dependency, province or other subdivision of government." In the general tariff laws of Canada, cement is taxable as follows: "Cement, portland and hydraulic or water lime in barrels, boxes or casks, the weight of the package to be included in the weight for duty; British preferential tariff, 5 per cent; intermediate tariff, 8 per cent; general tariff, 8 per cent."

In the last few years the greater proportion of foreign cement imported into this country came from Canada, but the total imports are very small compared with the amount made in this country.

Canadian National Rys. Prepare New Administrative Plan

The new board of directors of the Canadian National Rys. returned to Montreal on Oct. 26 after an inspection trip of more than 5,500 miles covering the principal lines of the system west of Quebec. The board has secured extensive information regarding traffic and operating problems which will enable it, on the return of the new president, to decide the important matter of the location and division of headquarters. A tentative plan, subject to the approval of Sir Henry Thornton, proposes to make Toronto head of the central division, Winnipeg of the lines west of the Great Lakes, Moncton of the road formerly known as the Intercolonial, with Montreal as general headquarters. Sir Henry Thornton's office will probably be in Ottawa. The board is now in good position to determine the number of new cars and locomotives to order, and the number of branch lines which it will be expedient to construct in the west.

October Municipal Bond Sales Low but Ten-Month Total High

October sales of state and municipal long-term bonds totaled a little under $70,000,000, the smallest total for the year, according to *The Daily Bond Buyer*. For the ten months ending Oct. 31, the same authority reports, the sales were $1,118,399,987, compared with $948,135,416 for a like period in 1921, the highest previous total on record. The October and the ten-month's figures from 1922 to 1913 are as follows:

	October	Ten Months Ending October 31
1922	$69,895,558	$1,118,399,987
1921	125,126,375	948,135,416
1920	62,592,014	627,494,610
1919	117,284,139	634,775,848
1918	10,292,635	217,275,175
1917	22,834,348	389,598,640
1916	56,943,946	433,285,461
1915	27,620,693	422,985,369
1914	11,332,910	381,995,564
1913	33,772,990	327,817,224

New Tunnel Under Construction on Southern Pacific R.R.

The Southern Pacific R.R. on Oct. 25 awarded a contract to the Utah Construction Co. for the construction of a single track tunnel on the main line of the coast route in Monterey County, 155 miles south of San Francisco. At this point a spur of the mountain range projects out into the Salinas Valley to the edge of the Salinas River and in rounding the spur curves as sharp as 10 deg. had to be used in the original location. This necessitated a considerable reduction in speed in a territory that otherwise would have only long tangents and flat curves. To expedite train movements and increase the safety of operation a 1,200-ft. tunnel is now to be driven through the rocky spur. The line change required totals 3,100 ft. in length and makes possible the substitution of a simple 2-deg. curve for the series of sharper curves now used. The tunnel will be lined with reinforced concrete 16 in. thick except in solid rock sections.

The Engineer in Public Life

WARREN STOUTNOUR

Warren Stoutnour, of Salt Lake City, now serving a second term as a member of the Public Utilities Commission of Utah, member of the executive committee of the Intermediate Rate Association and commander of the Salt Lake City Post of the American Legion with an enrollment of 1,400 ex-service men, is a civil engineer graduate of Lafayette College (class of 1903) with professional experience covering railroad work, bridge design and general contracting. He was born at Everett, Pa., 39 years ago and after leaving college he entered the employ of the Harriman Line railroads in the West. He served this connection in order to get in direct contact with construction work and for 3½ years served as foreman and superintendent with a contractor on the Pacific Coast.

Mr. Stoutnour went to Utah in 1912 and designed steel bridges for the Salt Lake & Ogden Ry. Co. and the Utah Ry. Co. Later he was made superintendent of construction and maintenance, Salt Lake & Ogden Ry. Co. His appointment as a member of the Public Utilities Commission of Utah occurred in 1917. During the war he served in the United States Navy as lieutenant, senior grade, Civil Engineer Corps, in the Hampton Roads district.

The Intermediate Rate Association on whose executive committee Mr. Stoutnour is serving, comprises some 500 commercial clubs, associations and public service commissions in ten Western states. Its purpose is to prevent discrimination against the intermountain territory and to oppose the charging of a greater freight rate upon east- or west-bound transcontinental traffic at any intermediate point than is charged to more distant points.

The chairmanship of the accounting committee, National Association of Railway and Public Utility Commissioners, is another of Mr. Stoutnour's activities.

"In accepting public service," Mr. Stoutnour says, "the engineer will find that engineering questions enter into almost every avenue of endeavor. This must be increasingly true as our civilization becomes daily more complicated and technical. An undue amount of professional modesty, it seems to me, is keeping the engineer from exerting the influence upon the public that his knowledge and experience qualifies him to do. In other words, as an average, engineers do not seem to make themselves aggressively felt in the community, as do some of the other professions. Until they do, they will not rightfully occupy the place that is theirs. Neither will compensation be commensurate with the time and money necessarily expended in fitting themselves professionally."

Tentative Railroad Valuations Nearing Completion

The Interstate Commerce Commission has issued notices of hearings on the tentative valuations of forty railroads. This is the largest block of hearings on valuations of railroads yet announced. As a rule, the hearings are on exceptions filed by the carriers against the valuations placed on their properties by the commission in the tentative reports which in the absence of protest would have become final. All these hearings are to be held before the end of the year.

The commission also issued this week its first complete final valuation, which covers the Evansville & Indianapolis R.R.

The commission is entering upon the final stages of the most monumental scientific valuation of property ever attempted, the property being scattered over approximately 250,000 railroad miles. Its expectation is that the tentative reports will be completed in the next two years, together with a very large number of final reports. There will remain, however, the continuing work of keeping the valuations up to date. Practically all of the field work has been completed. The commission is now concentrating upon the completion of reports upon the major properties.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

The San Francisco Section, Am. Soc. C. E., at the regular bi-monthly meeting on Oct. 17 listened to a paper on "The Work of the Bureau of Public Roads" by Dr. L. I. Hewes, deputy chief engineer, U. S. Bureau of Public Roads who is now stationed in the San Francisco office. There was also a talk by A. Griffin, superintendent of the eastern section, Canadian Pacific Ry. Irrigation block, Brooks, Alberta, in the course of which he described very rapid deterioration of concrete in that district due to the attacks of alkali salts. Moving pictures of the Hetch Hetchy excursion made in connection with the fall meeting of the patent society were shown.

The Texas Section of the American Society of Civil Engineers held its fall meeting at San Antonio, Oct. 20 and 21. Technical papers were presented dealing with the engineering problems involved in many of the public works of the state. The section endorsed the movement for reclamation and flood

control as advanced by the Texas Conservation Association, directed the appointment of a committee to confer with the state highway engineer in recommending legislation as to roads, bridges, and ferries, and authorized the appointment of a committee to report on spillway and wasteway dimensions. The officers elected were E. E. Sands, president; A. J. McKenzie, first vice-president; John A. Norris, second vice-president. As the secretary holds office for two years, E. N. Noyes continues in that office for the ensuing year.

The New England Water Works Association, through the nominating committee appointed at the recent New Bedford convention, has prepared a list of nominees for offices of the association for 1923, which follows:

President, Percy R. Sanders, superintendent of water-works, Concord, N. H.; vice-presidents, George A. Carpenter, city engineer, Pawtucket, R. I.; Reeves J. Newsom, commissioner of water supply, Lynn, Mass.; David A. Heffernan, superintendent of water-works, Milton, Mass.; Frank E. Winsor, chief engineer, board of water supply, Providence, R. I.; Theodore L, Bristol, president and manager Ansonia Water Co., Ansonia, Conn.; Vernon F. West, treasurer and manager of water companies, Portland, Me.; secretary, Frank J. Gifford, superintendent, Dedham Water Co., Dedham, Mass.; treasurer, Frederic I. Winslow, division engineer, metropolitan water-works, Framingham, Mass.; editor, Henry A. Symonds, consulting engineer Boston, Mass.; advertising agent, Fred O. Stevens, superintendent of water-works, Weymouth, Mass.

Personal Notes

F. T. MACK, chief engineer of the Sunnyside Valley Irrigation Co., of Sunnyside, Wash., has tendered his resignation.

R. M. BEANFIELD, civil and mechanical engineer, has opened an office in the Brix Bldg., Fresno, Calif.

JOHN STEPHAN WORLEY, of Worley & Black, accountants in New York City, and formerly consulting valuation engineer to the Interstate Commerce Commission, has been invited to become Professor of Transportation and Railroad Engineering at the University of Michigan. Mr. Worley has indicated that he will accept.

F. H. STEPHENSON, for the past three years assistant civil engineer on the design and construction of the Detroit Filtration Plant, has been appointed assistant superintendent, Detroit Department of Water Supply. He succeeds W. M. Mitchell, who recently resigned.

ROBERT S. PARSONS, vice-president in charge of operations on the Erie R.R., has been appointed vice-president of the Ohio region with headquarters at Youngstown.

W. A. BALDWIN, manager of the Ohio region of the Erie R.R., has been appointed vice-presdent in charge of operations, with headquarters at New York.

H. D. ROBINSON and D. B. STEINMAN, New York City, have been retained to act jointly as consulting engineers on the design and construction of a suspension bridge of 1,114-ft. span at Florianopolis, Brazil. The bridge will carry a highway, electric railway and aqueduct and will have 1,660 ft. of approach spans. The estimated cost is $2,000,000. With Messrs. Robinson and Steinman is associated L. N. GROSS as consulting engineer on erection. The contract has been awarded to a Brazilian firm, Byington and Sundstrum, São Paulo. The American Bridge Co. will fabricate the steelwork.

DR. J. A. L. WADDELL, consulting engineer of New York City, has been elected an honorary member of the National Society of Engineers of Barcelona, Spain.

R. B. ALLPORT, of the Allport Construction Co., Richmond, Va., was recently elected president of the Virginia Contractors Association.

DR. EDOUARD G. DEVILLE, for the past 37 years surveyor-general of Canada, was created an honorary life member of the Engineering Institute of Canada at a luncheon held by the Ottawa branch of the Institute Oct. 31.

C. R. THOMAS, editor of *Professional Engineer* and in charge of public information for the American Association of Engineers, has resigned to accept a position with La Salle Extension University as assistant to the Director of Publicity.

E. B. POWELL of Stone & Webster, Inc., of Boston, sailed Oct. 28 on the Majectic to make a study of recent developments in European power-plant practice. He expects to visit England, France and Germany and to return to this country early in December.

FRDERIC WILLIAM LYON, division engineer of the bureau of water, Pittsburgh, has been appointed by the director of public works of that city chief engineer of the bureau of engineering. Mr. Lyon replaces Charles M. Reppert, whose resignation was noted in these pages recently. Mr. Lyon has been in the service of the city for eleven years, having started as an assistant engineer during the building of the Aspinwall pumping station. During his early professional career he was with the Isthmian Canal Commission for several years, in the office of the chief engineer of the Bolivian National Rys. and stationed at La Paz, with the Pennsylvania State Highway Department, and the Pittsburgh Flood Commission. Until a definite appointment is made E. J. UMSTEAD, division engineer of the mechanical department of the bureau of water, will be Mr. Lyon's successor as head of the mechanical department.

GEORGE I. OAKLEY, former field superintendent for the Guaranty Construction Co., New York City, has joined the staff of the J. G. White Engineering Corp.

FREDERICK W. SARR, first deputy highway commissioner, and JOHN F. HUBER, senior assistant engineer of the New York State Highway Commission, were seriously injured in a recent automobile accident, at Poughkeepsie, N. Y., in which one person was killed. The machine in which they were driving, in an attempt to avoid a collision with another machine, skidded and crashed into a tree and overturned. Mr. Sarr received a compound fracture of the left leg and internal injuries, and Mr. Huber contusions and abrasions of both legs.

DR. GEORGE OTIS SMITH has resigned as director of the U. S. Geological Survey so that he might legally qualify as a member of the President's coal commission. It is understood that this resignation is purely temporary and made to remove all obstacles to his becoming a member of the commission. During his absence, PHILIP S. SMITH, who has been serving as the survey's administrative geologist, will become director.

DAVID WHITE will soon resign as chief geologist of the U. S. Geological Survey, and will resume private research work. He will be succeeded in the office of chief geologist by W. C. MENDENHALL. Mr. Mendenhall has been a member of the survey staff for twenty-eight years, for more than ten years of which he served as geologist in charge of the land classification board. Mr. White would have completed ten years of service as chief geologist of the Geological Survey in December.

Obituary

T. DEWITT CUYLER, chairman of the Association of Railway Executives and director of the Pennsylvania, the Santa Fe, and the New York, New Haven & Hartford and other railroads, died on Nov. 2 in his private car as it was entering Philadelphia from Rochester, N. Y., where he had spoken the preceding day on railroad matters. Mr. Cuyler was of Dutch ancestry and was born in Philadelphia, Sept. 28, 1854. He graduated from Yale University in 1874 and was admitted to the Pennsylvania bar. He was active in the National Guard and attained in its service the rank of colonel. Following the example of his father, who had been general counsel of the Pennsylvania Railroad Co., Mr. Cuyler entered railroad work and became a director of the Pennsylvania R.R. in 1899, of the New York, New Haven & Hartford in 1910, and later of the Maine Central, the Atchison, Topeka & Santa Fe, the Long Island, the International Ry. of Buffalo, the Interborough Metropolitan and Interborough Rapid Transit Cos. of New York, and the Long Island Consolidated Electric Co. He was associated also with many financial and industrial enterprises. For several years he has been the recognized spokesman of the railroad interests of the country and during the recent shopmen's strike occupied a prominent place in the councils of the executives.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Cement Demand Peak Taxes Transport Facilities

Makers Face Problem of Shipping 40 Per Cent of Year's Production in 90 Days

By L. R. Burch

Assistant to the President, Atlas Portland Cement Co., New York.

SEASONAL demand, governed largely by activity in the building and general construction industries which is always greatest in the warm months, is a controlling influence in cement shipments. To move this year's cement production, estimated at 120,000,000 bbl., about 600,000 cars are necessary, not including those required for coal and other materials used in the process of manufacture. Of this total almost 40 per cent, or 240,000 cars, must be moved within a period of 90 to 100 days —from the latter part of July to the beginning of cold weather. This short space of time constitutes the neck of the bottle and, unfortunately, it occurs at the season when the railroads are called upon to carry the heaviest traffic.

Furthermore, because the raw material, called "cement rock," from which portland cement is manufactured, can be found only in certain sections of the country, portland cement mills are frequently grouped, a circumstance which adds greatly to the burden of the railroads. Were the plants distributed over a larger area the tension would be relieved. This is an extremely important fact, because it has a tendency not only to increase car shortages, but result in embargoes and other conditions which are the outcome of overladen transportation.

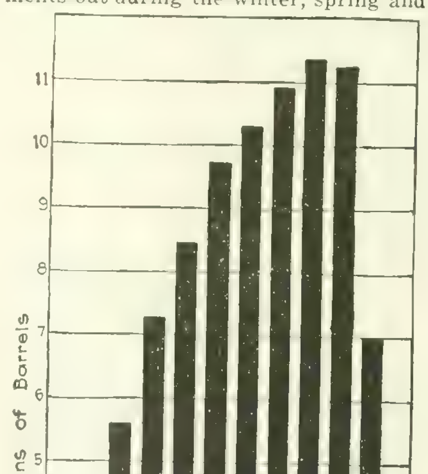
How Demand Varies

The accompanying chart shows the shipments of cement by months averaged for the years 1919, 1920 and 1921. From the low level of less than 3,000,000 bbl. in January it reaches the peak of over 11,000,000 bbl. in September and October, dropping off sharply in November to less than 7,000,000 bbl. Upon the ability of the cement companies to meet this peak demand depends, to a great extent, their year's profits. They plan to have their stocks and their production in such shape as best to handle the problem. In fact, their whole operation might be said to be regulated with this condition in mind.

With traffic conditions such as have existed in the past few years it has been impossible for the railroads to handle the volume of business that is thrown upon them. If the cement peak came when freight shipments were light it could be done, but just when the construction job needs building materials the farmer also needs cars to move his crops.

The cement manufacturers would be more than glad to correct such a serious evil in their business, for it is expensive from many different angles. But they cannot correct it. They cannot do more than make helpful suggestions.

This is their suggestion: Inasmuch as car shortages and railroad congestion will be with us until the railroads are able to get back on their feet, transportation facilities must be used while they are available. This means that every effort must be made to get shipments out during the winter, spring and early summer. To do so may entail some inconvenience and some expense, but neither is commensurate with the losses that result from delays apt to occur later on. Co-operation of the various branches of the construction industry toward the elimination of the peak load, by spreading shipments more evenly throughout the year, would mean a vast saving to everyone concerned.



AVERAGE MONTHLY SHIPMENTS OF PORTLAND CEMENT IN U. S., 1919-1921

Ban on Operating Machinery at Road Show Removed

By a decision of the committee in charge of arrangements for the Good Roads Show and convention to be held in Chicago, Jan. 15-19, the technical sessions will be held at the Congress Hotel, while the exhibits will be staged in the Coliseum. This will remove the ban on the operation of machinery during the convention sessions, which, when previously held in the Coliseum, were interfered with by the noise of the machines on the floor below.

Are New "Styles" in Demand for Construction Equipment?

A demand for constantly changing "styles" in rock drills is indicated by "Engineering and Mining Journal-Press" in an editorial reprinted below. Do manufacturers in the general construction field encounter the same conditions, for example, in the case of concrete mixers, steam shovels, cranes, hoists, buckets, motor trucks and other types of equipment? Comment is invited.—Editor.

"The multiplicity of rock drills and the speedy replacement of one type by a newer design has often been ascribed to competition between ambitious and progressive manufacturers. Undoubtedly, competition has been a primary cause, but one prominent drill manufacturer who discussed the subject with us recently ascribed the reason to the mine superintendent and manager. He said that when a salesman approached a manager, the salesman would be confronted with the question: What have you got that is new? Thus the demand for novelties has apparently come from the mines.

"New fashions are in order. Despite the repeated changes in drilling equipment, our drill manufacturer asserts that the average drilling performance of today does not greatly exceed the best obtained by the piston-drill equipment, once the standard. This is not the fault of the new drills, as their performance almost doubles that of the piston drill. It is attributable to the driller and his policy of holding back. As a result there is a capital input for drilling equipment that is not earning its way. The new drills require less manual effort, even with increased output, as compared with the older types. The mining company pays a stiff price for every change in design or added improvement in the drill and its accessories. A commensurate return in performance should result. Without it, there is a cumulative money loss that must necessarily have its effect upon the industry generally."

Seven Grades of Asphalt Ample, Says A. B. Fletcher

Supplementing the recent discussion in these columns by highway officials of the proposal to limit the number of varieties of asphalt to 7 (by the penetration test) the following comment has been received from A. B. Fletcher, state highway engineer of California:

"I agree with the producers' point of view, that for all practical purposes not more than 7 grades of asphalt are justified, and in my opinion we can get along very nicely with even a smaller number than this. The California Highway Commission specifications already comply very closely with the specifications suggested by the Asphalt Association and by the American Society for Testing Materials, except for the lower limits for penetration.

"At present we are not using much asphalt on state highway work in California with a penetration of less than 50, as it is felt that the value of asphalt of a lower penetration is still subject to demonstration. In localities where extreme heat conditions prevail we have used as low as from 30 to 40 penetration, but only in special cases.

"In general, however, it can be borne

in mind that California is not confronted with numerous varieties of bituminous products which are available in other states. It has not been considered necessary, therefore, to specify certain characteristics, since it is known that all California asphalts are practically standard between penetration limits."

To Allot Exhibit Space for Good Roads Show

Allotment of space for the Good Roads Show, to be held in the Coliseum, Chicago, Jan. 15-19, will take place Nov. 17 according to a decision reached Oct. 27 at a meeting in Chicago of the directors of the Highway Industries Exhibitors Association. Several plans of conducting the drawing and assigning space to exhibitors were discussed and by resolution the Exhibitors Committee was empowered to decide upon the procedure which, in its opinion, would best serve the interests of the exhibition and the manufacturers.

At the meeting of directors organization and constitutional details were approved and all of the old officers were re-elected to serve until March 1, 1923, when a new fiscal year will begin. The present directorate also will serve until that date.

Winter Buying of Pipe

Discussion continued from last week's issue.

FRANCIS T. CUTTS
Assistant Water Commissioner, St. Louis

Locally, money for the purchase of pipe is appropriated from water-works revenue by the Board of Aldermen, and of course no money can be appropriated unless the funds in water-works revenue are sufficient to cover the appropriation. Such appropriations are usually made in the spring of the year and contracts for the pipe would ordinarily be ready for letting about May or June, anticipating the delivery of pipe during the summer and fall. In the past this has generally been the practice followed. This year, however, bids for pipe were received during the first week of October calling for delivery during the fall and winter. I can see no reason why it would not be possible in most cases to anticipate needs for a year's business and purchase the material for delivery over an extended period.

In the locality of St. Louis winter construction is generally possible with the exception of about sixty days—that is, during January and February. We have found, however, that it is difficult to restore street surfaces to a satisfactory condition at a time when the weather is below freezing, and for that reason work during the winter can best be handled in the sparsely settled outlying districts.

The City of St. Louis has made a practice of furnishing an inspector at the foundry, and in order to keep inspection costs at a minimum it is, of course, desirable to have any individual order made up within the minimum time at the foundry.

It has not been our experience that the pipe manufacturers have exerted themselves in offering any price differentials that would encourage buying during the winter months. If such differentials were made, it would undoubtedly encourage purchases at that time.

St. Louis has never had any great difficulty in getting contracts promptly filled, regardless of the time of year at which the contract was let. In recent years our purchases of cast-iron pipe have been comparatively small and I presume that, under any arrangements, deliveries on contracts entered into at this time would be very much delayed. I believe, however, that some benefit might accrue if the pipe manufacturers would indicate a willingness to co-operate with the water-works departments in this respect.

W. S. CRAMER
Chief Engineer, Lexington (Ky.) Hydraulic & Manufacturing Co.

In this locality it is practical to lay pipe, with few exceptions, at any time of the year and if a price was made that was attractive a great deal of work would probally be done in winter months in a greater part of the country.

With our company we make most extensions on order from the city commissioners and this only where additional fire protection is needed. Most of the other extensions are made for development companies on such short notice that there is no time to anticipate the buying of material. Most of our extension this year was in a development that amounted to about 7,000 ft. of pipe with but a few days' notice of requirement.

We have never been approached to buy on winter schedule and a recent rise of \$6 per ton does not encourage us to do any work this winter.

It would be almost impossible for us to anticipate our requirements for a year for the reasons stated above.

GEORGE H. FENKELL
General Manager, Department of Water Supply, Detroit

Replying to your inquiry as to the desirability of water-works plants making purchases of pipe throughout the year rather than during the spring and summer months:

For the purpose of this discussion municipal plants may be divided into two classes: (1) those that contract for pipe-laying and provide that the contractor shall furnish the material; (2) those that lay the pipe with their own forces. With the first class, or those that contract their work, it will be necessary for the department to purchase the pipe and furnish it to the contractor, and while this may be done at times, I do not expect it will become a general practice. The contractor delivers the pipe from the cars, and as many of the departments are without storage facilities, I would expect that the present practice of buying during the working season would be continued.

The second class, or those departments that lay the pipe themselves, can spread the purchase through the year provided storage yards are available. Many departments are not provided with such yards, cranes and skidways, and so they prefer to haul direct.

I believe the purchase of pipe will be continued through the year when the foundries can prove to their customers that it will work to the latter's benefit financially.

Business Notes

AUSTIN MACHINERY CORP. has moved its general offices from Chicago to Toledo, Ohio, address Station C, Dorr St.

JOSEPH T. RYERSON & SON, Chicago, manufacturers of steel products, announce a celebration in honor of the company's eightieth anniversary this month. Joseph T. Ryerson arrived in Chicago 1842, rented a small two-story brick building at Clark and Water Streets for \$200 per year and began business with a \$20,000 stock of iron received from Pittsburgh. Today the Chicago plant of the company occupies a ground area of over 19 acres with nearly a million square feet of floor space. There are four other complete steel service plants in addition to offices in the principal cities. Mr. Ryerson died March 9, 1883, and was succeeded as president of the company by his son, Edward L. Ryerson. In 1912 when Mr. Ryerson became chairman of the board of directors Clyde M. Carr was appointed to the presidency.

RANSOME CONCRETE MACHINERY CO., Dunellen, N. J., due to an increased volume of business, particularly in the paving and small mixer fields, has decided upon a further enlargement of its plant. About a year ago the company doubled its floor space and the new extension to be undertaken now provides for an increased floor area of 33⅓ per cent in a new one-story building. The structure will have a monitor roof, will be of concrete and steel and will cover a ground area of nearly 10,000 square feet. Its erection will be commenced immediately.

THEODORE HENRY announces that he has severed connections with J. H. Burton & Sons Co., Inc., and has opened an office at 299 Madison Ave., New York City, to engage in the wholesale yellow pine and fir lumber, oak, and pine piling business under the firm name of Theodore Henry, Inc.

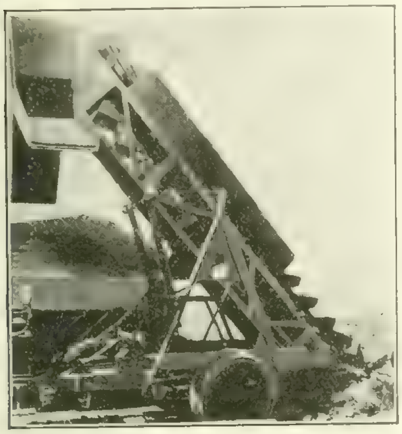
HEYL & PATTERSON, INC., Pittsburgh and New York, have received from the City of Providence, R. I., the contract for two traveling, revolving boom cranes of the hammerhead type for handling lumber at the new modern lumber storage yard now under construction at Fields Point. These cranes are to have a maximum working radius of 90 ft. and a capacity of 5 tons with a two-speed gear shifting arrangement built into the hoist engine so that loads lighter than 3½ tons in weight can be handled at a hoisting speed of 200 ft. per minute, whereas loads between 3½ and 5 tons will be hoisted at the rate of 100 ft. per minute. Bids for these cranes were opened in Providence on Sept. 5. The A. C. Dutton Lumber Corp., lessees of the Fields Point lumber storage development, have likewise awarded to Heyl & Patterson, Inc. a contract for two motor-driven lumber-carrying portals of 50 tons capacity, which are to be used in connection with the above-mentioned cranes.

THE HUBBARD MACHINE CO. has opened new offices and works at 969 Folsom street, San Francisco, Calif., and will specialize in all classes of machinery and plant installation.

Equipment and Materials

Motor-Truck Mounting Widens Loader's Operating Range

In its new path-digging bucket elevator, mounted on a motor-truck chassis, the George Haiss Manufacturing Co., New York, has developed a machine to meet requirements for



rapid loading with a single unit at a number of widely separated points. Examples of conditions to be met by this machine are indicated by the following: A coal dealer may have many yards, a contractor may receive material at different points, a material dealer may operate at several storage sites, the volume of work at only one place being insufficient to justify the purchase of loading apparatus. With a single mobile loader, however, many points may be served, as the truck can travel at speeds of 15 to 20 miles per hour.

In the machine illustrated herewith the regular A-frame supports on which the elevator is pivoted are erected over the rear axle of the truck, and the necessary transmission gearing, chains, etc., are placed as on standard loaders. The elevators are equipped with feeding propellers, so that no shoveling is required to clean a path into the pile for the loader chassis. Buckets are equipped with cutting teeth and a two-way side-discharge chute permits trucks to be loaded on either side.

When the truck chassis is equipped with a jackshaft for operating a body-dump hoist the elevator is driven by it; when not so equipped, a second motor is installed to drive the elevator. The second plan, while more expensive, gives better operation, the manufacturers state, as the loader can be backed into the pile while the elevator is operating. The loading capacity of the machine is from 1 to 2 cu.yd. per minute. The loader illustrated was timed by its manufacturers to load 4 tons of egg coal in 3 min. 40 sec., or at a rate of more than 1 cu.yd. per min.

Of the trucks which have been equipped with Haiss loaders one is in the hands of a large New York coal dealer who has several yards widely scattered throughout the Bronx; another is owned by a contractor in Toronto who has several gravel banks some miles apart and is also receiving material by rail; and a third belongs to a large trucking company in New York which uses the loader in connection with the hauling of ashes, sand and gravel and earth spoil.

Skip Guard for Paving Mixer

The Chain Belt Co., Milwaukee, is now equipping its Rex pavers with a patented, automatically operated guard which prevents workmen, or others, from getting beneath the charging skip while it is elevated. Heretofore skip guards used on pavers provided for the sides only, but did not prevent anyone from accidentally walking beneath the skip from the end. They were also stationary and to a certain extent interfered with efficient charging, especially with the industrial railway system.

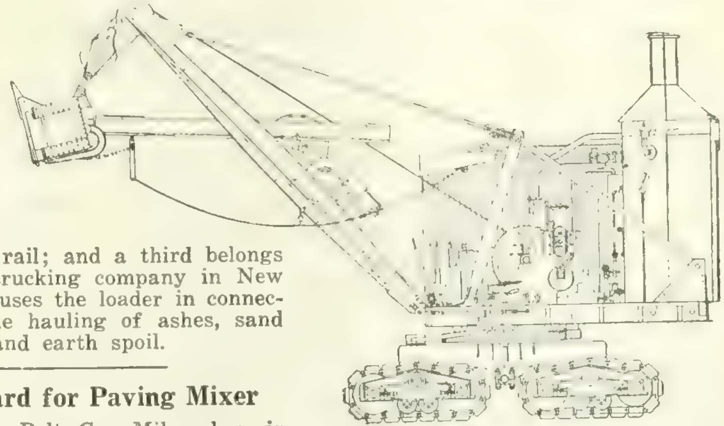
The Rex skip guard, illustrated herewith, completely surrounds the skip buckets but does not interfere with the charging of the paver. When the skip is down and the guard is not needed, it rests on the ground. Trucks and wheelbarrows can pass over it while boxes can be transferred from industrial railroad cars to the skip without interference from the guard.

As the skip rises, the guard also rises automatically to a position approxi-

mately 3 ft. off the ground. Here it is held, again automatically, until the skip returns to the ground. In the illustration the skip guard is shown just as it is rising into position while the skip is being elevated. The picture was taken on the Twohy Bros. project, near Tucson, Arizona.

Convertible 1¾-Yd. Revolving Shovel Has New Features

With a 1¾-yd. dipper, 25-ft. boom, and 17-ft. dipper handle, the new model 37 is announced as the largest of the Marion Steam Shovel Co.'s small revolving-type shovels. It is convertible into a dragline, clamshell or orange-peel bucket excavator. Three optional types of mounting—crawling traction, traction wheels, or railroad wheels—are provided. On standard and high-lift shovels the boom and dipper handle are a combination wood and steel, while for dragline or clamshell work the



boom is all-steel construction spread at the foot to resist side sway incident to sudden starting and stopping. The entire front of the dipper is a single manganese steel casting riveted to the side plates.

The hoisting engines are direct-geared to the drum which has a grooved barrel of sufficient length to require only a single wrap of the cable to raise the dipper to its highest position. Gears and pinions are of open-hearth steel, annealed and heat-treated, and have machine-cut teeth. For dragline or clamshell work an extra drum may be attached in tandem with the hoisting drum. Digging and rotating operations are entirely controlled by three hand-levers and a foot brake.

The lower or truck frame is formed from a large openhearth steel casting—a form of construction which the manufacturers claim is entirely different from anything heretofore produced for a machine of this size. The boiler is of the vertical through-tube type, the tubes being electric-welded at both ends to prevent leaks.

The design provides for the addition of parts necessary to convert the standard shovel into a clamshell, orange-peel, or dragline excavator, or into a material-handling crane. Any one of several combinations can be effected.

Publications from the Construction Industry

Steel Structures — McClintic-Marshall Co., Pittsburgh, designers, manufacturers and erectors of steel structures, indicates the scope of its service in a 69-p. book of photographs of buildings of all types which it has constructed. The views cover a wide range of structures, including shops, office buildings, factories, pier sheds, power stations, department stores, warehouses, cold storage bins, airship hangars, shipyard runways, roundhouses, and lock gates for the Panama Canal.

Conveyor and Elevator Chain—Brown Hoisting Machinery Co., Cleveland, in a 12-p. illustrated catalog, describes various sizes and types of dropforged chain for conveyors and elevators. The bar of the link is an I-beam section, designed to produce great rigidity, while the upset ends provide a large wearing surface. Tables are given designating each type of chain by number and containing other detailed information.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Production and Material Stocks in Eight Cities

Steel, Lumber and Brick Output Increased—Car Shortage Causing Heavy Mill Reserves but Small Dealers' Stocks

Steel—The annual rate of steel ingot production is now at about 37,000,000 tons as against 32,000,000 one month ago, and 19,000,000 tons in 1921. The steel industry generally, is proceeding at about 75 per cent of capacity, despite the perceptible falling off in steel buying throughout the country. Inquiries, however, regarding 45,000 new freight cars are pending in Chicago. Although production is increasing slightly, the bulk of the output applies on back-log tonnages. Rail embargoes still greatly impede steel shipments.

Lumber—An average of 388 mills reporting to the National Lumber Manufacturers' Association, for the four weeks ending Oct. 21, show 974,259,065 ft. cut; 753,901,097 ft. shipped and orders covering 750,330,122 ft. b.m. This represents a gain of 5 per cent in output; a falling off of over 6 per cent in shipments but a decrease in orders of only 0.7 per cent, as compared with the four weeks ending Sept. 23. According to the latest reports, production is still only 2 per cent, while shipments have dropped to 28 per cent and orders, 27 per cent below normal.

Cement—Manufacturers report 2,227,000 fewer bbl. of cement on hand Oct. 1 than were available at the same time last year, yet 9,256,000 more bbl. were produced in the nine months of 1922 than during the corresponding period of 1921, according to the Geological Survey. A total of 81,563,000 bbl. were produced in this country during the three-quarters of this year while the entire output for 1921 amounted to 98,842,049 bbl., indicating that total production for 1922 will probably exceed the output for the preceding year by about 9,000,000 bbl. Shipments, from Jan. 1 to Oct. 1, 1922, reached 88,684,000 bbl., an increase of nearly 20 per cent over the same period last year.

Brick—Out of eighty-one firms reporting to the Common Brick Manufacturers' Association of America for the month of October, only two were closed for lack of coal and one by car shortage. Total production for the month was 95,192,000 brick, with shipments of 78,000,000. There was a slight reduction of orders on books during the month; stocks of unburned brick on hand increasing over 17,000,000.

San Francisco—Kiln products plentiful with unlimited supplies to draw from; cement stocks still low. Lumber being used almost as rapidly as received from mills; no reserve stocks. Native asphalt always available in any quantity. Fair stocks of structural steel; nails and rivets scarce.

Denver—Car shortage holding up lumber deliveries particularly from Pacific Northwest. Local dealers' stocks sufficient to meet present demand. Brick supply good; cement stocks running low.

Minneapolis—Local lumber dealers' stocks about 20 per cent below normal, with probably 50,000,000 ft. in yards. Stocks piling up at lumber mills owing to shortage of cars for making deliveries to dealers. Brick and hollow tile stocks show improvement over last month but only small quantities available. No shortage of lime. Cement warehouses depleted, what shipments are received are delivered to job from cars. No asphalt available; road jobs being held up awaiting shipments.

New Orleans—Plenty of sewer pipe, cement, brick and hollow tile but no market for asphalt and crushed stone. Lumber stocks about 25 per cent of normal. Scarcity of cars holding up mill deliveries, particularly of lumber, sand, and gravel.

Atlanta—Scarcity of crushed stone; brick and lumber plentiful. Situation improving somewhat as compared with last month. Deliveries still being held up, however, particularly on highway construction materials, owing to present freight situation.

Philadelphia—Sewer pipe stocks depleted because of slow rail deliveries from mill. Lime being sold faster than received. Some grades of lumber still to be had in quantities but rail situation affecting mill shipments adversely. Heavy reserves of asphalt. Dealers' stocks of brick, cement and hollow tile about exhausted.

Birmingham—Lack of cars, for shipping out orders, tending to pile up materials stocks beyond usual limits.

New York—Shipments of sewer pipe from mills, improved within the last week; pine lumber deliveries, however, take five to six weeks as against seven to nine weeks, during October. Cement stocks are low but plenty of other kiln products available. Owing to freight embargoes, materials not transported by water, are holding up building construction to a considerable extent.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Lumber, Minneapolis, 50,000,000 ft.), time required for delivery of carload lots to city job, example: (sewer pipe, Atlanta, 10 days), and stocks on hand in general terms, example: (common brick, Philadelphia, no reserve).

	San Francisco	Denver	Minneapolis	New Orleans	Atlanta	Philadelphia	Birmingham	New York
Sewer pipe	Plenty	Del. 24 hr. local plant		Plentiful	Del. 10 days	Depleted in most sizes	Large	Mill del. improving
Cement..........	Low	Del. held up by car shortage	Warehouses depleted	Fair	15 cars	Stocks small	Plenty	Stocks low
Lime	Enough	Plenty	No shortage		10 cars	Sold faster than shipped in	Extensive	Plenty
Common brick	Well supplied	Supply good	Stocks small	Ample	Plenty	No reserve	Well stocked	100 barge-loads Hudson hard brick
Hollow tile.......	Fair	Sufficient	Supply limited	Sufficient	Del. 5 @ 6 days	Del. held up by car shortage	Big reserve stock	No shortage; del. by water.
Lumber	Used as fast as rec'd. from mill	Local stocks sufficient; mill shipments delayed.	50,000,000 ft. Dealers' stocks 20 per cent below normal	Stocks 25 per cent normal	Heavy pine stocks	Plenty, some grades	Plenty pine	Pine, del. 5 @ 6 wk. from mill.
Asphalt.........	Extensive reserves	10 cars	None	No market	10 cars	Heavy reserves	Ample	Large reserves
Structural steel...	Stocks low				3 cars	Delayed mill shipments	Heavy	Mill del. affected by car shortage

REPORT ON COMMON BRICK FROM 81 YARDS AS OF OCT. 1, 1922

Dist. No.	Including States of	No. of Firms Reporting	Plants Closed Down	Burned Brick on Hand	Unburned Brick on Hand	Orders on Books	Price per Thousand At Brickyard
1	N. Y., New England	5	1	4,053,000	4,785,000	3,326,000	$13.00 to $18.00
2	Pa., N. J., Md., D. C., Del.	9	1	8,210,000	10,258,000	26,681,000	14.00 to 19.00
3	Va., N. C., S. C., Ga., Fla.	5	1	520,000	911,000	2,408,000	14.00 to 18.50
4.	Mich., Ohio, W. Va...........	11	2	3,707,000	8,490,000	12,409,000	12.50 to 18.00
5.	Ill., Ind., Wis.................	25	2	156,674,000	4,677,000	170,524,000	11.00 to 15.50
6.	Ky., Tenn., Miss., Ala., Ark., La.	10	0	[illegible]	5,426,000	12,567,000	9.25 to 16.00
7.	N. & S. Dak., Minn., Neb., Ia., Kan., Mo.	5	3	2,758,000	99,000	520,000	10.50 to 18.00
8.	Okla., Tex., N. M............	5	1	5,545,000	1,030,000	1,108,000	7.50 to 12.00
9.	Wash., Ore., Mont., Wyo., Ida., Utah, Colo.	3	0	[illegible]	350,000	835,000	13.50 to 16.00
10.	Calif., Ariz., Nev.............	3	0	3,131,000	6,136,000	3,950,000	14.50 to 15.50
		81	11	[illegible]	[illegible]	234,328,000	

Fifty Big Contracts Since Sept. 1 Total $82,450,907

Of These, Industrial Plants Lead—Commercial Buildings Next—Hotels and Apartments Third

Lists of contracts awarded on the most important engineering construction projects since the first of the year have been published from time to time in *Engineering News-Record* in the following order: twenty-six covering the first quarter of the current year, in the Searchlight Advertising Section of the April 20 issue; fifty, awarded from March to June, in the July 27 issue, p. 169, and twenty-five lettings between June and August, in the Aug. 31 issue, p. 375.

In this issue the accompanying table shows fifty of the largest awards recently let or actually under way since Sept. 1. These jobs represent a total value of $82,450,907, 34 per cent or $28,450,000 of which was for industrial expansion, indicating the general upward turn in this class of construction.

Commercial buildings, i. e., banks, offices, stores and warehouses, stood second with $19,000,000 or 23 per cent and hotels and apartments followed with $16,250,000 or 19 per cent of the total for these fifty contracts. Five waterworks jobs totaled $4,500,604.

To Insure Long-Time Supply of Building Mechanics

A. G. C. Recommends Plans to Remedy Conditions Revealed by Its Survey of Situation

By Eugene Young
Executive Secretary, the Associated General Contractors of America

It is plain to anyone studying the operation and effect of the three per cent immigration law that, if continued, it will foster a labor monopoly which will seriously effect the whole nation, and that a speedy relief is imperative which will provide for scientific, selective immigration, equal to the country's need. Our domestic industrial regulations are such that our recruiting sources are practically limited to the supply created through apprentices. A survey recently conducted by the Associated General Contractors of America has disclosed some startling conditions in this field. In every case except that of the plumbers, fewer apprentices were employed per thousand journeymen than in 1910, and in the case of bricklayers, plasterers and carpenters, the number of apprentices employed is less than 50 per cent of the number of mechanics dying or retiring on account of old age. The situation, therefore, resolves itself into two problems. The first is to provide, as quickly as possible, mechanics to supply the present shortage. The second is to interest young men in the building trades and to provide means for their education.

To assist in solving the first problem, we recommend: (a) That men now engaged on construction work as building laborers and otherwise who show an aptitude be employed as helpers to the skilled mechanics, being permitted to do any work their experience warrants. In a short time they could execute much of the plain work, releasing the older and more skillful mechanics for the most intricate work. (b) That there be established by employers, under their control, special trade schools where the age limit and scholastic requirements be waived, and the only conditions for entrance be an aptitude for and a willingness to learn a given trade. These schools should teach merely the handling of tools and the rudiments of the trade, leaving skill and efficiency to be acquired on the job, where experience has shown it is most successfully acquired.

The second problem is to provide means to insure a supply of mechanics to care for the normal growth of the nation. To do this all building trade organizations and persons interested in the construction business, should inaugurate a campaign to attract young

ESSENTIAL DATA ON LARGE CONTRACTS AWARDED SINCE SEPTEMBER

Place	Work	Size	Price	Successful Contractors
B. C., Elko	Power house. dam and paper making plant	25,000 hp. plant; concrete dam (Total cost)	$10,000,000	McDougall & McNeill, Ltd., 514 Standard Bank Bldg., Vancouver, B. C.
Calif., Sacramento	Filtration plant		771,957	Mathews Constr. Co., Forum Bldg., Sacramento, Calif.
Colo., Denver	Hotel	8 story with 4 wings	5,000,000	Fleisher Construction Co., 606 Builders Exchange, Minneapolis, Minn.
Conn., Devon (Milford P. O.)	Power plant unit	1 story	2,000,000	J. A. P. Crisfield Construction Co., Gravers Lane, Germantown, Phila.
D. C., Washington	Office	10 story	4,000,000	G. A. Fuller Co., Munsey Bldg., Washington, D. C.
D. C., Washington	Office		1,500,000	J. Stewart, 30 Church St., New York
Ill., Chicago	Hotel	10 story, 160x348 ft. (1st unit)	5,000,000	Caldwell & Son, State Savings & Trust Bldg., Indianapolis, Ind.
Ill., Chicago	Plant	3 story, 125x240 ft.	500,000	Simpson Construction Co., 133 West Washington St., Chicago, Ill.
Ill., Chicago	Bank	8 story, 65x115 ft.	500,000	F. Burke, 35 S. Dearborn Rd., Chicago, Ill.
Ill., Urbana	Stadium		2,500,000	English Bros., 419 Lincoln Bldg., Champaign, Ill.
Md., Baltimore	Hospital	9 buildings	658,600	Price Constr. Co., Maryland Trust Bldg., Baltimore, Md.
Md., Williamsport	Generating plant	30,000 kw.	2,000,000	Sanderson & Porter, 52 William St., New York, N. Y.
Mass., Boston	Office	12 story, 113x184 ft.	3,000,000	Evatt Construction Co., 161 Devonshire St., Boston, Mass.
Mass., Somerville	High school	3 story	800,000	F. G. Coburn, 294 Washington St., Boston, Mass.
Mass., Weymouth	Power plant	60,000 kw	8,000,000	Stone & Webster, 120 Broadway, New York
Mich., Detroit	Plant	1 story, 245x1,570 ft	750,000	Walbridge-Aldinger Co., Penobscot Bldg., Detroit
Mich., Detroit	Sewers		1,246,028	T. A. Gillespie Co., 50 Church St., New York, N. Y.
Mich., Detroit	Office	14 story, 168x177 ft.	2,500,000	O. Misch Co., 1370 Broadway Ave., Detroit, Mich.
Mich., Detroit	Apartment	10 story, 150x171 ft.	1,500,000	Natl. Construction Co., 1031 Dime Bank Bldg., Detroit, Mich.
Mich., Detroit	Hotel	14 story	1,000,000	Van Blarcom Co., Plymouth Bldg., Cleveland, O.
Mich., Flint	Plant	2 story, 202x401 ft.	500,000	Realty Construction Co., Flint, Mich.
Mich., Hamtramck	Plant	8 story, 200x400 ft.	1,500,000	Day labor. Smith, Hinchman & Grylls, 800 Marquette Bldg., Detroit, Engrs.
Minn., Duluth	Hotel	12 story, 100x140 ft.	1,500,000	Jacobson Bros., 619 Columbia Bldg., Duluth, Minn
Minn., Minneapolis	Apartment hotel	13 story, 50x150 ft. with 3 wings	1,500,000	Fleisher Construction Co., 1000 Builders Exchange, Minneapolis, Minn.
Mo., Cape Girardeau	Sewerage system.		330,866	J. J. Dunegan, Shenandoah, Ia.
Mont. Billings	Ditch		450,000	O. Schleuter, Fremont Neb. and H. Schleuter, Cartersville
N. Y., Geneva	Plant	160x280 ft	1,000,000	Curan-Mason, Inc., Rochester, N. Y.
N. Y., Long Island City.	Warehouse		1,750,000	Amer. Concrete Steel Co., 27 Clinton St., Newark, N. J.
N. Y., New York	Clubhouse	9 story, 128x168 ft.	750,000	M. Eidlitz & Son, Inc., 41 E. 42d St., New York
N. Y., New York	School		624,000	T. Dwyer, Broadway & 216th St., New York
N. Y., New York	Hotel	12 story, 115x130 ft	750,000	Empire Contracting Organization, Inc., 130 W. 42d St., New York, N. Y
N. Y., New York	Sewers		518,984	Spadaro Contracting Co., 827 E. 217th St., New York, N. Y.
N. Y., New York	Store and office.	12 story, 45x100 ft.	1,250,000	Fountain & Choate, 110 E. 23rd St., New York
Okla, Tulsa	Water supply project			
	Dam		787,610	Standard Paving Co., 321 N. Boston St., Tulsa
	Tunnel and approaches		304,057	Standard Paving Co., 321 N. Boston St., Tulsa
	60 in. concrete conduit		2,136,980	Walbridge-Aldinger Co., Penobscot Bldg., Detroit, Mich.
Pa., Clairton	Plant		2,000,000	Koppers Co., Farmers Bank Bldg., Pittsburgh, Pa.
Pa., Jeanette	Plant	1 story	1,500,000	Heyl & Paterson, Inc., 51 Water St., Pittsburgh, Pa.
Pa., Philadelphia	Office	17 story, 53x230 ft.	1,000,000	F. W. Mark Construction Co., Commercial Trust Bldg., Philadelphia, Pa.
Pa., Philadelphis	Office	20 story, 79x138 ft	1,250,000	F. W. Mark Construction Co., Commercial Trust Bldg., Philadelphia, Pa.
Pa., Philadelphia	Plant	7 story, 71x104 ft.	700,000	J. N. Gill Construction Co., Otis Bldg., Philadelphia, Pa.
Pa., Pittsburgh	Bank		1,000,000	Mellon-Stuart Co., Oliver Bldg., Pittsburgh, Pa.
Que., Montreal	Water mains	11,000 ft. 40 in., 2,000 ft. 30 in.	500,000	Laurin & Leitch Eng. & Construction Co., 590 Union Ave., Montreal, Que.
Que., Montreal	Quay walls	4,500 ft. long	450,000	Atlas Construction Co., Belmont St., Montreal, Que.
Que., Montreal	Piers		409,950	Atlas Construction Co., Belmont St., Montreal, Que.
R. I., Scituate	Tunnel		1,318,340	Keystone State Construction Co., 210 S. 13th St., Philadelphia, Pa.
Tex., Ft. Worth	Sewage disposal plant, Imhoff tanks, filters, etc.		525,090	McKinzie Construction Co., 302 West Mulberry St., San Antonio, Tex
Utah, Salt Lake City	Bank and office	20 story	1,250,000	P. J. Walker & Co., Monadnock Bldg., San Francisco, Calif.
Va., Winchester	School	1 story, 197x551 ft.	1,000 000	J. L. Crouse, Greensboro, N. C.
Wis., Madison	Hospital	7 story, 250x300 ft.	668,443	Immel Construction Co., 200 N. Main St., Fond du Lac, Wis.
Total			$82,450,907	

men to the trades; showing how interesting, profitable and honorable mechanical vocations are. Educational officers, both state and municipal, should be urged to establish courses to teach the building trades. having in charge men who have had actual experience at the trade in addition to theoretical knowledge.

Trade unions should be induced to revise their rules regulating apprentices. Under the present rules it is impossible to interest either the American youth or the employer. Under these rules. apprentices are limited to boys between the ages of 16 and 20 years. It is well known that few American boys have any serious intention to learn a trade. Only after they have reached their majority do they look on life seriously and realize the necessity of having some trade.

The length of time required for apprentices is from 2 to 4 years. This is too long to teach the rudiments of a trade and is longer than a young man is willing to work for the wages an employer can afford to pay for the kind of work apprentices are permitted to do. Because of this limitation on the scope of employment, the boys wages are small. His whole outlook is limited,—quite naturally, he is discouraged—and he quits the job. General utility work would expand his knowledge and experience, make him a more all-around useful mechanic to both the employer and himself.

As apprenticeship rules are made by the local unions, it is up to the local employer to work the desired changes. The situation really is serious.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 2; the next, on December 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.14	$3.95	$4.20	+$3.02½	$3.15	$3.85	$3.25	$3.80	$3.75
Structural rivets, 100 lb.	3.85	4.60	6.00	+3.75	4.00	4.80	4.50	5.00	—5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.04	3.85	4.00	+2.92½	3.05	3.85	3.00	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	61.15%	45%	59½%	+57-5%	41%	47.9%	+40%	30.00
Cast-iron pipe, 6 in. and over, ton	55.30	—50.00	51.50	48.70	55.50	63.00	+54.00	—53.00	55.00
Concreting Material:									
Cement without bags, bbl.	2.60	2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd.	+2.00	2.00	2.25	+2.25	1.75	+1.90	2.25	1.00	1.50
Sand, cu.yd.	1.00	1.35	1.87½	+2.25	1.00	+1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	+2.10	1.65	+2.25	2.25	3.50	2.25	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59.00	42.00	40.00	51.00	—39.75	39.75	35.00	—22.00	50.00
Lime, finishing, hydrated, ton	+16.80@17.17	23.00	—22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	17.45@18.28	12.00	—9.90	11.00	18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	—.0796	.065	....	.11	.08
Hollow partition tile 4x12x12, per block	.1230	.0776	.115	.0808	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	.93	.97	—1.07	+.95	1.00	1.08	1.04	.86	—1.02
Common Labor:									
Common labor, union, hour	.60	.35	......	......	....	.50@.55	.56¼	.50@.60	....
Common labor, non-union, hour	+.45@.60	.30	+.30@.50	.72½	.35@.50	.35@.50	.47½@.50	....	—.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — sign. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2 ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars, tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81½c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180 lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit, stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5¾ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding, brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par.) Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

In the face of freight embargoes upon shipments of badly needed building materials, consequent to the most acute car shortage in railway history, premiums, recently ruling, on prompt deliveries of structural steel, are rapidly disappearing from the market. The exigency, however, recently prompted a firm of New York contractors to purchase twenty-five bad order freight cars and make repairs at their own expense, in order to expedite necessary steel shipments.

Shapes are quoted as low as $1.90 on attractive tonnages and at a maximum of $2.10 where orders involve special considerations and speed in shipment, consistent with present embargoes, but average remains at $2 per 100 lb., f.o.b. Pittsburgh. Market is soft on reinforcing bars with few new inquiries. Some orders booked at $1.90 but average price $2. Sales, however, of carload lots for early delivery, quoted at $2.10 per 100 pounds.

Cast-iron pipe advanced $3 in San Francisco but telegraphic reports from Seattle show a drop of $1 per ton, owing to the fact that shipments are coming through much easier this week.

Transportation difficulties have adversely affected sand, gravel and crushed stone. Advances are reported in Chicago, Denver, Atlanta, and New York.

Yellow pine prices fairly firm throughout the country; Douglas fir dropped $1.25 in Minneapolis and $2.50 per M. ft. in Seattle during the week.

Downward tendency of cement prices reflected in quotations of $2.48 as against $2.73 per bbl., without bags, f.o.b. Jersey City; $2.47, down from $2.48 at Toledo and Detroit, respectively.

Linseed oil though firm in New York for several weeks, has dropped 6c. in Dallas and 4c. per gal. in Montreal.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc. James H. McGraw, *President*

Engineering News-Record

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*

Volume 89 NEW YORK, NOVEMBER 16, 1922 Number 20

Two Decades of "Engineering Literature"

TWENTY years or 240 monthly issues of the "Engineering Literature" section are concluded with the present issue. The first fifteen years of the section was reviewed at length in the issue of Nov. 15, 1917, p. 934. Included in that review was a reprint of the statement of the scope and aims of the section as printed in the initial number. Both scope and aim remain the same: To chronicle and characterize books and other publications in the field of civil engineering as they appear, treating them as news and, where demanded, with constructive criticism.

Excess Mixing Water Made Obvious

EXCESS water in concrete is now accepted generally as a source of weakness but few users of concrete appreciate how much of the water apparently necessary to make a workable mix is actually superfluous. Visual evidence of this superfluity is offered in the manufacture of the centrifugal concrete pipe described on another page. It is really remarkable to see how much water can be squeezed out of a mortar which is by no means sloppy but is in fact drier and more mushy than much of the concrete that is being placed today. Unfortunately the centrifugal process, or any pressure process indeed, is not practicable for any but precast pieces, so the extremely dense and strong concrete formed by thus expelling needless water can hardly be expected in structural work but the lesson so graphically taught in making these pipes can be taken to heart and possibly applied in some other form to the greater complications of cast-in-place concrete.

Traffic Officers on Roads

TRAFFIC control by semaphores and by officers is an obvious necessity in the crowded city street but the importance of such control on the country road is only beginning to be recognized. Many roads now carry traffic of a density surpassed only by the most busy of city streets and the problems of safety and congestion which arise call for constant supervision, not only to put a stop to much of the abuse of the road, but also to improve general traffic situations in such a way as to make possible its more effective use during periods of unusually heavy traffic. Unrestrained impatience on the part of a few motorists during holiday rushes can start traffic jams that create prolonged blockades. Recently such a jam involved 1,500 or 2,000 automobiles and extended for more than a mile along a well-paved California highway, and held up individual cars more than an hour. With adequate policing that same highway has carried larger volumes of traffic without delay, which emphasizes the sometimes forgotten fact that well controlled traffic will operate effectively over a roadway on which a much smaller volume unregulated will choke itself. The highway engineer, who now deals in transportation, has a responsibility in seeing that the road is properly used, but beyond that there is an economic consideration which affects first costs. The present-day tendency is unmistakably toward wider pavement, but there is a limit beyond which it cannot go. On roads of reasonable width adequate policing, particularly during special heavy traffic, will forestall the premature demand for widening the pavement.

Against Public Expenditure

ELECTION results last week were everywhere so one-sided that there could be no question of the temper of the people. Because of this obvious running together of many minds it is significant that so far as the returns are now available votes for all measures which involved the direct appropriation of public funds, with the exception of those for the building of schools, dropped far behind the vote for the winning ticket, which represents the general trend of the voters' thought. In some states, as in the case of the California hydro-electric state ownership amendment, the vote was definitely against adoption; in others, as in the New Jersey highway bond issue, the favorable vote fell far below that cast for the winning ticket but still remained sufficient to insure passage by a small margin. This result can hardly be called surprising; it is the natural reaction from the spending era of the war and the post-war inflation. The people want economy in public affairs and the most elementary and obvious way to start to be economical is not to spend. Arguments that expenditure now may save future greater expenditures fall on deaf ears when the tax rate keeps mounting. In the highway field the resentment against expenditure lies deeper and constitutes a real danger to the proper development of the roads of the country. So serious is this situation that next week *Engineering News-Record* will discuss it in detail, with some suggestions for a program to combat a tendency which may put us in back years in our highway development.

Tax the Highway Sign

ON THE ground that advertising signs along highways are conducive to accidents, an Oregon highway engineer has recently ordered the removal of all such signs that trespass on the highways. This is one more addition to the long list of protests against a public highway nuisance. Many states do not allow such signs on highway right-of-way but, so far as we know, Massachusetts is the only state that attempts to control them on private property along the highways, and even there the cities and towns have superior powers over the road signs inside their boundaries. The glaring signboard close to the highway, challenging every motorist who passes, besides being an accident menace is an imposition on the traveling public and an offense to every lover of nature. Because the owner of private property has been paid for the privilege, a bill posting company assumes the right to reap a benefit—and that

in an objectionable way—from the public highway toward which it pays nothing. The advertising value of the sign depends on the highway owned by the public, and not on the private property whereon it stands. Therefore the first obligation of the bill posting company is to the public. Permission from the land owner is a secondary consideration—another matter altogether. As now tolerated, the billboard is a parasite on the taxpayer who pays for the highways. He is, generally speaking, offended by the nuisance as much as any one else and the great wonder is that he has so long endured the imposition. Highway engineers have done well to exclude advertising signs from the right-of-way. It is now time to go one step further and urge that each state legislature pass a law extending the Massachusetts idea of control so that at least there will be some governmental supervision of the character and location of signs. Those which can not be excluded should be made to pay a proper tax.

By the Lamp of Experience

SEVERAL months ago we commented on the effort of the French government to turn over its state railways to private operation. Now we learn from the news dispatches that a commission appointed last spring by the Chamber of Deputies has recommended similar action with the telephone system. It appears that during the last two years the telephone administration has sought to lighten its burdens by the simple expedient of discouraging applications for telephones, and for this purpose it has imposed an extra charge of 700 francs per year. M. Lambert, head of the commission, is quoted to the effect that France must base her telephone system on the commercial spirit or it never will be any good, and he recommends private operation under government supervision. In Italy, too, the new Premier is planning to transfer the telephones, telegraph and railways to private ownership, and we are told that the government already has begun negotiations for turning over the telephone system to a private company of Milan. This trend toward private operation at a time when the nations are trying so desperately to develop their highest efficiency is an illuminating commentary on the relative worth of public and private managements.

Making Both Ends Alike

AFTER a recent visit to half-a-dozen of the great ports of northern Europe, B. F. Cresson, Jr., chief engineer of the Port of New York Authority, comes home with the suggestion that there must be international co-operation in the design of ports, particularly in respect to the material-handling machinery. It is little short of absurd, he thinks, that the two termini of the transatlantic ferry should be radically different in equipment and in routine of loading and unloading. He therefore proposes some sort of international association of port authorities who could get together to meet each other's mind even if complete similarity of port design could not be developed. With due acceptance of the inevitable differences in port layout and in the local transportation and labor conditions some greater degree of uniformity in freight handling could certainly be brought about by such an association. It need not aim at standardization but it could harmonize methods and equipment so that a more rapid turnaround would result at both sides of the Atlantic.

A Modern Porous Foundation Dam

ONE of the first requirements for a dam is a solid foundation, for in spite of—though it may be because of—the theory of dam design which guards against shearing, slipping and overturning as major dangers, the records show that most dam failures are due to percolation under the dam and consequent partial removal of the sub-foundation ground. Nevertheless sometimes dams have to be built where there is no solid bottom and then a technique of design is used quite different from that which governs the normal dam on good rock. The base is spread so far up and downstream that the structure may be truly said to float on the weak subsoil and by great length of base and by cutoff walls the undercurrent of water is led through so long a path as to remove its destructive force. Such dams were common in the primitive irrigation of India and the principles learned there have been extended to numerous modern structures in that birthplace of irrigation, but only a few have been built in this country. The one built by the Indian Service across the Gila River, described elsewhere in this issue, is therefore eminently worth recording, not because it shows any new principles but because it illustrates the adaptation of the porous foundation dam to the materials and engineering ability available today.

Regulation of City-Owned Utilities

THE wide extent to which privately-owned municipal water-works have been put under state control while those owned by the cities have generally been left scot free, except as regards the sanitation of water, has led a subscriber to suggest a "campaign looking to the financial control by state utility commissions over municipally-owned and operated water-works" in order to promote "business" rather than "political" administration. It is significant that the suggestion comes from a man who for years has held a responsible position in the administration of a municipally-owned water-works. Wisconsin is a notable instance of state control of some phases of the financial administration of city-owned water-works. Apparently the plan has been beneficial in that state. The extension of the plan might well be given attention, now that most of the legislatures will soon have their biennial session. Strong objection may be expected from the "home rulers," of whom there are many. The extremists in this class object even to state control of privately-owned utilities, claiming that the cities themselves, untrammelled, should do all the regulation. The argument in favor of a reasonable degree of state control of municipally-owned water-works is stronger than that against.

Higher Municipal Bond Interest

ALTHOUGH still considerably lower than in the earlier post-war days the interest rate on municipal bonds has risen of late. Combined with a like advance in labor and material prices this tends to discourage municipal enterprises but there is some offset in improved industrial conditions. Moreover, the lag in municipal construction for several years past is a constant urge for water, sewer, paving and other improvements. Sound judgment in the planning, adoption and execution of municipal work is more necessary than at any time since the war, but with such judgment assured there should be no recurrence to a holdup of needed improvements.

Studies in Engineering Economics

WHEN we think of great engineering enterprises as depending on the solution of difficult technical problems of design and execution, we are apt to overlook the equally vital economic problems involved. The justification of every major piece of civil engineering construction lies in the fact that it yields large return on its cost, and in nearly all cases this return must be demonstrated before construction can begin. Such advance calculation of results contains formidable economic problems. If they are looked upon with less respect than they deserve, it is because superficial methods of solution have usually been thought sufficient. When painstaking study is applied and a precise and dependable result is sought, the dominant importance of the economic phase appears clearly.

A remarkable instance is presented in the appraisal work of the Miami Conservancy District, described for the first time in this issue. The great flood-protection enterprise called into being by the disaster of 1913 could not enter on its first step toward realization until a scrupulously precise reckoning had been made of what it would ultimately accomplish, not merely for the region as a whole but for every parcel of property contained. Unless this appraisal had been made and had been found absolutely fair, there would be no completed flood-protection system in the Miami Valley today. The engineers and appraisers who carried it through accomplished the most difficult task of the whole period of struggle since 1913. Their success exemplifies strikingly both the possibility and the difficulties of computing results before construction; and at the same time it gives an emphasis to the broad economics of engineering planning that has long been needed.

It is to be remembered in connection with the Miami benefit appraisal that the questions of fact and logic which it involved were only one element of the problem in hand; and by no means the largest. The dominant one was the human element. The entire population of the extensive valley district was involved. The citizens and farmers, owners of 70,000 individual properties, were to be called upon for a huge sum of money, $30,000,000 or more, and such demands mean strong protest and opposition. The people had to be awakened to sympathy and support, and all antagonisms eliminated. The advantage which the project would bring to the district had to be computed so convincingly that it would assure the approval not merely of the court but also of the great majority of those who would have to pay; and at the same time it had to be sound and practical enough to overcome the arguments of the few who remained unconvinced. It was necessary, finally, that the distribution of the aggregate benefit among the different parcels of land should be based on principles clear and definite enough to permit its fairness to be demonstrated almost mathematically. Unerring judgment of physical conditions and equally unerring judgment of the action of the human mind had to be combined in working out the solution of this tangled problem.

Such appraisal of returns from an engineering enterprise is possible, we learn from the Miami record, even in the face of exceptional difficulties. This is a worthwhile lesson. Many a promising project lies idle today that could proceed at once, were the benefits to be derived from the completed work demonstrated. The same condition will always exist. There will always be boundless opportunity for careful forecasting of the benefits of public-service improvements. The Miami work is a heartening stimulus and its methods furnish a precedent and model for such studies.

The special importance of benefit appraisal in flood protection is worth a separate word. Floods menace innumerable valleys throughout the country and are responsible for huge annual losses. But for any one valley the danger and the loss are speculative rather than present, while the cost of protection is a real and onerous burden, and under these circumstances it is not easy to overcome the inertia of a large population and induce it to undertake the construction of protective works. Only by a penetrating analysis of flood risks and flood damages can the necessary conviction be produced; and, as some actual cases have shown, even this work will fail if the allocation of flood damages—or flood-protection benefits—is not made with such refined fairness that the final project can justify itself in every detail as well as in the whole. In the future flood-protective science, whose development lies not far ahead, the details of economic analysis will have a leading place.

Theory and Practice

IN CONSIDERING the unusually interesting theoretical study of the strength of various rivet arrangements printed in this issue, the engineer will find it advisable to keep in mind rather carefully the bearing of theory and practice on the problem in hand. It happens that proper rivet grouping is one of the very fundamentals of structural design, as it is also of boiler construction; but, while mechanical engineers may have succeeded in dealing with their riveted seams in perfectly satisfactory manner—which, in the lawyer's parlance, not knowing we deny—civil engineers can not claim as much for the riveted connections used in structures. Certain elements of the problem make it quite appropriate to enter into a careful mathematical study of proportioning even though the method seems to go far beyond the available empirical knowledge. Mr. Cochrane has gone into such a study, with quite illuminating results. It will be recalled that the past year has brought out a considerable amount of discussion of the same problem, the effective net area of a built-up tension member. The present article may be considered as a concluding contribution. The entire discussion has helped to clarify the problem; but as to practical procedure, or a desirable specification rule, engineering judgment is likely to refer back to the fact that the strength of built-up tension members is one of the least known subjects, so far as large size experimental study is concerned. Until such study furnishes a basis for quantitative thinking on rivet arrangement, two important considerations are that there is unquestionably a non-uniform distribution of stress in the spaces between rivet holes, which reduces the effective resistence of the member, and that the rivet holes probably weaken the metal in other ways than by mere reduction of cross-section.

These points suggest caution in applying refined calculations to rivet grouping, unless there is an ample margin of safety to allow for error in the basic assumptions. Further, on the view that small staggers are undesirable and should be discouraged by a conservatively framed specification, it is likely that most bridge engineers would rather put a penalty on deficient stagger than to seek a meticulously accurate measure of the proper rivet deduction for each stagger ratio.

Floating Concrete Dam Built on the Gila River

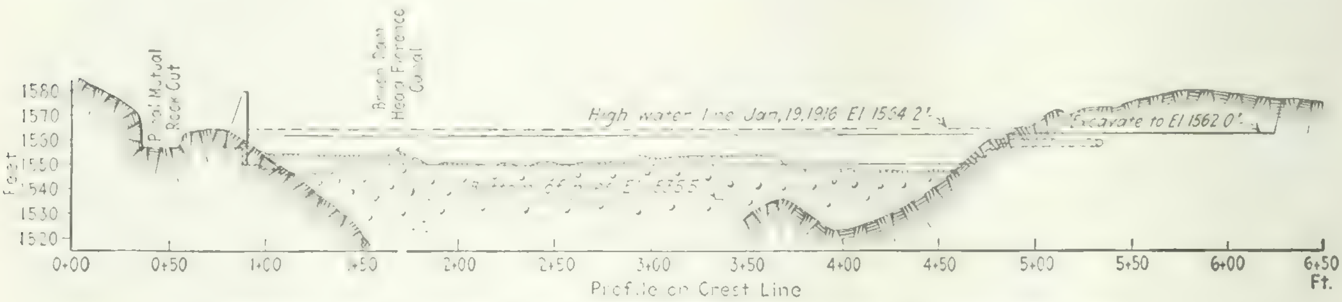
Porous Foundations Require Spread Footings for Low Diversion Dam—Built by Indian Service Under Force Account—Special Construction Details To Avoid Floods

Compiled from the field and progress notes of Maj. C. R. Olberg, Ass't Chief Engineer, U. S. Indian Service, who had charge of the work.

By C. J. Blanchard
Statistician, U. S. Reclamation Service, Washington, D. C.

POROUS foundation dams of the floating weir type so common in India have not been built in great numbers in this country. This description of a notable one, across the Gila River near Florence, Ariz., is offered as an example of the design and methods of construction of this kind of structure. It was built as a diversion dam for an irrigation canal by the U. S. Indian Service by force account.

The dam is located about 12 miles above Florence at a point where the Gila River passes through a low granite ridge which is a part of the range cut by the lower Gila Canyon, the mouth of which is a few miles above the dam site. At the dam site the channel is about 400 ft. in width with rock walls rising about 30 ft. high on each side. Borings at this point disclosed the fact that the river bed is really a filled in canyon, the rock on both sides of the river extending only a short distance into the channel and then dropping off vertically more than 100 ft. It being impracticable under these conditions to construct a dam on bedrock, the weir type of floating dam was selected.



CROSS-SECTION THROUGH FLORENCE DAM SITE SHOWING POROUS BOTTOM

The Florence Dam consists of a floating slab of concrete 396 ft. in length, 212 ft. in width and varying from 2 to 5 ft. in thickness. It is keyed to the rock on both sides of the river and supports a hollow weir or dam, 10 ft. in height of the same length as the slab. In order to provide greater spillway capacity the crest of the dam is extended into the rock forming the north bank, a distance of 120 ft. The total width of freeway for the passage of water from the wall of the intake gates on the south bank to the face of the upper rock cut on the north bank is 515 ft. Additional width on the north bank could not be secured without trespassing on the right-of-way of the Arizona Eastern Ry. which parallels the river opposite the dam.

The weir is keyed into the face of the lower rock cut on the north and on the south a retaining wall protecting the intake gates forms the abutment. A sluiceway provided with suitable guide walls is located in the weir immediately in front of the intake gates. The intake works include a bank of nine regulator gates which divert water into the intake of the Casa Grande Canal 40 ft. wide on the bottom, 6 ft. deep and with a capacity of 1,000 sec.-ft. Like the spillway on the north bank the upper section of the canal, including the forebay behind the intake works, is blasted out of the solid rock.

The dam and headworks are designed to pass a maximum flood of 150,000 sec.-ft. With such a flood there will be a depth of 17 ft. of water over the crest, the elevation of which is 1,562 ft. above sea level. This depth required that the curtain wall in front of the intake gates should be brought up to El. 1,580 to avoid drowning the canal during high water. Additional freeboard is provided by a solid parapet wall over the gates, 3 ft. in height. The dimensions and relative location of the component parts of the slab and dam are shown in the accompanying plan and section.

The slab is divided into four sections: The rear apron, main slab, fore apron or upper talus and the lower talus.

The rear apron is 16 ft. in width and 12 in. thick; reinforced through its length with ⅝-in. bars spaced 28 in. on centers. A 9-in. concrete cutoff wall 3 ft. in depth, also reinforced, protects the heel or upper edge of the apron.

The main slab is 56 ft. wide and varies from 2 ft. in thickness at the lower edge to 5 ft. at the upper. It is not reinforced but is provided with expansion joints every 40 ft. Specifications for the concrete in the slab called for 1:3:6 mix with 35 per cent plums. The slab rests on two rows of Wakefield sheet piles composed of three 2x12's bolted together driven to a depth of 16 ft. below the bottom of the slab.

The upper talus is 70 ft. in width and 2 ft. thick and is composed of 1:3:6 concrete with 60 per cent plums. It is reinforced with ½-in. steel bars spaced 2 ft. on centers both ways. The lower edge is protected by a cutoff wall, similar to the one under the fore apron. There is a drop of 18 in. between the surface of the upper and lower talus.

The lower talus is also 70 ft. wide and 2 ft. thick, the lower 40 ft. constituting the so-called "articulated section," which is divided into blocks 10 ft. square, tied together with iron rods. These blocks are intended to settle so as to conform to the bed of the river if

erosion should occur under flood action. The lower talus is reinforced like the upper and the composition of the upper 30 ft. is identical with it. Specifications for the articulated section called for 1:3:6 concrete, ¾-in. crushed rock and 60 per cent plums. A talus of large rock was laid below the articulated section as an additional protection for the dam. The rock was laid as the river scoured out the sand and gravel and varies from 5 to 20 ft. deep and from 20 to 50 ft. wide.

The ogee weir on the fore apron is thoroughly reinforced in both directions with steel bars and anchored to the slab. It includes a 42-in. cement pipe intended to carry water from the intake gates across the river to a small canal on the north bank. The weir was poured in 40-ft. sections conforming to the expansion joints in the main slab. The cement pipe was provided with copper collar or coupling at each joint designed to take up the expansion and prevent leakage. Specifications for the weir called for 1:3:6 concrete and 2½-in. crushed rock. River gravel, however, was substituted for the rock as it reduced expense.

The sluiceway is located immediately in front of the intake gates so the sand and silt can be sluiced out before entering canal. Openings through the dam are provided with four 4x8-ft. gates of the rising type separated by reinforced-concrete piers 3 ft. thick while the sluicing channels leading to the gates are formed by thin reinforced-concrete walls of appropriate height, shape and direction to assist in sluicing action.

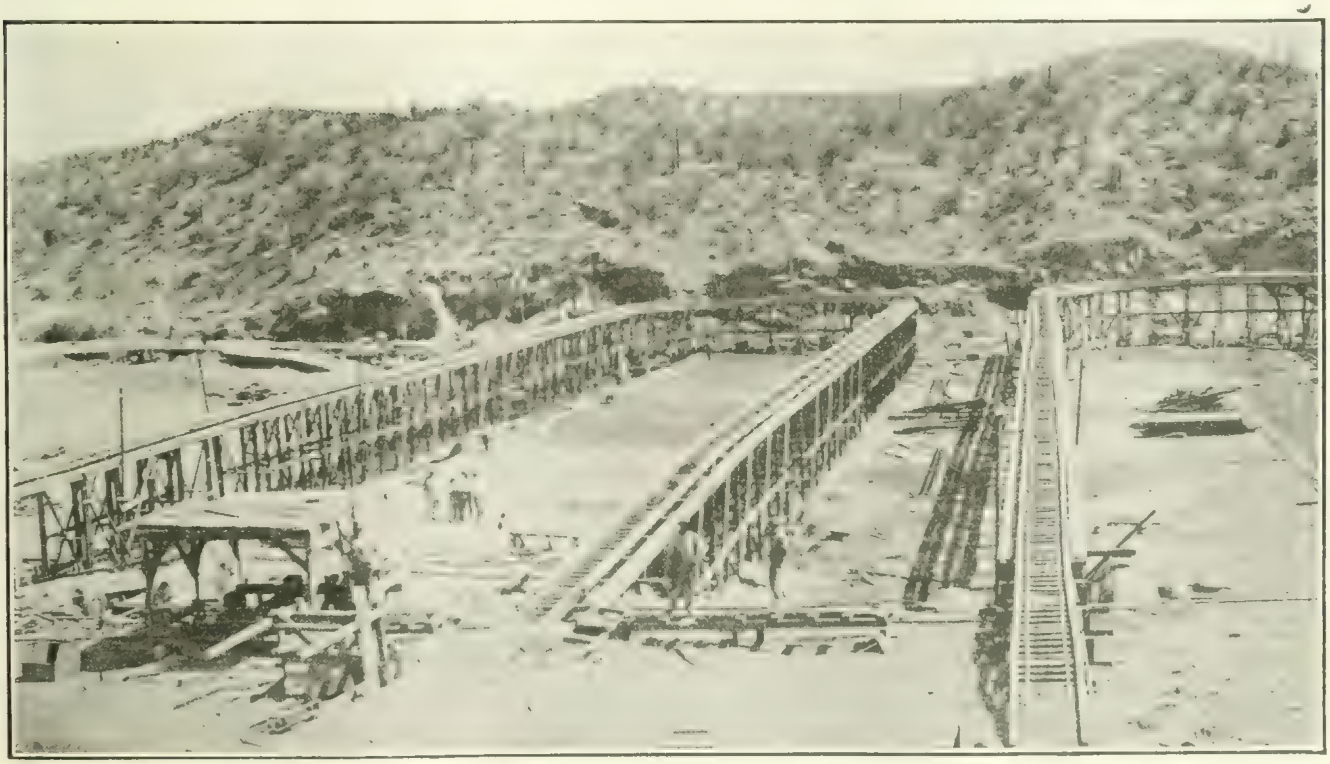
A bank of nine 4x8-ft. regular gates of the folding or leaf type is provided for the heading of the main canal, so that water may be skimmed from the surface of the river to prevent rolling sand and silt from entering the canal. The elevation of the gate sills is 4 ft. above the crest of the dam and 3 ft. above the bottom of the canal.

Reinforced-concrete piers 2 ft. 6 in. thick resting on bedrock separate the gates. These piers are 25 ft. high and 20 ft. wide. The face of the intake is formed

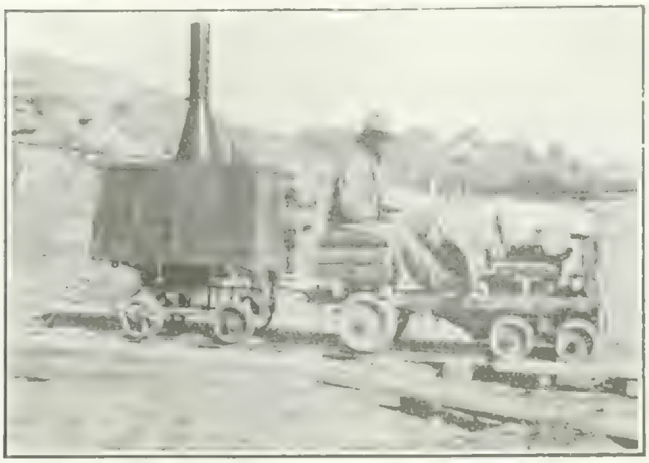
LOOKING ACROSS THE COMPLETED DAM TOWARD THE HEADWORKS

by a reinforced curtain wall 18 in. thick extending from the top of the gates to a point above high water. An operating deck supporting the machinery for raising the gates is located between the piers and 8½ ft. above the canal bed. These piers and deck are heavily reinforced and composed of 1:7 concrete, using river gravel. Gates and frames for both sluiceways and intake are of cast iron. Both sets of gates are operated with hydraulic power, the operating machinery consisting of a pressure tank and heavy-duty pump driven by an electric motor, and are located in a small room under the road and adjoining the first or downstream bay of the regulator gates. Pipes lead from the tank to the cylinder operating the gate, the gate being raised or lowered by simply turning a valve. Power for operating the force pump is supplied by a small 15-hp. gas engine and 7.5 kw. d.c. generator. Clear water for the cylinders is obtained from a well in the rock under the spillway section.

The regulator gates are protected from the river on the upper or east side, by a concrete retaining wall joining the curtain wall in front of the gates to the rock bluff behind the intake. Since the curtain wall



ELLIPSE SHAPED TRESTLES FOR CONCRETING FLORENCE DAM



TRANSPORTING CONCRETE TO THE DAM
Note automobile engine mounted to make locomotive; also [illegible]

is extended back, it acts as a retaining wall to round out the forebay to the canal. The space between the two walls is filled in with waste from the quarry. These upper retaining walls, like those below the gates, are composed of 1:8 concrete, using 2-in. river gravel, with 10 per cent plums. The downstream side of the gate intake is protected by the retaining wall forming the south abutment of the dam. This wall is surmounted by a paved slope, protecting the earth fill, which slopes from the top of the curtain wall in front of the gates to the level of the canal bank to avoid excessive rock excavation or a contraction of the river channel. To secure the necessary width for an inclined slope, the canal face of the fill is protected with a retaining wall. This wall, like the one against the river, slopes from the top of the curtain wall to the canal bank. The surface of the fill between the walls is utilized for a road. This road passes along the canal bank, over the canal, and over the gates making accessible not only the small power plant and dam tender's cottage located on top of the bluff back of the intake gates, but also some of the most interesting scenery in America.

Construction of the Dam—The Gila Valley is usually subject to two rainy seasons a year, one occurring between November and March, which generally occasions a continuous flow in the river but seldom gives rise to a large flood; the other extending from July 1 to Sept. 1 is due to violent local disturbances which often cause extreme high water.

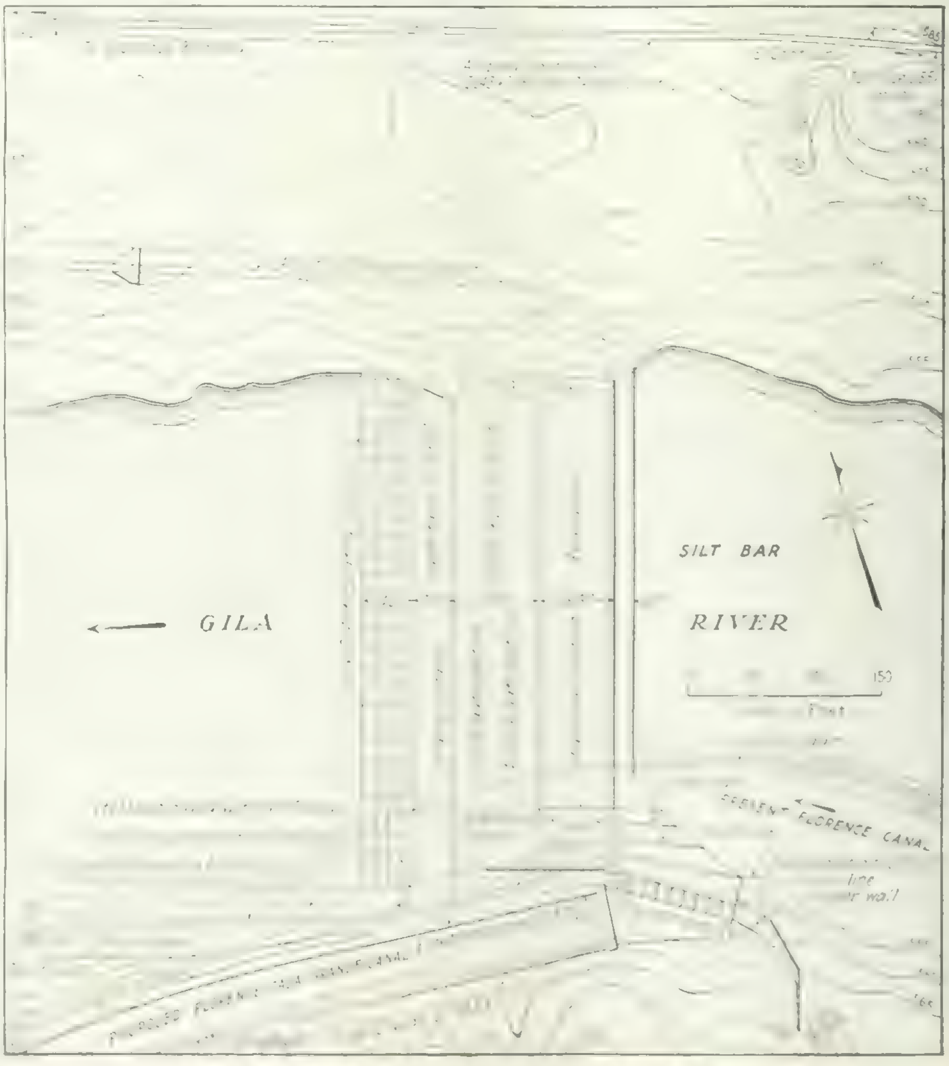
Under these conditions it was essential that the slab, which in case of high water would be subject to almost certain destruction if but partially completed, should be finished before the first of July.

Since instructions to commence the work did not reach the employees of the Indian Service until the latter part of January, there were only five months in which to make the necessary preparations and install the slab. Owing to the risks attending the work reasonable bids were not obtainable and force account was decided upon. The task was rendered rather trying owing to scarcity of construction equipment and materials, poor transportation, high-priced and limited labor.

The work required for the completion of the dam comprised 25,000 cu.yd. of rock excavation, 82,570 cu.yd. of earth excavation and 12,933 cu.yd. of concrete.

The construction problems demanding immediate solution included excavation for practically the entire work, the driving of the sheetpiling and the pouring of 8,480 cu.yd. of concrete, forming the main slab and talus of the dam, over an area some 400 ft. in length by 212 ft. in width. The work had to be done in the bed of a sandy river, always subject to flood, and completed before July 1 to prevent its almost certain destruction.

Construction Plans—The rock excavation promised to give little trouble since it could be commenced almost at once and the work was not subject to the vagaries of the Gila river.



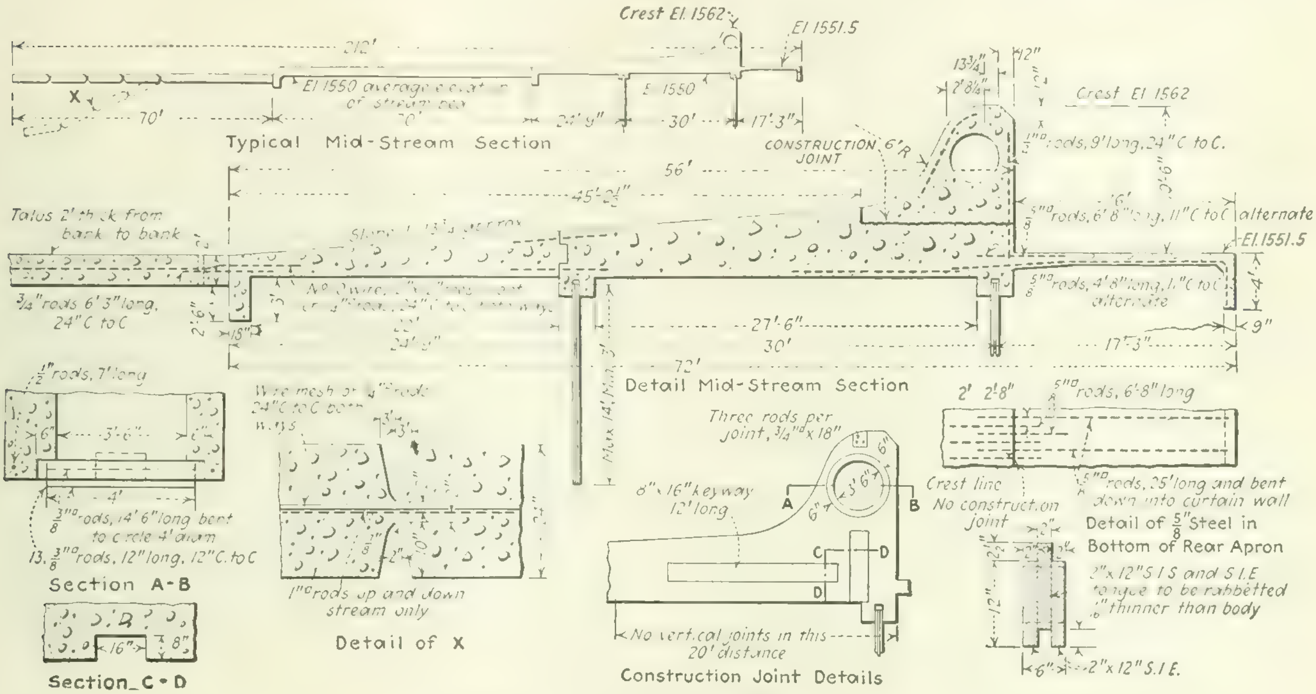
[illegible] FOR FLOATING DAM [illegible]

The pile-driving and the pouring of the slab had to take place in the bed of the river, and had to be done at the time of least danger from flood, since the river channel at the dam site was too narrow to attempt any diversion or flood protection, even if the expense were permissible. Little difficulty was anticipated in the actual driving of the piles, aside from the danger from high water, since the borings at the dam site revealed only sand and gravel in the bed of the river. To escape high water due to the spring rains it was decided to defer the pile-driving and excavation for the foundation of the dam until about May 1. It was also deemed unsafe to commence pouring the slab much before June 1, and since it had to be completed by July 1, it was evident that the pouring of the slab would call for the maximum effort, requiring a large force of men, and during that time it would probably be necessary to work three shifts. With the exception of the crest, which it was hoped could be poured with the slab, the balance of the work promised to give no greater trouble than is usually incident to work along rivers.

It was finally decided that the only system that at all promised to satisfy the requirements of speed, flexibility and cost, was a set of tramways supporting a narrow-gage track over which small concrete cars could be operated. It is true that the bents of the tramway were subject to destructive flood action but it was considered that they were comparatively inexpensive and that in case of a flood much of the material could be salvaged and the only loss would be that of reconstruction. It was hoped, however, that the work would be completed before the danger from high water became imminent.

The securing of an efficient and rapid means of operating the cars proved a puzzle. A cable system was devised, considered and abandoned as being too expensive and subject to loss from flood. The puzzle was solved by the decision to use small gasoline locomotives but since locomotives of the type suitable for the work could only be obtained in the east at a cost of between $3,000 and $4,000 each, and required three or four months for delivery, they were out of the question and it was decided to attempt the manufacture of locomotives using Ford motors. With this equipment, employing five motors and 2¾-yd. concrete mixers, it seemed possible if necessary to pour the slab in 12 days running full time. This would require a maximum force, for all purposes, of about 600 men divided into three shifts.

As shown in the large view two pairs of trestles joined at each end roughly in the shape of an ellipse or oval were erected across the river with a concrete mixer located at the end of each oval. The trestles supported a narrow-gage track on which ran the locomotives hauling the dump cars. The cars passed under the mixer spouts to receive their loads and then were run out on the trestle to dump the concrete into hoppers discharging into chutes through which the material was delivered to any part of the slab. The trestle legs were set in 12-in. cement pipe so that the structure could be removed, and the holes filled up without breaking the slab. At first the locomotives proved too light for adequate traction. The fault was overcome by weighting the engines with worn-out crusher jaws. The little cars made a round trip in less than 6 minutes and with two trains operating on each trestle the mixers worked up to maximum capacity of ¾ yd. every three minutes.



SECTION THROUGH FLORENCE DAM

With the completion of the two sections of talus, work was again started from the north bank of the river on both the articulated talus and the main slab. Two days were spent in forming the ends of the main slab, where it joined the rock making in effect an expansion joint so the slab would not rest both on solid rock and sand and provide an opportunity for the slab to crack if any settlement should occur. This joint was so devised as to prevent slippage, if there should be any tendency for it to happen.

The forming of the under part of the slab between the blocks of the articulated section was a puzzling problem since any wooden forms would necessarily have to be left in after the concrete was poured. The problem was finally solved by making "dobie" forms for

the lower part of the slab, which would wash out as the articulated section settled.

From the beginning of June, when concrete work started, it was apparent that nature was getting ready for the summer rains. Dark cumulus clouds, that only required proper conditions to produce heavy precipitation, crowned the mountains and obscured the sky to the east. In fact the weather was so threatening that a flood was looked for daily but it was really too early for the summer rains and fortunately the weather held. A flood at that time flowing around the end of the partly poured slab would probably have caused its destruction as well as that of the trestles from which it was poured, and a financial loss of $100,000.

On July 5 at 5 p.m. the flood came and took away the brush diversion dam. Recurring floods retarded the work greatly. On August 1 a heavy flood carrying large masses of brush snapped the trestle legs, tore out the dike protecting the work on the south side, destroyed the forms for the guide walls and the sluiceway section of the weir and washed out the temporary canal along the river bed through which the Florence canal was being bypassed. The total monetary loss, however, did not exceed $7,000. Floods continued at intervals up to August 15. During one of these the scour induced by the whirlpool action of the water caused not only a number of the articulated blocks to fall as anticipated but was so extensive that a sector of the upper part of the lower talus dropped with it. The whirlpool action was due to a number of rock points in the channel. These were blown out and 10,000 cu.yd. of rock from the spillway section was dumped into the holes. This work cost approximately $20,000 and entailed strenuous effort to accomplish it before the damage became serious. Each flooding of the work left a mass of sticky mud which had to be shoveled and washed from the concrete before pouring could be taken up again. It was not until October that the flood stages ceased and the work could proceed uninterruptedly.

The loss of the trestles cut off the south bank of the river from the materials on the north bank and forced the engineers to look for gravel on the south side. A good bank of gravel was located about half a mile below and the proportion of sand and gravel proved about right for a 1:3:5 mixture.

The dam was appropriately dedicated on May 10, 1922, in the presence of a large assemblage of Arizona citizens and many members of the Indian tribes of the valley. The exact costs are not yet available but are known not to have been excessive considering the speed required and the adverse conditions under which the work was done. Including the formwork on the crest the cost of the concrete composing the slab probably will not exceed an average of $13 per yard. The dam itself was completed within the estimate of $250,000, which is below the lowest figure set by any contractor. The intake works forming an integral part of the canal and not properly chargeable against the dam consisted of reinforced concrete requiring much formwork. The cost did not exceed $15 per cubic yard.

More than passing interest attaches to this structure the completion of which brings to an end a controversy over the waters of the Gila which has long disturbed the relations between the Pima Indians and the white farmers of this valley. An amicable agreement has been concluded under which the waters are divided on a basis of 35,000 acres of irrigated land for the Indians and 27,000 acres for the whites. The white farmers will be assessed their pro rata of the cost of the dam and payments will be in twenty annual installments.

The successful completion of the Florence dam reflects great credit upon the efficient organization of the engineering section of the Indian Bureau of which W. M. Reed is chief engineer. He placed his assistant, Major C. R. Olberg, in charge of the work. Associated with Major Olberg was Captain Earl B. Patterson as superintendent of construction. Both were eminently fitted for the task by reason of many years of experience in the Southwest while engaged in similar work under the Reclamation Service. Recognition for most valuable services is due Supervising Engineer Herbert V. Clotts, General Foreman Welsh McGuire, formerly of the Reclamation Service, Boss Carpenter B. Bruce and Master Mechanic Dee Brown.

Lightning Bolt Follows Reinforcing in Concrete Highway

By Charles T. Fisher
State Commission of Highways, Binghamton, N. Y.

FIG. 1—EFFECT OF LIGHTNING BOLT AT JOINT

AN UNUSUAL case of damage to a highway by the elements occurred during the summer, when a section of reinforced-concrete pavement on a state highway near Sherburne, N. Y., was struck by lightning.

FIG. 2—PATH OF BOLT [illegible] HOLES

The bolt first struck a maple tree which stood at the side of the road, and then entered the edge of the pavement and traveled along the metal reinforcement for about 100 ft. in both directions. At the point where it jumped from the tree to the pavement a small piece of concrete was broken out of the edge, and at the expansion joints, which are of $\frac{3}{8}$-in. bituminous material spaced on 33-ft. centers, holes in the surface about 5 in. in diameter and 3 in. deep were formed on both sides of the joint filler, indicating the path of the current in passing from the metal in one panel to the metal in the next.

Reinforced-Concrete Pipe Made by Centrifugal Process

Pipe Cast With Special Joints Manufactured by Whirling Cylinder Mold on Longitudinal Axis

CENTRIFUGALLY made concrete pipe is now being produced commercially by the Lock Joint Pipe Co. in two plants, one at its home yard at Ampere, N. J., and the other in a specially built yard at Denver, Colo. The former pipe, 20 in. in diameter, is being made for the East Orange, N. J., water-works, the latter 27 in. in diameter for the Greeley, Colo., system. Except for differences in size of pipe and for some minor variations in plant layout, the two plants are alike and the product the same.

FIG. 1. PLACING REINFORCEMENT IN CAGE FOR 27-IN. CENTRIFUGALLY CAST CONCRETE PIPE

Reinforcement consists of one layer of wire mesh, longitudinal tie-rods hooked into cast-iron end joints and a spiral reinforcing of $\frac{3}{8}$ in. round rod. Cylinder shown at left is not part of pipe form but the revolving and traveling mandrel on which the reinforcing cage is built up.

Centrifugally cast pipe are made by filling in concrete mortar on the inside of a horizontally placed cylindrical form and whirling that form rapidly on its longitudinal axis, thus throwing the concrete to the inside of the form by the centrifugal force and forming there the shell which makes the pipe. The general idea was used some years ago in Germany in the manufacture of concrete poles, pipes, and piles, and more recently has been developed commercially in Australia and South Africa by the firm of Hume Bros. This latter process was described in *Engineering News-Record*, Oct. 9, 1919, p. 707. The Lock Joint Pipe Co. system has many features of originality, particularly in the casting of a special joint on each pipe whereby the pipe line may be made tight for high pressure.

The first step in the process of manufacture is to make the reinforcement cage to which are tied the metal end joints. These joints are cast-iron rings of the section shown in the accompanying drawing (Fig. 3) which fit bell and spigotwise into one another, the closure being made by the gasket of flattened fiber-filled lead pipe. The bell end of the pipe is forced into the spigot end until the joints come up tight, by a special pressure machine in the trench. This leaves a small V-groove around the outside of the pipe, but no projection, as will be noted from the drawing. The reinforcement consists of two layers of circumferential wire mesh with longitudinal tie rods which fit into slots in the joints and thus hold the whole framework tightly together. In the larger diameters one layer of mesh is supplanted by a spiral rod reinforcement.

A machine, consisting of a mandrel and a guide for the spiral reinforcing, is used in building up of this cage. The machine is shown in the view in Fig. 1. In the production of the pipe at Ampere two men are kept busy making the cages and can take care of the twenty pipe per day production of the plant. From the cage-making platform the cage is carried over to another platform and encased in the outer form, a shell made up of two semi-cylinders of bent plate iron braced with circumferential lugs, with grooves or sheaves for the wire rope which imparts the whirling motion.

The pipe-making machine consists of a concrete mixing plant, a loading platform, and a whirling machine arranged in progressive order and all controlled either by a paralleling track on which is a crane or by overhead track. Concrete is mixed at one end of the plant, carried over and dumped into a charging platform which has side boards that drop down as aprons into the charging buckets, one on either side of the charging platform, each bucket being in longitudinal line with the whirling axis. This charging bucket consists of a longitudinally placed cylinder with a slot a few inches wide along its elements. It is completely filled with the concrete through the slot and then moved longitudinally on tracks into the center of the whirling form. This form, as noted above, is of wrought iron in take-down construction and is set up around the reinforcement

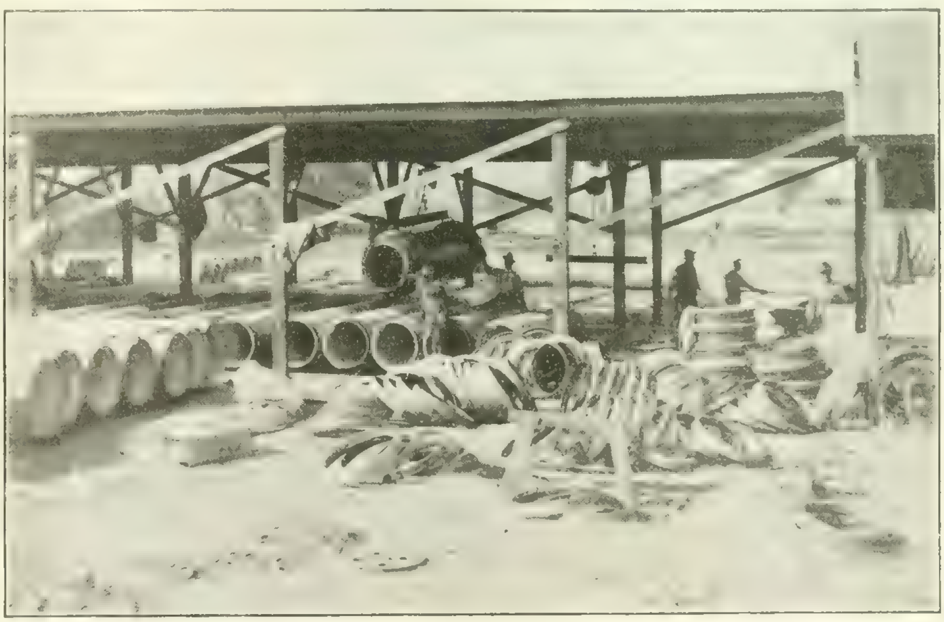


FIG. 2. FINISHING YARD OF CENTRIFUGAL CONCRETE PIPE AT DENVER

Cast-iron joints in foreground; whirling frame out of view at right; on overhead track is being shifted a completed pipe still in its form; finished pipe in the yard.

cage so arranged that the cast-iron joints at the end of the cage are flush with the circumference of the form. The grooves or sheaves on the form are then engaged by the endless steel cables that hang from frame and give the form its whirling motion.

Once the charging bucket is inside, the form is started to whirl and the charging bucket is slowly turned over, so that it discharges its concrete content

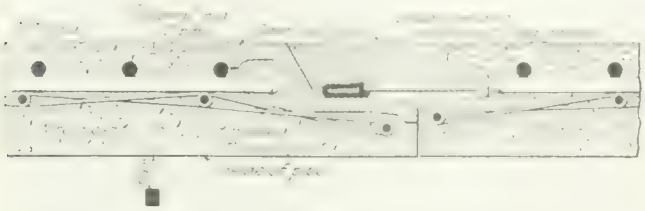


FIG. 3. SECTION THROUGH JOINT AND SHELL OF CENTRIFUGALLY CAST CONCRETE PIPE

uniformly along the inside of the form where it is immediately thrown outward by the centrifugal force, to the inside surface of the form. The size of this charging bucket is so designed as to give the proper concrete content to form a shell of a required thickness. This varies slightly at times and the exact amount is controlled by adding small bucketfuls of concrete by hand inside the forms. The form is speeded up to about 200 revolutions per minute and is allowed to whirl for about five minutes; then there is inserted into the center a pan resting clear of the form at either end and pro-

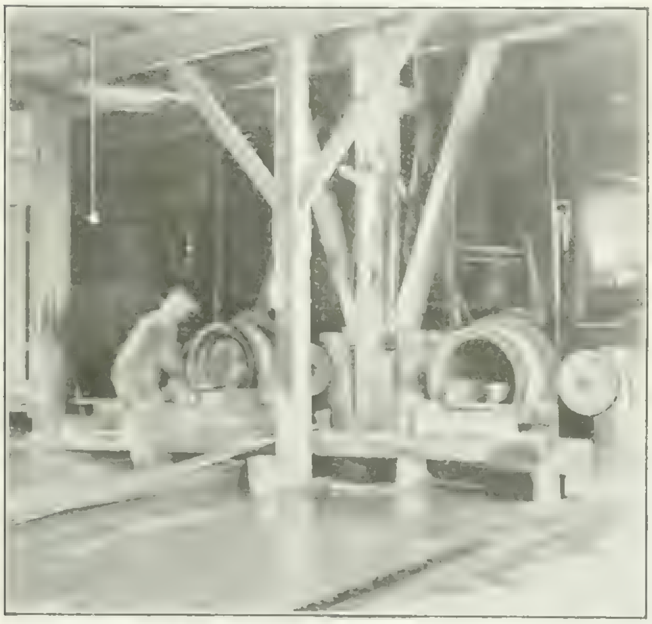


FIG. 4. END OF WHIRLING FRAME

Arranged in duplicate on either side of center line. At right form [illegible] shown at right of man. At left pipe being whirled from cables hung from overhead sheaves.

jecting from the center of the form. It is used as a guide for brushes, manipulated by the attendant, which clean the interior of the pipe and collect the excess water which clings to the whirling surface. These brushes scrape the excess water and laitance from the inside of the pipe. It is surprising to note that in a pipe 20 in. in diameter, $2\frac{1}{2}$ in. shell thickness, and 12 ft. long, with a concrete that would be considered a normal working mortar plasticity, a full wheelbarrow load of cement, colored water and laitance is drawn off.

After the pipe is whirled about 15 min. two or three bucketfuls of neat cement grout are applied by putting in a second pan running on the first interior pan and dumping it, thus distributing the grout content uniformly along the whole pipe. This forms a thickness of about $\frac{1}{16}$ in. of cement grout on the inside surface of the pipe. The final operation is to brush this cement surface by the brush running on the pan as a guide and after 20 min. of whirling the machine is stopped and the pipe with its form withdrawn. At that time it has reached a remarkable degree of hardness, so great, indeed, that the forms with the pipe in them could be immediately removed from the machine in a horizontal position without injury. In practice the pipe with the form still on is placed on the platform and is treated in a steam chamber for about 18 hr. The pipes are then stored to be used after two weeks.

The concrete, from which the pipe are made, is in reality a mortar, not a concrete. It is a 1:2 mixture of portland cement and ordinary good, clean building sand, with no special provisions as to grading. The mortar is mixed, as stated above, to a consistency common in bricklaying mortar, but inasmuch as excess water is forced out by the process, no extra pains are taken to insure a proper water content in the mixer.

The finished pipe present a remarkably uniform surface, both inside and out, and when lined up are true to circumference and line. So far no tests have been made as to their strength, but they are being used for pressures up to 50 lb. per square inch for the 20-in pipe, and they have resisted pressures up to 200 lb per sq.in. Both the 27- and the 20-in. pipe have thicknesses of $2\frac{1}{2}$ in. and are made in 12-ft. lengths.

Salaries of State Sanitary Engineers

Publication of the statement that the chiefs of the divisions of sanitary engineering of the state health departments in Maine and New Hampshire were the poorest paid of any of the states, contained in an article entitled "Salaries of State Sanitary Engineers" in *Engineering News-Record*, Oct. 12, 1922, p. 609, has brought forth protests from individuals in these two states. It appears that in Maine sanitary control of public water supplies and sewers is divided between the State Department of Health and the Public Utilities Commission and that the person who does the sanitary engineering work for the former body is not by training and experience an engineer. From New Hampshire comes the statement that the sanitary engineer of the State Board of Health is a subordinate in the division of water supplies, foods and drugs, the chief and state chemist receiving a salary of $3,000. These letters were turned over to James A. Tobey, author of the article, who comments as follows: "The data concerning salaries of personnel of state health departments was compiled from returns to a questionnaire sent out to state health officers by the Committee on Salary Standards of the American Public Health Association, replies having been received in January, 1922. It may be using a misnomer to apply the title of sanitary engineer to the individuals who do the sanitary engineering work for the state health departments of Maine and New Hampshire. It is a fact, nevertheless, that in each of these state health departments there is a person who is called a sanitary engineer by the state health officer, and that in each instance he receives a salary of $1,800 a year."

Appraisal of Flood Protection Benefits and Damages in the Miami Valley

Increase in Value from Protective Works Estimated on Basis of Flood-Time Depreciation—Equitable Distribution and "Flooding Factors"—Farm and Utility Benefits

CONSTRUCTION of the flood-control works of the Miami Conservancy District in Ohio was financed by means of special assessment bonds issued by the district. Under the Conservancy Act of Ohio the assessments authorizing the issue of these bonds constitute a lien against each property benefited, up to the amount of benefits assessed against the property. This lien is paramount to any other except that of the general taxes for state, county and city purposes. It was therefore of primary importance to make careful determinations with reference to each tract or property as to just how much it is benefited.

Benefit Appraisal—In the case of most land reclamation, drainage or improvement projects it is possible to make a reasonably accurate estimate as to the value of the land after its improvement, and the difference between this new value and the original value gives the amount of the benefit. In the case of the Miami flood-control project, however, the benefit accruing to properties in the cities of the valley could not be determined so simply. Real estate values were considerably disturbed by the 1913 flood, in fact some values were completely destroyed. Street pavements were torn up, and light, water and sewer systems damaged. Residences and other private property were destroyed or damaged and railways and telephone and telegraph companies suffered in the same manner. The protection of these properties against a recurrence of such damage and destruction constitutes a direct benefit, but it does not follow that the amount of damage sustained during any past flood is a direct criterion as to the amount such property may be benefited.

The flood had a tendency to depreciate property values, but after the immediate effects of the disaster had been overcome and plans initiated to secure protection, values were maintained at more nearly what they would be with protection actually accomplished. It was therefore difficult to estimate present values. Those obtaining immediately before the flood could not be universally used as a basis for the appraisal of benefits because they had in some cases been wholly or partially destroyed. This confusion in values tended to complicate the appraisal problem.

The conservancy law of Ohio fully recognizes the difficulties inherent in establishing benefits, and gives the three appraisers wide discretionary powers, while fully protecting the property owners and communities by a number of appeal provisions.

Two Basic Requirements—Two conditions in the relation of benefits to cost were of critical importance. There were (1) the total of benefits must warrant the expenditure, and (2) equitable distribution must be accomplished.

Unless the flood-protection project should benefit the property owners within the district in real, demonstrable manner by an amount exceeding the cost of the project, it should not be carried out. The bonds would have an adequate margin of security and would find a ready market only in case the total benefit should exceed the cost of the proposed works by a very large margin (a ratio of 3 to 1 between benefit and cost is a satisfactory ratio). The Conservancy Court would no doubt have killed the project in case the cost of the proposed works had been nearly equal to the resulting benefits, or in case of obvious lack of equity in the distribution of appraisals as between different pieces of property in the flood territory, or in case the benefit appraisals could not stand the test of common sense.

Magnitude of Work—Viewed as a whole the appraisal work was an undertaking of very great magnitude. About 77,000 separate pieces of property had to be dealt with, distributed along 110 miles of river valley. In about one-fifth of the cases, damages were concerned; that is, the property would be taken in whole or in part for the construction of the flood-protection works. The other parcels were affected by benefits only. Whether damage or benefit, the definite amount had to be determined separately for each parcel. As a preliminary step complete engineering and property data had to be compiled.

Surveys and the determination of flood outlines indicated what properties would be affected. Engineers then prepared real estate maps of the entire territory, including the cities, and determined the depth of flooding by the flood of 1913 on each individual piece of property and the extent of the physical damages to property resulting from the proposed construction work.

Since many of the data required by the appraisers were of an engineering character, it became necessary for the engineering staff to assume a large part of the work of compiling and classifying data. Obviously, a close co-operation between appraisers and engineers was indispensable to the successful carrying out of the appraisal program.

Benefit Equated to Depreciation—City property constituted by far the largest element of value in the district, and also that class of property on which the flood benefit was the most difficult to determine. It was not considered that the actual physical damage to any one piece of property in the 1913 flood had an identifiable relation to the benefit produced by flood protection. However, the depth of flooding during the 1913 flood was the basis of the curve of flooding factors, shown in Fig. 2.

"Flooding Factors"—The flooding factor was the device developed to insure a uniform determination of benefits on the town properties. Many considerations entered into the making of this curve. It is expressly emphasized by the engineers and appraisers that both the values and the variation represented in this curve are not generally applicable to other cases, or to property other than that considered in the Miami district, because of the large number of individual or locality influences concerned.

Generally speaking, the first-floor level of a house constituted the most important datum point with respect to flood height or submergence. When water

reaches the first floor the habitability of a house at once is directly affected. Again, in actual flood-time experience the condition of a house generally became critical and the last remaining vestige of habitability was destroyed when water reached the second-floor level. This consideration in fact was largely determinative in fixing 10-ft. submergence as corresponding to full depreciating effect of a flood.

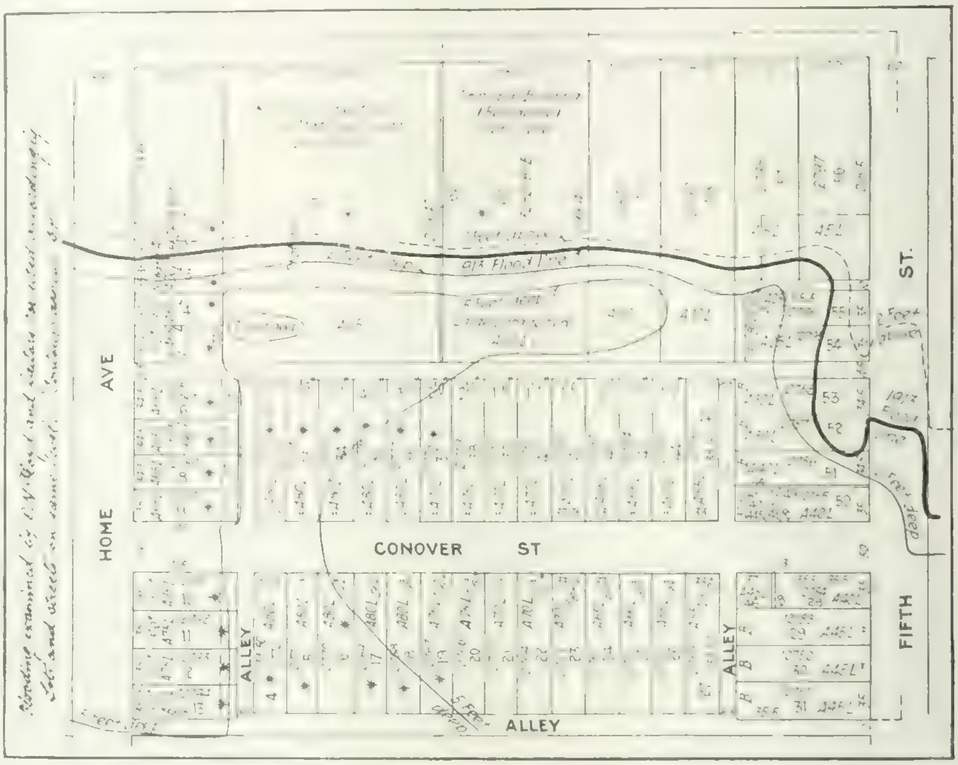
However, it could not logically be concluded that the flooding factors would be in direct proportion to depth of submergence between zero and 10 ft. With shallow flooding the injurious effects are small except in interfering with entrance to buildings, use of streets, etc. At about 3 ft. depth or more, water ordinarily enters the first story, the streets are no longer fordable, and a considerable proportion of the entire injury in property depreciation has occurred. From 3 ft. to 5 ft. swift velocities develop, ingress and egress to and from buildings becomes practically impossible, damage is done to furniture and buildings, and danger to life develops. From 5 ft. submergence upward the conditions described become aggravated, but the increments of depreciation are small, until substantially full depreciation is reached at 10 ft. flooding depth. The lower portion of the curve purposely was left somewhat indefinite in order to allow latitude for judgment. This is because property bordering on the edge of the water or having portions inundated to inconsiderable depths required a range of factors, varying from zero to as high as 20 per cent, depending upon the circumstances of the case.

These factors, described as applying to depreciation, apply conversely to the benefit resulting from protection.

Industrial Property—Related considerations governed the appraisals of industrial property. Special conditions, however, were always looked for and taken account of. For instance, if machinery was located in the basement it was exposed to injury the moment water entered the basement, and therefore the basement level was treated as first-floor level. Losses in machinery and similar shop equipment were in fact so prominent a feature of the flood damages observed in the past that a benefit appraisal fully equal in its percentages to that on residential or commercial property was considered appropriate, in spite of the fact that habitability and danger to life are not concerned, and that factory buildings are not often damaged or destroyed in floods.

Gain in Value by Flood-Protection—The next step was to determine that portion of the value of property due to complete elimination of the flood risk. It happens that there was a great decrease in values directly after the 1913 flood, due to the general realization of the flood risk; and this decrease was in effect the reverse of the increase of value which it was desired to estimate. Stated differently, the benefit to be determined was held to be that portion of the original market value that would be restored through flood protection.

Often this restoration was anticipated, and the restoration of values took place on the mere assurance that flood protection would be provided. In fact, to a very large extent values never dropped, for before the first shock was over plans for preventing flood injury were in progress and the people were assured that protection was feasible and would be secured. Prior to 1913, property values in such valley cities as Dayton and Hamilton were practically unaffected by fears of flood, and it could fairly be assumed that the values prevailing prior to 1913 represented the values with full flood protection; on the other hand, the values at which property was held during the five or six months following the 1913 flood did not represent fairly the depreciated values on account of the flood risk, because values were maintained in the hope that protection would be secured.



PARCEL PLAT USED IN FIELD CANVASS

Reproduction of a blueprint plat such as was used in determining flooding factors for city lots. It covers a section of Dayton. Contour lines delineate the water stage at the crest of the 1913 flood; in addition to the high-water line there are contours of the 2-ft., 5-ft., 7-ft. and 10-ft. depths, and a contour 2 ft. above water to indicate the rate of rise of the land not flooded. On each lot is written the flooding factor, preceded by a reference letter denoting the classification used and followed by the initial of the engineer who determined the factor. The asterisks indicate lots visited on field inspection. The numbers in feet and inches give depth of water on first floor of building at crest of 1913 flood. The serial numbers are those used in the tax duplicate.

Six or seven of the largest property holders in downtown Dayton and a number of representative real estate experts were consulted as to the permanent depreciation in property value that would result in the city from a failure to secure flood protection. They discussed the matter and arrived at a figure of 40 per cent of the value with protection, as the difference in value with and without protection, for the most seriously affected properties, and hence the benefit which would result from flood protection. The most

seriously affected properties were the ones where the depth of flooding was 10 ft. or more, and where the flooding factor, discussed above, was 100 per cent. The same process was gone through in other cities with the help of corresponding groups of local men.

At a later stage of the work the figure of 40 per cent was reduced to 30 per cent as the basis of benefit, because calculations on this basis gave a sufficient total of benefits in the district for all purposes of financing, and there was no reason for encumbering the property beyond that point. However, the 40 per cent figure was then and still is considered a fair estimate of actual benefits.

In its simplest aspect the benefit appraisal consisted of first, appraising the market value of the property

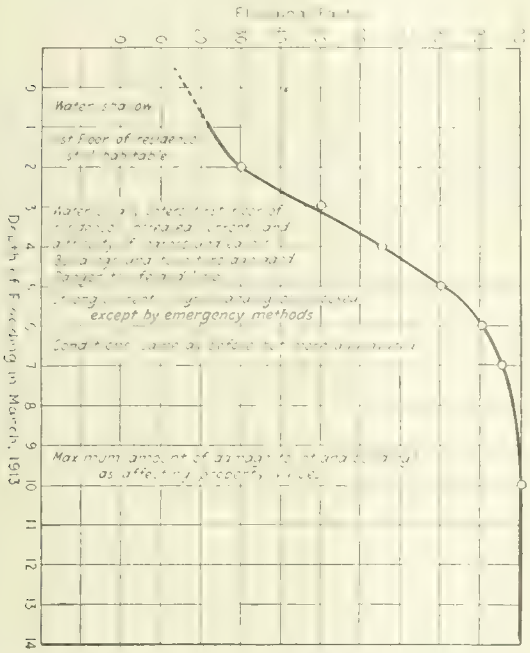


FIG. 2. CURVE OF FLOODING FACTORS
Notes under the curve indicate the conditions which commonly existed at the various depths of flooding.

benefited; second, determining, for each parcel, the physical facts relating to its flooding conditions, especially during the March, 1913, flood; third, determining the completeness of protection afforded; and fourth, applying the flooding factor to the 40 per cent (later 30 per cent) of the appraised market value. Since the proposed flood-control works provided complete protection for city property in most cases, the third factor was 100 per cent except as to a few situations.

Benefits to Communities—It was held that the elimination of the flood risk would benefit cities and other communities as municipal units, as well as the individual pieces of property. Consequently benefit appraisals were required on cities, counties, etc., as units.

Taking the case of a city: The flood-protection works give protection to all property owned by the municipality as such, and to all the property constituting the wealth and business strength of the community. When a flood paralyzes industry and all principal forms of community and business life, as it did in the Miami valley cities in 1913, it affects every human being living in the community and affects the value of every piece of property within its boundaries. Thus the flood-protection project would guard the assets of the city and assure the future existence, growth and prosperity of the community. That a destructive flood has far-spreading effects falling on the community as a whole may be seen from the fact, for example, that there existed for years afterwards numerous cases of pauperism, sickness, and insanity resulting from the 1913 flood; and such ill effects obviously fall as a burden on the community, and their elimination (for the future) constitutes a direct benefit to the community. Likewise the difficulty in a flood-menaced city of securing credit needed by business enterprises to properly carry on their business constitutes a definite deterrent to the normal growth and development of the city.

Upon considering the direct benefits to municipal property, and also the extensive but rather intangible effects of flood protection upon the city as a whole, it was concluded, after conferences with numerous officials, that the city as a unit would be benefited by an amount equal to the total benefits to its citizens individually. This conclusion applied to the larger valley cities except Piqua. For the latter a credit was allowed against the appraisal because of the fact that the city had already done certain work on its own account, and in consequence the city's net benefit was taken as half the sum of the individual benefits.

In determining the benefits to counties, the community benefit is not related in such clearly recognizable manner to the benefits accruing to individual property holders. Much county property was submerged and temporarily put out of use or damaged in the 1913 flood (and to lesser extent in the more frequent smaller floods). The values with and without protection of this property were estimated, and the difference taken as the measure of benefits. Loss of tax value resulting from the depreciation that took place after the 1913 flood was also carried into the benefit column, since similar loss of tax value would not occur under full protection. In all instances local business men were drawn upon for counsel as to the fairness of the values fixed on counties.

Property Outside of Cities—Benefit appraisals on individual parcels of country property were of necessity dealt with in a way quite different from that applied to city property. In the case of agricultural land, not used for residence, the injurious effects of flooding and consequently the benefit conferred by flood prevention probably would not be as great as on city property, and in some cases perhaps would be absent or negative. On the other hand, land which was ruined by either erosion or gravel deposition in the 1913 flood could not properly be considered to be benefited in high measure by future flood protection, as but little value remained to be protected. Creek bottom pasture land also had to be given a very low benefit estimate, as the actual gain here through elimination of future flood rises from the river would be almost negligible. Where buildings were involved, however, it was possible to base comparative benefit estimates on factors involving depth of submergence, somewhat as in the case of city property.

In the main the estimates for country property were in the largest measure based on conference of the appraisers with local experts such as retired farmers, after detailed personal inspection of the site and study of the flood conditions as revealed by the engineering plats. Agriculture benefits in the aggregate constituted less than 5 per cent of the whole.

Benefits to Utilities—Benefits to railroads were taken to involve the same quality and quantity factors as those

influencing the benefits to private property. Appraisals were based on physical value, being guided to some extent by valuation figures of the Interstate Commerce Commission, plus land value. The latter was appraised on an area basis at figures equal to that of the adjoining lands. This work throughout required the co-operation of both engineering and appraisal departments. Here also the amount of benefits appraised was as nearly as could be determined the difference in value with and without protection.

Street-railway benefits also were appraised on a basis of physical value including the land value; the latter, being only a right-of-way, was taken as 25 per cent of the ownership value of adjoining land (per square foot) and was estimated for a width equal to the track width plus 18 in. on each side. To the physical valuation thus determined, flooding factors were applied similar to those used for city property.

Power houses in the flood territory were treated like other buildings, using the same flooding factors and basing on 10 ft. depth as full submergence. Those located outside the flood territory, on the other hand, were appraised no direct benefits, though they contributed indirectly to the project the tax rate increase caused by the benefit assessments against the city and county as units.

In valuing wire-line property in the flooded area, values taken from the companies' inventories were generally used as bases. Full benefit, corresponding to the 40 per cent tentative depreciation effect of the 1913 flood on individual properties, was taken as 12½ per cent of the value.

This figure was later reduced 25 per cent to accord with the reduction from 40 per cent to 30 per cent previously mentioned, and the resulting figure was applied to the total value of the wire lines located in submerged territory. Similar methods were used in determining the benefits to other public utilities.

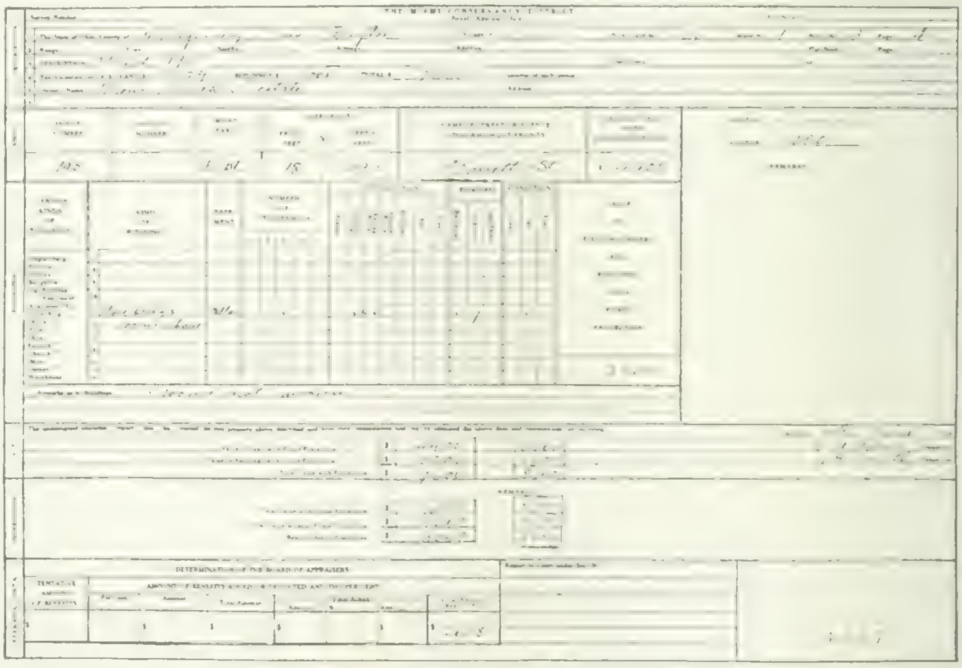


FIG. 3. BENEFIT-APPRAISAL RECORD CARD

It is important to note that throughout the benefit appraisal of both public service utilities and large manufacturing establishments, the appraisers and their agents consulted with the officials of the various companies, and obtained data from them which enabled benefit figures to be arrived at which at once were fair and satisfactory to the companies. By thus enlisting the co-operation of the companies much subsequent disagreement was avoided, as evidenced by the fact that practically no exceptions were filed by public service companies or manufacturers. With about 100 public service corporations affected by benefits or damages, amicable settlements were reached in all but three cases.

Large Benefit Total Found—When the benefits were compiled and totaled, it was found that the entire benefit in the district amounted to something over $100,000,000. Inasmuch as only about $25,000,000 to $30,000,000 was estimated to be spent on construction of the flood-protection works the ratio between appraised benefits and required assessments of benefits was considered to be unnecessarily large. Three times the amount of bonds to be sold for the construction of the works was believed to represent an ample benefit appraisal. Accordingly the initially determined benefit of 40 per cent for fully submerged property was reduced to 30 per cent, and all the appraisals correspondingly modified.

Of the nine counties included within the district, five (Miami, Montgomery, Warren, Butler and Hamilton) contained property that was benefited. The total benefits finally assessed in these five counties were: Individual benefits, $38,000,000; cities, $33,000,000; counties, $6,000,000; total, $77,000,000.

Damage Appraisals—The most extensive work in dealing with damages was that concerned with the lands in the retarding basins, which would be subject to overflow during flood periods, on account of the large areas involved and the novelty of the questions presented. Such lands as were actually to be occupied by the dams or used for borrow pits or otherwise necessary construction purposes naturally were bought outright and remain in the possession of the conservancy district. Outside of this range, however, the basin lands are not permanently withdrawn from the agricultural service of the community, since only those in the very bottom of the valley will be frequently flooded, and those near spillway level will be wetted only in the conjectural, improbable rainfall-and-flood contingencies on which the whole project is based as an ultimate possibility. The upper lands of the basins, therefore, might be considered as being not at all affected by the exposure. However, the farmers, knowing but little about the engineering details of the project, necessarily took a different view, and their estimates of the damage to which they would be subjected differed materially from that of the board of appraisers.

Much Basin Land Bought—When this situation was fully realized, the district decided to buy in fee simple

most of the basin lands. A smaller proportion of the total, chiefly the lands lying far up towards spillway level, was dealt with by purchasing an easement to put water on the land at irregular intervals, this easement including the right on the part of the district to require the removal of buildings from below a certain level, to prohibit all future building below a specified level, and in general to control the occupancy and use of the land so far as flood questions would bear on the matter.

The district determined a fair easement price on these lands after a field inspection, in which frequency and depth of flooding of the various tracts, the value and condition of the land, and other items were taken into consideration. This price, determined by the appraisers, was used as a guide in determining whether or not it would be necessary to buy the basin lands in fee simple.

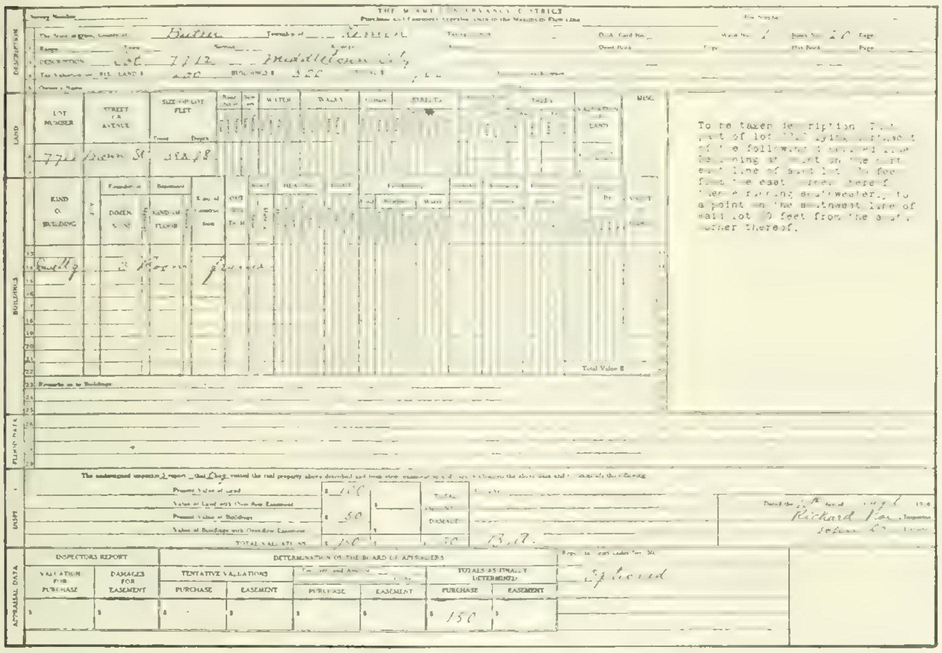


FIG. 4. PURCHASE AND EASEMENT APPRAISAL DATA

Special procedure was adopted in a few individual instances, namely, an agreement was made with the owners of the land to pay damages due to flooding caused by the works of the district when damage occurs.

Land Resold—The lands in the basins purchased by the district have recently been put on sale, full information being supplied to intending purchasers as to the susceptibility to flooding and the probable effects of flood ponding upon the agricultural value of the lands. The net result to date is that an average sale price of about 85 per cent of the price at which the land was purchased has been realized, and in individual instances land has even been sold at higher figures than those paid by the district. Thus, it may be stated that the practical outcome of the methods used is to make the cost of the flood easement in the lower part of the basins about 15 per cent of the full value of the land. These figures are derived from sales representing about 20 per cent of the total area which the district expects to dispose of. As the sales continue these figures may have to be modified.

In proceedings under the conservancy law no separate condemnation of different parcels is required. Accordingly, all the damage and benefit appraisals were submitted to the court in itemized form in a single appraisal roll, objections by property owners were heard by the court, and a decision was reached both as to the entire roll and as to individual parcels. The final court order contained both an easement price and a purchase price for each particular piece of damaged land, and the directors of the district were free to take over the easement or take over the property, at the figures entered in the order.

Results of the Appraisal—About 1,900 exceptions were taken by property owners to the appraisals of benefits and damages made by the district on about 77,000 parcels. Of the cases in which exception was taken to the district appraisals, not more than 500 were appealed to the Conservancy Court.

Expressing this in percentage figures it might be said that the district appraisal, carried out by the methods outlined in the preceding, proved something over 99 per cent efficient when measured by the attitude taken by the property owners affected, and substantially 100 per cent efficient when measured by the action of the court. In only a dozen or two cases were the exceptions and appeals made by the property owners effective in leading the court to modify the figures of the district.

Large Force Engaged in Work—As the whole appraisal undertaking dealt with some 77,000 parcels of land, a large organization had to be built up to deal with it. In control of the entire work there was a board of three appraisers appointed by the Conservancy Court, and consisting of J. Edward Sauer, Charles W. Kiser, and Samuel M. Goodman, three business men who were thoroughly acquainted with real estate values in the Miami valley. Great credit is due these men for the faithful and absolutely impartial manner in which they carried out the gigantic task assigned them. It required their close personal attention for a period of over a year, during which they had to sacrifice many of their private and other interests.

They were assisted by a large engineering and clerical force supplied by the district, a force of about 100 field inspectors alone being required. In the cities these inspectors were equipped with copies of the county auditor's plats, and in the country districts with plat maps supplied by the engineering department, upon which the flood outlines had been traced. The appraisers' inspectors were concerned primarily with determining actual values, which they entered on inspection sheets (see Figs. 3 and 4 for specimens), to be reviewed later by the board of appraisers themselves.

The appraisal board in person viewed every site and every parcel of property concerned, verifying and correcting the appraisals of the various field inspectors.

Dismantling 150-Ton Shear Legs in Havana Harbor

Landmark Removed to Make Way for New Port Works—Tubular Legs Weighing 18 and 25 Tons Swung by Aid of 90-ft. Tower

BY F. J. LITTER
Chief Engineer, Frederick Snare Corporation, New York

IN ORDER to provide space for additional port facilities in the harbor of Havana, Cuba, the Port of Havana Docks Co. has recently found it necessary to remove one of the few remaining landmarks of the old Spanish régime. Visitors to Havana have noticed a large tripod shear-legs, one of the first objects to meet the eye in the harbor, and known as "La Machina."

It was purchased by the Spanish government from an English concern in Southhampton, and erected about 1880. The shear-legs was intended for the handling of ordnance, munitions, and other heavy weights. It is said that it has been used but three times; once prior to the Spanish-American War, and twice since, once to set ashore a gun turret and guns from the U. S. S. Maine to form part of a monument to be erected to the men who lost their lives in that explosion.

"La Machina" was of 150 tons rated capacity. The legs were tubular, built up of ½-in. plate with riveted joints. The two front legs were each 136 ft. long and of tapering diameter, with a maximum near the center of 44 in. The weight of each was about 18 tons. At the lower end they were pin connected to concrete and cast-iron pedestals which rested on the bulkhead, and at the upper end they were similarly connected to the back leg. The pin at the upper end carried also the upper block of the hoisting falls. The back leg was 170 ft. long, of tapering diameter with a maximum of 48 in., and weighed approximately 25 tons. The whole rig when in a vertical position stood 142 ft. above the bulkhead level, including the height of the pedestals. Hoisting falls were of 1¼-in. diameter chain with nine parts running over blocks of 4 and 5 sheaves of 30-in. diameter. Movement backward and forward was controlled through the back leg which at its lower end was pin connected to a worm screw, 40 ft. long, driven by an independent connection to the main hoisting engine.

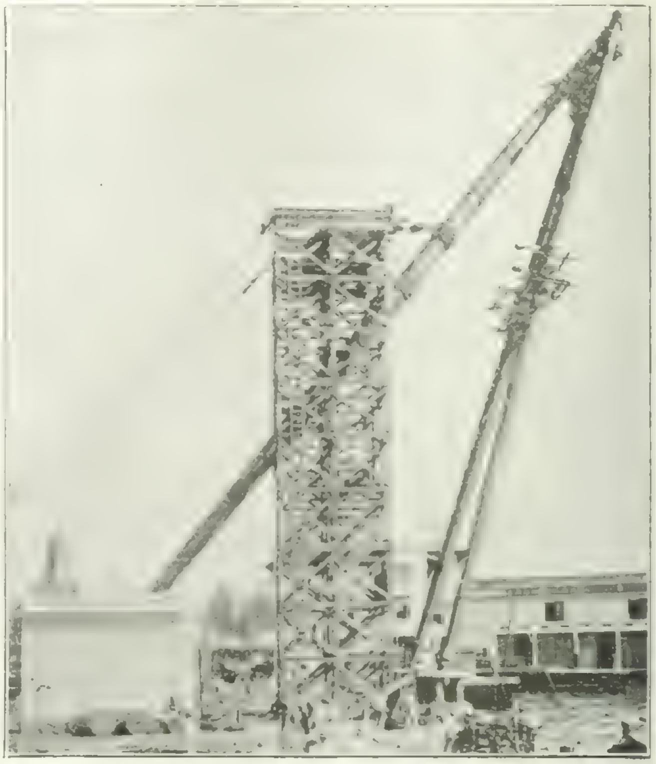


FIG. 1—LOWERING EQUIPMENT IN PLACE

A 90-ft. wooden tower was erected directly behind the two front legs and straddling the back leg. To this tower lowering tackles and guys were passed. The shear-legs was then pushed forward by its own power to its point of farthest reach when all lowering tackles were hauled tight. The connection between the back leg and the two front ones was then broken by cutting through the back leg near the top with an acetylene torch. This was then moved backward and lowered simultaneously until it was entirely separated from the two front legs and the position of minimum strain on the tower was reached. The two front legs were then lowered as one until they were rested on cribbing placed on a deck scow. In order to relieve the buckling strain in these legs during the last 30 ft. of lowering, a 40-ton capacity derrick scow was hooked on to the outer end and lowered simultaneously with the main lowering engine on shore. The lowering of the back legs was then completed, all pins were taken out, and the three legs loaded separately on scows to be taken to the site designated by the government.

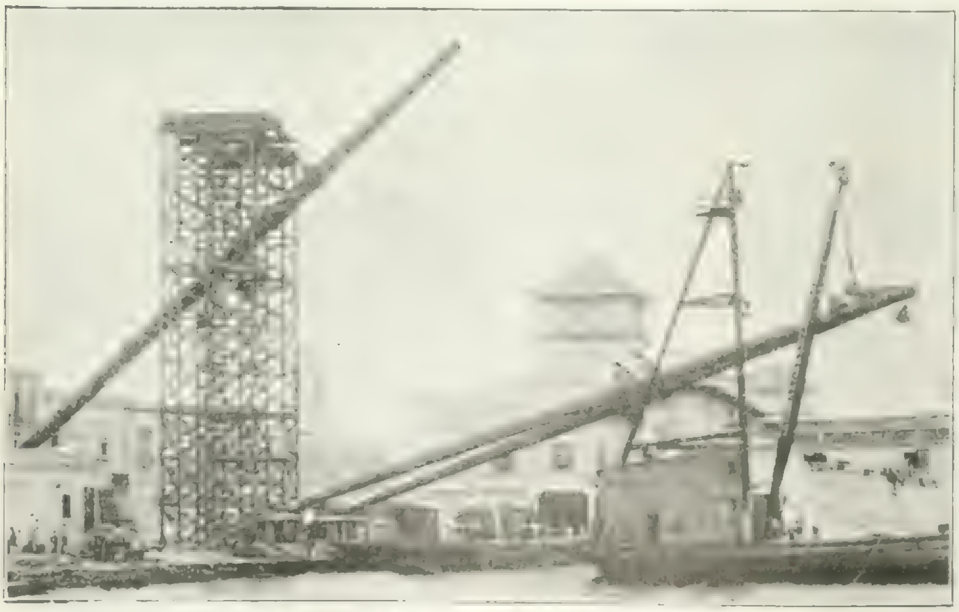


FIG. 2—FRONT [illegible] SCOW
The [illegible] stresses

The work was done by the Frederick Snare Corporation of New York and Havana, subcontracted from the Parklap Construction Co., and under inspection of the Obras Publicas.

Studies of Discharge of Sanitary Sewers at Phoenix

Total Discharge Curves Compared With Other Cities Velocity Tests, *n* Value, Per Capita Flow Relation to Water Consumption

By S. M. Cotten
Assistant City Engineer, Phoenix, Ariz.

In connection with the extension of the sanitary sewer system of Phoenix, Ariz., a study was made of the conditions obtaining in the then existing system. This study developed some facts which are believed to be of general interest, and which are here given.

Phoenix is a residential city with a population of 29,053 in 1920. The sanitary sewer system is composed of three mains and their laterals. The mains are known as the Original, the North, and the South. The Original serves the retail business and office district, and empties into the South Main. The North Main serves the greater part of the area of the city, but a purely residential territory. The South Main serves a very mixed residential, warehouse, and shop district. The North and South Mains combine to form the Outfall, through which the flow is carried to septic tanks and discharged into the Salt River. Flow readings were taken at various points on these several lines.

In taking readings for depth of flow, the distance from invert of pipe to a fixed point on the manhole ring was read and recorded. Thereafter, readings were taken from this point to the water surface, the difference being the depth of flow. Measurements were made with an ordinary Philadelphia level rod, and the instant that the bottom of the rod came into contact with the water surface was clearly shown by the formation of ripples. The method gave quite accurate and satisfactory results. The size and grade of the pipe were known, and the discharge was computed on the basis of Kutter's formula, with n equal to 0.013, unless otherwise noted, and by a proportional discharge chart, shown by Fig. 1.

Discharge Curves—In order to arrive at some conclusions as to the applicability of generally available data to Phoenix conditions, the total Phoenix discharge curve was plotted against the combined discharge curve for seven cities, as shown on p. 191, Vol. 1 of Metcalf & Eddy's "Sewerage." The result is shown by Fig. 2. Considering the great dissimilarity of the communities represented, the practical identity of these curves, except for the time element, is remarkable. This difference in time is readily explained by the character of the cities represented.

For various reasons, it was necessary in some cases to take depth readings at manholes where there was a material change of grade in the sewer, and a corresponding change in the hydraulic properties of the line on either side of this point. In order to compute the discharge, it was necessary to determine whether the depth as read applied to the reach above or below the manhole. No statement covering this case could be found in the textbooks available. Theoretical speculation led to the belief that the depth would apply always to the reach below, and tests were made which verified this conclusion. For this purpose, simultaneous readings were taken at three consecutive manholes on the same main line, connected by quite different grades. The discharge of these lines, running full, beginning at the lowest reach, is 15.66, 12.76, and 23.75 sec.-ft. respectively. The depth readings applied to the reaches below the point of reading gave discharges of 3.06 and 3.13 sec.-ft.; applied to the reaches above, they gave discharges of 2.83 and 5.70 sec.-ft., showing quite conclusively that the correct application was to the reach below. This conclusion was further verified by velocity measurements of actual discharge over the same reaches, the method for which will be described later.

Readings were taken on the North and South Mains at points close to their junction, and on the Outfall at a point close below this. The main series of these readings covered a period of forty-eight hours, taken at half-hour intervals, and as nearly simultaneously as possible. The discharge curves for this period are shown in Fig. 3, on a basis of n equals 0.013.

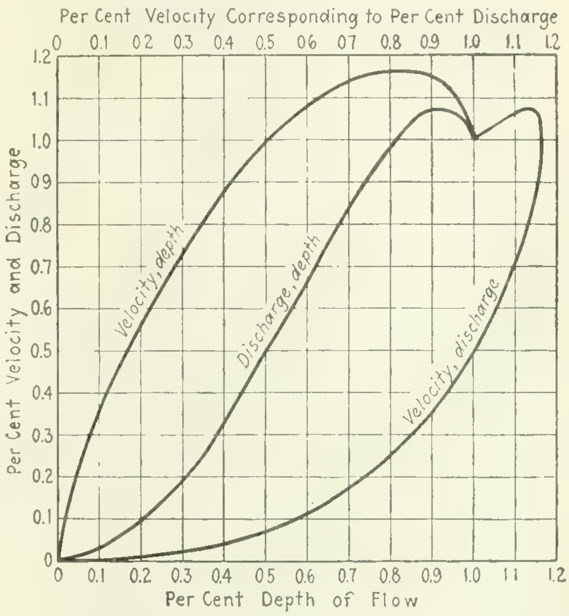


FIG. 1. COMPARISON OF HYDRAULIC FUNCTIONS OF CIRCULAR SEWERS RUNNING PART FULL AND FULL
All percentages refer to like functions for a pipe running full

Making allowance for the time interval involved, it is apparent that the sum of the computed discharges from the North and South Mains should equal the Outfall discharge. But, on the basis of the depths as actually read, and a value of n equal 0.013, the former was very considerably in excess of the latter. The character of the several lines and of the flow in them indicated that the depths of flow for the North Main were in error. To determine this, simultaneous readings were taken at the point on this line where these readings had been taken, and at points adjacent above and below. These readings and the corresponding computations indicated that the original readings were in error by an amount of depth equivalent to 0.50 sq.ft. of flow area. This error would be a constant, irrespective of the depth of flow, and was apparently occasioned by a small dam or other obstruction in the pipe a short distance below the point of measurement. The necessary computations were made and the depths as read changed accordingly. Combining the corresponding discharges with those of the South Main, it was then found that their sum was somewhat less than that of the computed Outfall discharge, as shown on Fig. 4.

Velocity Tests—In an effort to clear up this discrepancy, a series of velocity tests were made on all of these lines, designed to give the actual discharge within

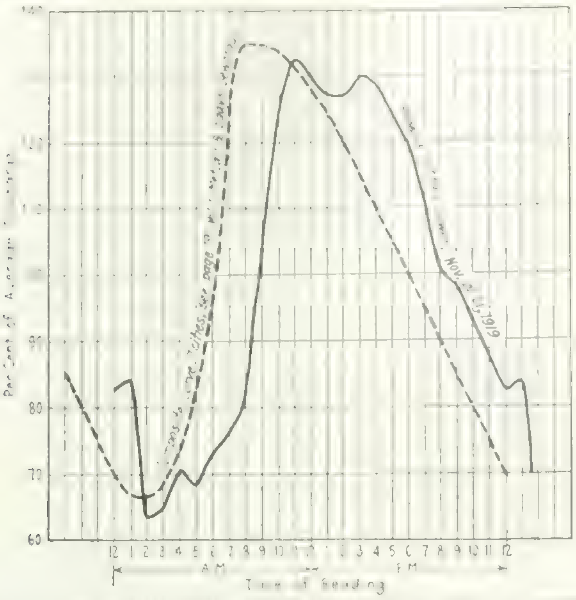


FIG. 2. DISCHARGE CURVE OF PHOENIX OUTFALL SEWER AND COMPOSITE CURVE FOR SEVEN CITIES

reasonably accurate limits. The tests were made at the time of maximum flow, when there was a good depth in the pipes, and this depth was essentially constant during the period of the tests. Four floats were put through the selected reaches, and accurately timed. The first three floats were small circular discs, designed to give the maximum surface velocity, and to serve as a check on the fourth. This last was a specially constructed apparatus, consisting of two circular segments of heavy red pressboard fastened together at right angles and securely braced with string. They were cut to a diameter 3 in. smaller than that of the pipe for which they were intended, and had wooden strips fastened to their tops so as to float them with their bottoms about 1½ in. from the invert. It was expected that these floats would give the average velocity of flow very closely, and the evidence indicates that they did.

For the North Main the average velocity of the three disc floats was 2.65 ft. per second, and for the special float the velocity was 2.39 ft., being 90.4 per cent of the surface velocity. With this velocity and the measured area of flow, the discharge was 2.43 sec.-ft. and the corresponding value of n is 0.01173.

For the South Main the discs gave a surface velocity of 2.92 ft. per second, and the special float an average velocity of 2.74 ft., being 93.9 per cent of the former. The corresponding actual flow was 3.81 sec.-ft., and the corresponding value of n is 0.01111.

For the Outfall, the discs gave a surface velocity of 2.27 ft. per second, and the special float an average velocity of 2.06 ft., being 90.8 per cent of the former. The corresponding actual flow was 6.35 sec.-ft., and the corresponding value of n is 0.0125.

Combining the North and South Main discharges, we have a sum of 6.24 sec.-ft., as against the 6.35 sec.-ft. computed Outfall discharge, which for such work is a very close check and much better than was anticipated. In connection with the velocity test on the North Main, depth readings were taken at points and computations made which gave a very close check on the conclusions heretofore noted concerning the reach to which readings are applicable, and as to the existence and effect of the obstruction in the line.

Actual Discharges and Water Consumption—The actual values of n for the three lines having been determined as above, the corresponding actual discharges were computed for the 48-hour readings, and the two main-line flows combined. This was plotted against the Outfall discharge, as shown on Fig. 5, and, in general, gave a reasonably close agreement. At least, it is much closer than in the case where a value of n equals 0.013 was used throughout, as in Fig. 4.

During the period of the 48-hour readings, observations were made also of the water pumped at the city water-works. These readings were averaged over a period of an hour and a half and their curve plotted on Fig. 5, the time being 1¾ hours later than the average reading time, to allow for the water reaching the Outfall. It will be observed that this curve is essentially parallel with the curve of Outfall discharge, and that the difference in quantity represented is not greater than would naturally be expected. The relation here indicated between water pumped and sewage discharge will hold good only during the winter months, when practically no water is being used for lawn sprinkling; there would be little similarity between these curves during the summer months.

For the purpose of the following discussion, the relative sewer discharge is equally as usable as the actual,

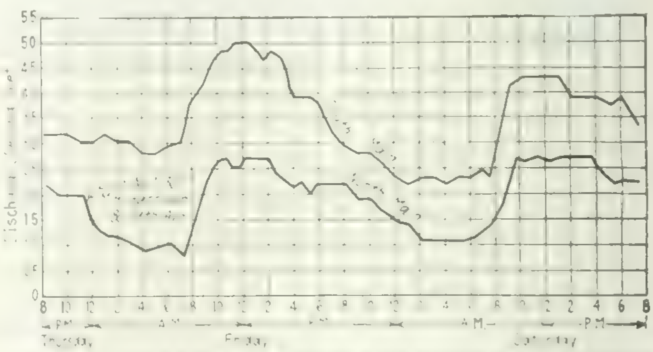


FIG. 3. DISCHARGES OF NORTH AND SOUTH MAIN SEWERS
Based on n = 0.013. Measurements Jan. 20-22, 1921.

so a value of n equals 0.013 will be adopted and conclusions reached on this basis.

Readings were taken daily at the same points on the main lines for a period of one week. They were begun well before and ended well after the peak flow had passed. Contrary to all expectations, the maximum flow in the North Main was found to occur on a Sunday, about noon, at which time it was 17 per cent greater than the maximum for any other day of the week. This line, it will be remembered, serves a purely residential district. The maximum Sunday flow of the South Main was somewhat less than its greatest daily maximum, which occurs on a Monday.

The readings above referred to were taken in January. At this time of the year the daily per capita water consumption is about 145 gal. During July this rate rises to about 220 gal. It might be anticipated that there would be a somewhat proportional increase in the summer maximum rate of sewage discharge over that for the winter. Such is not the case, as readings taken the previous July show essentially the same maximum rate as those for January. It appears that the daily peak flow during the summer covers a considerably longer time than it does in the winter, and that there is a consequently greater volume of sewage, but not a greater rate of discharge.

The maximum rate of discharge of the North Main was 3.20 sec.-ft., of which 0.47 sec.-ft. was contributed by a district entirely outside of the city. The remain-

ing 2.73 sec.-ft. was contributed by 3,566 actual house connections, making the maximum rate per connection equal to 0.00076556 sec.-ft., or 494.76 gal. per day. This rate checked surprisingly well with readings taken at various points along the North Main, the number of contributing connections above such points being known.

Per Capita Discharges—The total number of residential sewer connections in the city is roughly 5,000, and the population is 30,000. It is conservative to say that at least 25,000 of the people live in residences connected to the sewers, giving an average of five persons per connection. Considering only the North Main, the per capita sewage discharge then is 98.95 gal. per day. At the same time the maximum rate of water pumped was 10 sec.-ft., or 215.5 gal. per capita per day. It might appear, then, that of this water, only 46 per cent finds its way into the sewers, but such a conclusion would be entirely erroneous, as a study of the distribution of the total sewage flow will show.

During the 48-hour readings, the maximum actual discharge from the South Main was 5.86 sec.-ft., and of the North Main, 3 sec.-ft., giving a sum of 8.86 sec.-ft. This as against a computed actual discharge of 8.66 sec.-ft. in the Outfall, and a water pumpage rate of about 9.5 sec.-ft., showing that the water pumped is approximately accounted for by the total sewage discharge. The 5.86 sec.-ft. discharge of the South Main was contributed by 2,350 connections. Of these, 1,360 were contributary to the Original Main, which developed a maximum discharge of 2.46 sec.-ft. The balance, or 3.40 sec.-ft., was developed by only 990 connections, whereas on the North Main it required 3,566 connections to develop 3 sec.-ft. This is accounted for by the fact that the North Main serves a purely residential territory, whereas the South Main serves a mixed residential, warehouse, and shop district, and it is evident that the rate of water consumption in these districts was proportional to their rates of sewage discharge. It appears further that the per capita rate of water consumption as above established is really of no significance; that the residential districts do not consume any such amount of water; and that most of what they do use finds its way into the sewers.

Because of the different character of the properties

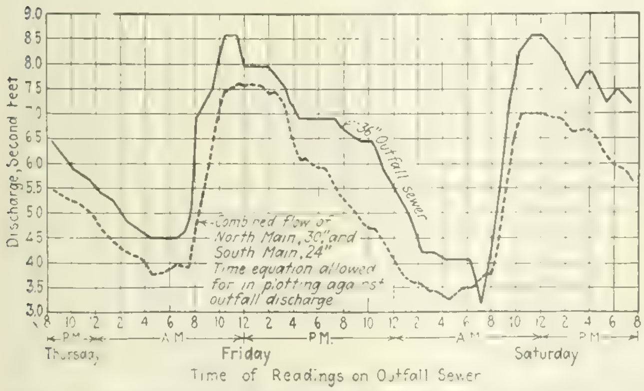


FIG. 4. COMPARISON OF FLOW IN OUTFALL SEWER WITH OBSERVED FLOW IN NORTH AND SOUTH MAIN TRIBUTARIES ADDED TOGETHER

Based on $n = 0.013$. The combined discharges should equal the discharge through the outfall. Observations made Jan. 20-22, 1921.

served in the retail business and office district, it is evident that a rate per connection would have no significance. It was thought, however, that a per capita rate for this district would have some value for the purposes of this study and for predictions as to ultimate developments. Consequently, a census was taken of the people engaged or living in this district during business hours, including hotel and rooming-house guests. It was found that there were 9,300 such. Dividing the maximum sewage discharge of 2.46 sec.-ft. by this num-

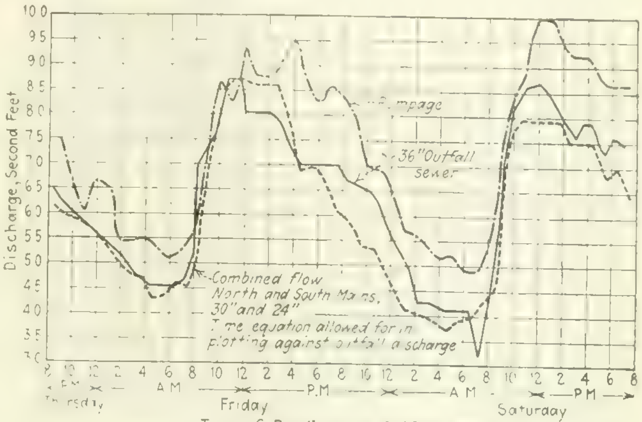


FIG. 5. SEWAGE DISCHARGE AND WATER PUMPAGE

Sewage discharges based on velocity tests. Water pumpage based on half-hour readings averaged over 1½ hr., curve plotted 1 hr. 45 min. later than average reading time. Observations on Jan. 20-22, 1921.

ber gives a rate of 0.0002642 sec.-ft., or 171 gal. per capita per day. It will be observed that this rate is 73 per cent greater than the residential per capita rate as previously established.

Conclusions—The principal conclusions of this study may be summarized as follows: (1) The size, grade, and depth of flow of an ordinarily well constructed vitrified clay sewer being known, the corresponding discharge will be given approximately by Kutter's formula, using a value of n equal to 0.013. The actual discharge may be determined very closely by the use of a special float, such as described, giving the average velocity of the flow. The values so derived indicate that the actual value of n is somewhat less than 0.013, and the discharge correspondingly larger.

(2) In taking readings of depth of flow, a point on the line should be selected where the flow is in a state of passive equilibrium; that is, where, for considerable distances on either side, there is no change of grade, size, or alignment of pipe. If it is necessary to take readings at a point where grade or size changes, it is indicated that the depth as found will always apply approximately to the reach below, or downstream.

(3) It is possible that there may be a dam or obstruction of some character in the pipe, a short distance below the point of reading, resulting in increasing the depth over what it should be. To guard against this, a point selected for readings should be investigated and checked by taking simultaneous readings at this point and at another one immediately above or below. If these readings give approximately identical discharges, a free flow through the pipe is indicated, and the selected point is acceptable.

(4) It is indicated that the characteristics of the total sewage discharge curve for a small residential city are practically identical with the curves as heretofore established for large commercial cities, except for a probable difference in time. The maximum flow will be about 135 per cent of the average.

(5) A per capita rate of water consumption or of sewage discharge, based upon these total quantities and the total population, is meaningless and misleading.

A per capita or a connection rate is of significance only when determined for or applied to, districts of uniform character. The residential rate will be very much smaller than that of a mixed commercial and residential district; the former may be only one-half to one-fourth of the latter, and in the design of a sewer system this fact should be given due study and consideration.

(6) The maximum rate of sewage discharge is practically constant throughout the year, though the total discharge varies, increasing in the summer. The maximum residential rate of discharge occurs on a Sunday, about noon, and is 17 per cent greater than the maximum for any other day of the week.

Heavy Concrete Pavement on Wide Chicago Boulevard

Mat Reinforcement of ½- and ⅜-In. Bars—Slab Built Half at a Time — Transverse Joint Every 25 Ft.—Large Arc Curb Corners

A SECTION of concrete pavement 55 ft. wide and 12 in. thick, heavily reinforced with steel bars, has been constructed as part of the future development planned for Sheridan Road in Chicago. The location of the new pavement was open Lake front only a year ago. During the winter of 1921-22, the area was filled in with cinders and earth to a depth of 8 to 16 ft. As settlement of this "made ground" was to be expected, a heavy concrete pavement, strongly reinforced, was decided on and a particularly well-drained subgrade planned.

A plan of the new pavement showing the joint arrangement, the drainage system and the wide curves of the curb corners at intersections is shown by Fig. 1. The slab is uniformly 12 in. thick and is 55 ft. wide between curbs. There is a continuous longitudinal joint at the center and transverse joints about every 25 ft. except at intersections where the spacing is irregular. The longitudinal joint is merely a construction joint except that the edge of the slab first laid is painted with hot asphalt before placing the abutting concrete. Along the curbs, which were built separate from and after the pavement slab, there are similar paint joints. The transverse joints are ⅜-in. fiber matrix joints. Across both transverse joints and the center longitudinal joint, ¾-in., 5-ft. dowels are spaced 5 ft. apart.

The slab reinforcement consists of ½- and ⅜-in. bars fabricated into rigid mats. Except for the weight of the reinforcement, about 125 lb. per square, the mat construction is that commonly employed. Each slab between

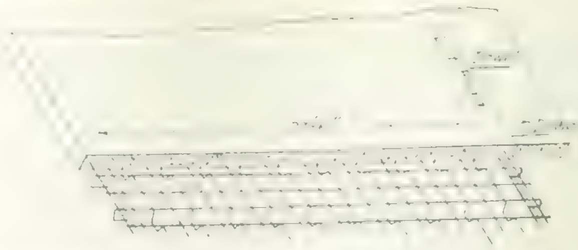


FIG. 2—ARRANGEMENT OF REINFORCEMENT

joints is separately reinforced, the dowels being the only steel that crosses the joints.

As indicated by Fig. 1, subgrade drainage was given especial attention. The general grade line was flat, so it was necessary to provide for surface drainage by alternate high and low spots in the gutter flow line. Catch basins were built 150 ft. apart in each gutter and connected by 6-in. tile pipe with a storm-water sewer paralleling the pavement on the Lake-shore side.

FIG. 3—BELT FINISHING HALF SLAB UNDER CONSTRUCTION

No unusual equipment or methods were employed in constructing the pavement. It was force-account work with the regular road-building equipment of the Lincoln Park Board. A 1:2:3 concrete of washed and screened sand and pebbles was employed. The slab was constructed a half at a time and Fig. 3 shows the finishing operations on a half slab. By building the slab half at a time, belting was possible with no more than the usual labor. A paving mixer with boom and bucket distribution placed the concrete and was charged from stockpiles on the grade. The slab was cured by ponding.

Construction of this extension was under the direction of H. A. Marbach, chief engineer of Lincoln Park Board.

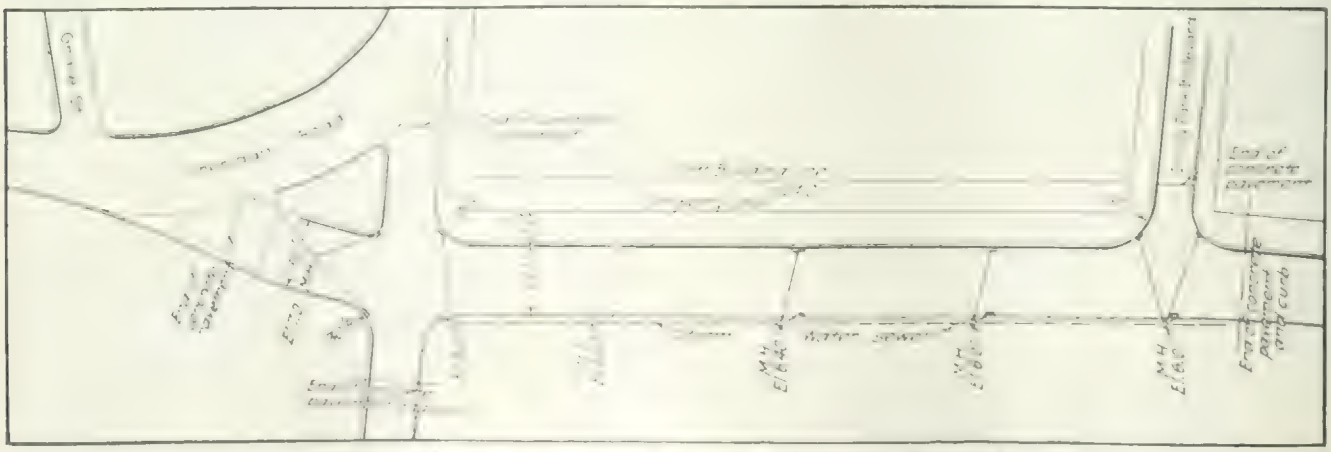


FIG. 1—[illegible] DRAINAGE SYSTEM

Illinois Central Announces Plans for Chicago Terminals

Begins 18-Year Program of Improvement on Suburban and Terminal Electrification and Lake-Front Park Extension

IN ADOPTING the 1,500-volt direct-current system with overhead wires for the electrification of its Chicago terminal lines the Illinois Central R.R. has taken an important step in its extensive program of improvements for these lines, which program covers a construction period of approximately eighteen years. Besides the electrification the program includes a large passenger terminal station with tracks on three levels, a separate suburban terminal, track depression with concrete retaining walls, track elevation, revision of trackage and provision of additional tracks on about 38 miles of line, sewer alterations necessitated by the track depression, and extensive filling for land reclamation along the lake shore. Parts of these works are now under construction. A stock issue of $50,000,000 for this and other work has been authorized by the railway company and the first $10,000,000 issue has been approved by the Interstate Commerce Commission. The extent of the electrification is shown in Fig. 1.

North of 51st St. the improvements along the shore have been planned in co-operation with the South Park Commission for the new lake-front park which will give the city a continuous park along the shore outside of the railway tracks where now there is deep water. This great public improvement was described in *Engineering News-Record*, Aug. 21, 1919, p. 360, and is indicated also in Fig. 1.

Report on Electric Traction Systems—Abandonment of the use of steam locomotives on the Illinois Central R.R. lines within the city limits except for interchange with other railroads and for trains of perishable freight, is provided for in an ordinance passed by the city and accepted by the company in 1919 (see *Engineering News-Record*, Aug. 21, 1919, p. 360). Late in 1920 a commission to consider the electrical systems best adapted to the conditions of the terminal service of this road was appointed by C. H. Markham, president of the company, with the late A. S. Baldwin, vice-president, as chairman. The other members were D. J. Brumley, chief engineer of terminal improvements, I.C.R.R., and three consulting engineers, George Gibbs, Bion J. Arnold and Dr. Cary T. Hutchinson. The secretary was W. M. Vandersluis, formerly signal engineer of the railway. Much investigation work was done by Hugh Pattison, electrical engineer for the commission.

A special and unusual feature of this problem is that the lines to be electrified include not only heavy suburban and main-line passenger service but also extensive freight switching in yards and freight transfer between yards of numerous railways. Four principal electrical systems were considered: (1) 750-volt direct-current with third-rail conductor; (2) 1,500-volt direct current; (3) 3,000-volt direct-current, and (4) 11,000-volt alternating current, these last three using overhead wires. The third-rail system was rejected as unsuitable for an installation including extensive freight yard trackage and switching.

With low voltage, the cost of line equipment is relatively high and that of electric train equipment relatively low. Therefore the 1,500-volt system was found economical in this case, since the installation is short but involves a large number of motor equipments for heavy traffic. Furthermore, it is purely a terminal installation and does not include any main-line division. Nor is there any intent or prospect of extending electrification for adjacent main-line service, since electric traction is not considered as offering any advantages under the operating conditions of the Illinois Central R.R. and was adopted only because of the city's demand for the elimination of steam locomotives within the city in the interest of smoke abatement.

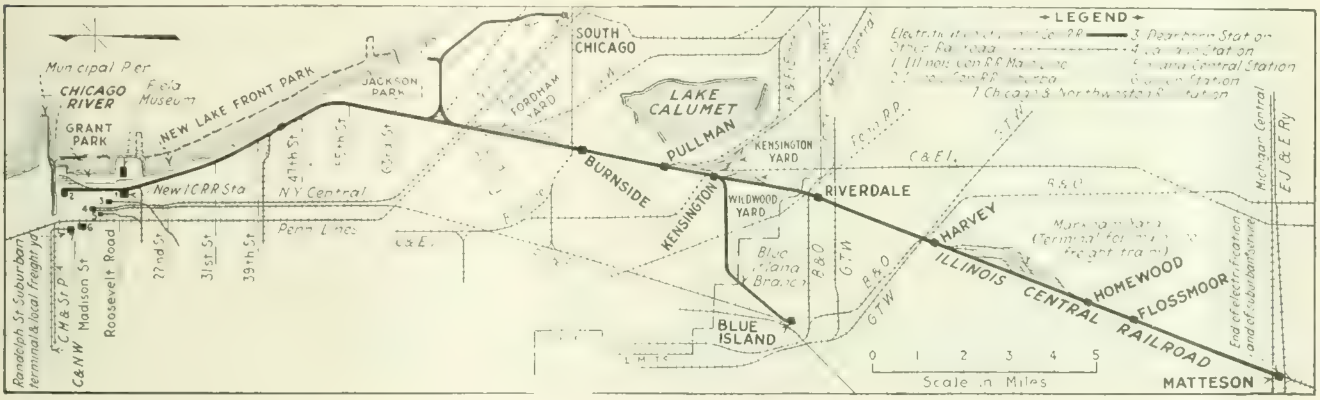


FIG. 1—ELECTRIFICATION AND LAKE-FRONT IMPROVEMENT ON THE CHICAGO TERMINAL LINES OF THE ILLINOIS CENTRAL R.R.

Taking these several conditions into consideration the 1,500-volt system was recommended by the commission and has been adopted. Details of the system will now be worked out, including a main power house and several substations. Electric locomotives will handle the main line trains, transfer service and yard switching, but motor cars operating on the multiple-unit system will be used for the suburban trains. Electric train equipment will be designed for a speed of 50 m.p.h., with an acceleration rate of 1.5 m.p.h. per second and a deceleration or braking rate of 1.7 m.p.h. per second.

Electrification Program—Although the ordinance covers only tracks within the city the electrification will have to be carried 11.6 miles south of the city limits to Matteson, as this is the terminal of the suburban service. The electrified lines are shown by the map. The company's line running west at 16th St. is not included in the ordinance. Four stages of the work are prescribed, as follows:

1. By 1927. the entire suburban passenger service

is to be equipped, including the main line to Matteson, 28 miles, with the 4.5-mile South Chicago branch and the 4.4-mile Blue Island branch. This will include about 125 miles of track. The great passenger terminal at Roosevelt Road and the city suburban terminal at Randolph St. are also to be completed by 1927. About 240 motor cars for multiple-unit trains will be required, operating a daily service of 350 trains making about 5,000 miles. This suburban traffic during 1921 amounted to nearly 20,000,000 passengers, or about 30 per cent of the total Chicago suburban traffic handled by steam railways.

2. By 1930, all freight service north of Roosevelt Road is to be operated electrically. This involves more than 40 miles of track which is mainly yard trackage, so that special problems are involved.

3. By 1935, all freight service within the city limits is to be electrified. To provide for the large amount of interchange with other roads, however, steam locomotives will be permitted to operate over the electric lines years. Contracts amounting to over $1,000,000 have already been let for parts of this work.

1. A dam or bulkhead is being built to enclose an area of the lake between 16th and 23rd Sts. and thus provide about 47 acres for deposit of excavated material from grade revision and other works. This dam, requiring about 110,000 cu.yd., is a fill formed by suction dredges and having slopes of about 1 on 20, as shown in Fig. 2. It is being built by the Great Lakes Dredge & Dock Co. in connection with similar work for the South Park Commission. Another dumping area of about twenty acres is being formed by 1,100 ft. of pile and rock breakwater off the shore at 29th St. to 31st St. This breakwater is being built by the same contractor.

2. Grade revision is being carried out to lower the tracks between 25th and 41st Sts. in order to give the required headroom for overhead viaducts to be built by the South Park Commission to provide communication with the park extension along the east side of the railway. The grade will be lowered about 10 ft., or to an

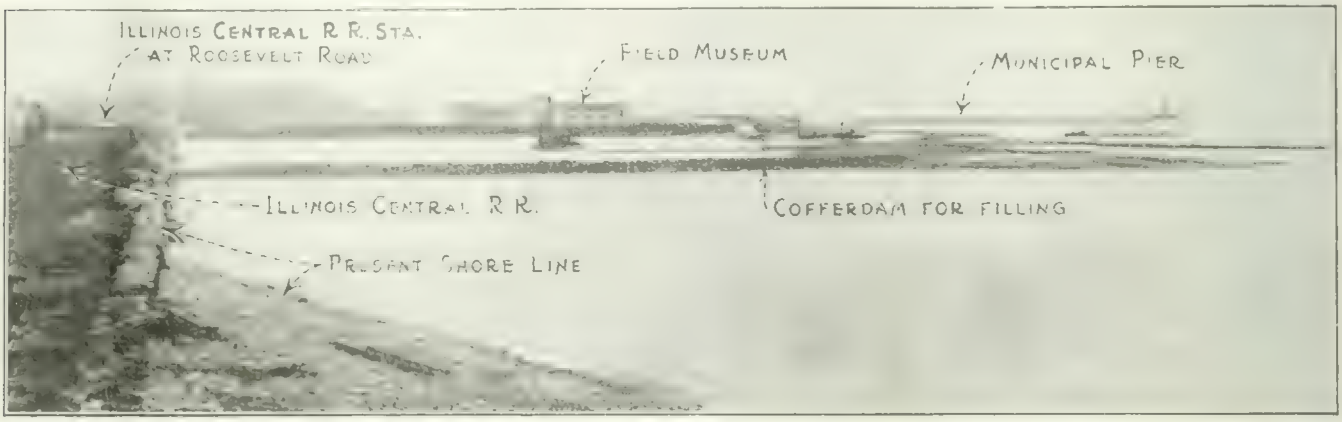


FIG. 2—SUCTION DREDGES MAKING DAM FOR LAKE FRONT FILL OF ILLINOIS CENTRAL R.R. AT CHICAGO

View looking north [illegible] St. The [illegible] excavated material [illegible] track depression work.

for transfer service. Thus a train of cars for delivery to some other road may be operated by steam from the Markham freight yard northward to destination, and the engine may return with a similar train, but no switching movements within the electrified zone may be made during the trip. The Markham yard, which is not yet finished, will be the terminal for main-line freight trains, as described in *Engineering News-Record* of Aug. 5, 1918, p. 313.

4. By 1940, the through passenger service is to be electrified within the city limits. The ordinance provides, however, that this work may be deferred if at that time the steam trains of tenant roads using the new terminal station constitute more than 20 per cent of all the trains using that station. What these tenant roads will be is not now known. At the present time the Illinois Central R.R. terminal facilities are used by the Michigan Central R.R., the Chicago, Lake Shore & South Bend Electric Ry. and the Cleveland, Cincinnati, Chicago & St. Louis Ry. The first two lines diverge at Kensington, the electric trains being handled by steam locomotives on the Illinois Central tracks. The third railway continues south over the main line as far as Kankakee.

Work Now in Progress—A great amount and variety of work is required preparatory for the electrification, and the following is a summary of work now under construction and to be carried out during the next five elevation 4 ft. above the lake level. This work will be completed in 1923 and a contract for the first 700,000 cu.yd. of excavation was let in August, 1922, to the States Contracting Co. Concrete retaining walls on the west side of the depressed tracks will be built from 30th to 41st Sts. and will be largely of the L or counterfort type as they must be kept within the right-of-way line. These walls will contain ducts for electric wires and will carry supports for the overhead wire system. From 44th to 51st Sts., the present tracks will be elevated.

3. Extensive sewer construction is made necessary by the track depression. The smaller sewers range from 1 ft. to 6 ft. in diameter and now connect with a 16-ft. sewer in the right-of-way, which latter discharges into a 20-ft. intercepting sewer on 39th St. It was considered preferable to rebuild the sewers outside of the right-of-way rather than to lower them. Part of this work is being done by the Mortimer & Lindstrom Co. The 20-ft. sewer will have to be strengthened where the railway crosses it. A heavy piece of work now being done by the Underground Construction Co. is a 7-ft. brick sewer for four blocks in Rhodes Ave., with a connection to the 20-ft. interceptor. This involves a trench 24-ft. deep, sheeted and pumped, the work being complicated by a large inflow of water and the existence of a network of public utilities. Further, the connection with the 20-ft. sewer offers difficulties, since this

sewer extends from a pumping station at the lake shore, so that it runs full and under pressure.

4. Rearrangement of tracks will be carried out on a large scale and existing grade crossings with other railways at 67th St., Burnside, Kensington, Blue Island Junction, Riverdale, Harvey and Matteson will be eliminated by track elevation. As far as Kensington there will be thirteen tracks instead of eight as at present. North of 47th St. there will be six suburban, four through passenger and five freight tracks, while south of that point there will be four suburban, four through passenger and five freight tracks. From Kensington to Harvey there will be two suburban, two through passenger and five freight tracks, and from Harvey to Matteson there will be two tracks each for the three kinds of service.

5. Suburban station facilities will be enlarged materially and the Randolph St. terminal will be lengthened by extending it north to a new headhouse at South Water St.

6. A fine new passenger terminal station will be built fronting on the south side of Roosevelt Road, the present station being torn down as it lies in the way of extending this thoroughfare to the lake front. Tentative plans provide for three track levels. A stub-end terminal on the upper floor; baggage, mail and express tracks and facilities next, and through passenger and suburban tracks below. Definite plans for the track layout and station building will depend somewhat upon the number of tenant roads.

All these works are being planned and carried out under the direction of D. J. Brumley, chief engineer of Chicago terminal improvements, Illinois Central R.R.

Complications of Transportation on Western Power Job

Good Highways Through Mountains First Built and Then Heavy Material Brought in by Tractors and Trucks

TRANSPORTATION of materials and equipment into remote sites is the most serious problem connected with Western water power projects which for the most part are located in mountainous country far removed from railroads and good roads. The methods used on the Kerckhoff project of the San Joaquin Light and Power Corporation give some idea of the magnitude of this transportation task.

The development is located on the San Joaquin River 48 miles northeast of Fresno, Calif., and four miles from the nearest railroad point at Auberry, where the San Joaquin & Eastern Ry. has terminal facilities. The first party of construction engineers to move in on the job, found only wilderness between Auberry and the dam site. Without so much as running a line to determine the levels, teams were put to work on a road over the mountains, plowing and grading behind pioneers, who cut away the timber and blasted the rock. Sixty days' work brought the road to the canyon side, where a clearing was made for a supply dump and hoist house. A power line run parallel to the road and tapped at points, furnished power to operate a portable air compressor, which was used in drilling rock where blasting was necessary. The four miles of road built between the Kerckhoff dam and Auberry winds around mountains and skirts ravines, ending on the brink of the San Joaquin River Canyon at a point 1,100 ft. above the river bed and half a mile from the big construction work.

With a road completed to the canyon side, the next job was to get materials and men down the 1,100 ft. to the dam site. The plans called for a 3,700-ft. incline cable tram, the construction of which would require several weeks' time. Speed was required, as the time was limited for the construction of the project. It was decided to begin operations at once on the foundation while the construction of the incline cableway was in progress. Both skill and daring were required in

TRACTOR-TRAILER TRAIN HAULING TRANSFORMERS

the work of transporting materials down a mountain side having grades of 100 per cent, yet this feat stands out as a prominent factor that made possible the completion of the Kerckhoff dam in seven months' time.

Diamond drills, air compressors, and camp supplies for 100 men were lowered by means of sleds built up of lumber that was later used in construction work. These sleds were drawn by mules and snubbed from the rear by lines hitched to trees along the pathway. Timbers for a bridge 300 ft. in length and 65 ft. high, and compressor units weighing 14,000 lb., were let down the canyon sides in this way.

With the opening of over four miles of mountain road and the installation of the tramway and hoist, the movement of materials began in earnest. While the road was cut out of the side of the mountain, and it was passable, it was far from completed and required a large crew of men to get it into shape for the heavy trucks carrying cement, lumber and machinery. The material for the dam was hauled with three 5-ton and seven 2-ton trucks, operating constantly under the urgent need to make all speed possible. These trucks cut the roadway into deep ruts that were smoothed out as quickly as it was possible to work men and road machinery between trips and at night. The road was sprinkled at night. Water for the sprinkling and also to supply the main camp at Auberry was pumped from the San Joaquin River through a three-pipe line laid along the new road.

All hauling was done during the day, while two trucks equipped with sprinklers operated at night. Materials were delivered at the end of the road to the head of the incline, where platforms were built for storage, so

that trucks would not be held up waiting for the incline cars.

As material was delivered to the foot of the incline, it was placed at points where needed on the dam by means of two cableways anchored across the canyon, each having a capacity of ten tons. They were so arranged that a complete load on the incline car could be picked up and delivered to any part of the work.

The work of loading the trucks at Auberry was handled by cranes placed conveniently near sidings and storage platforms. The materials were kept moving constantly toward the job as rapidly as the construction crews could handle them, and no opportunity was lost to load direct from the car to trucks, thereby eliminating as much handling as possible.

An additional nine miles of road was constructed to points of approach for tunnel adits and to reach the power house camp. These roads were of the same character as required for the dam construction with the advantage of a down-grade haul for 90 per cent of the distance. The maximum up-grade to the power house camp is 6 per cent, while the maximum down-grade is 12 per cent. The road to the power house was kept in condition by sprinkling and dragging with a curved edge drag to give a slight crown to the road.

The heaviest pieces hauled were the generator rotors, weighing 29 tons each. These were transferred from the car to the 30-ton trailer and hauled by the 75-hp. caterpillar to the power house, requiring a half day's time for each piece. Cement was also hauled on 10-ton trailers loading three in a train behind the caterpillar. At one time six transformer tanks were hauled in one train of six trailers. During the rush hours of completing the big job, one thousand tons of material were hauled in seven days from Auberry to the power house.

The cost per ton-mile for hauling with trucks was 31 cents to 35 cents, as against about 16 cents by tractor. The element of speed, however, made necessary the more rapid truck transportation wherever possible.

The power house is located in a box canyon, and 400 ft. below the only available space which could be used for storage. It was, therefore, necessary to install an incline railway for transportation from storage yard to power house site. This incline was 1,000 ft. long and had a maximum grade of 100 per cent as it entered the building. A $\frac{3}{4}$-in. cable was used and hoist equipped with 150-hp. slip-ring induction motor. A 15-ton derrick was installed between the track and road for

[illegible] TRAILER [illegible] LENGTH OF PENSTOCK

MAKING A MOUNTAIN ROAD TO CARRY MATERIAL TO HYDRO-ELECTRIC PLANT

transferring material and equipment from trucks and trailers to the incline cars.

The heaviest units entering into the development were taken over this power house road by means of a 75-hp. Holt caterpillar, drawing a 30-ton four-wheel trailer. The road stood up well under heavy loads of 29 tons. Lighter loads were handled by trucks and by means of 10-ton trailers. Additional transportation equipment was placed on the work as required until the peak of the load required the following:

1—75-hp. Holt caterpillar
1—[illegible]-hp. Holt [illegible]
1—[illegible]-ton trailer
6—10-ton trailers
2—1[illegible]-ton [illegible] wagons
4—5-ton two-wheel trailers
3—5-ton Mack trucks
1—[illegible]-ton [illegible] truck
1—5-ton White truck
1—2-ton Mack truck
4—[illegible]-ton White trucks
2—[illegible] cars
9—Light service [illegible]

Cement was the most important material to be transported because of the constant need for it, and the great aggregate weight of the material required. Lumber was a close second in tonnage hauled, averaging four pounds to the board foot because of the large content of moisture in the green lumber, most of which came direct from the sawmills.

A summary of the total tonnage hauled for the Kerckhoff development, exclusive of the transportation of men and the work of light service cars, shows the following:

Cement 161,623 sacks	[illegible] tons
Rail	[illegible] tons
Lumber, [illegible] ft.	[illegible] tons
Explosives 1,280,300 lb.	640 tons
Equipment and supplies, [illegible]	[illegible] tons
Power house equipment	[illegible] tons
[illegible]	[illegible] tons
[illegible]	1,6[illegible] tons
[illegible] of equipment, [illegible] and supplies	3,196 tons
	[illegible] tons

The work was carried out under the direction of Rex C. Starr, then construction engineer of the company, who supplied the material from which this article was prepared.

Traffic-Storage at Congested Street Crossings

Local Widening of Streets Provides Space Where Deviating Traffic Waits Outside the Lines of Through Traffic

BY CLARENCE W. FARRIER
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STREET widening as a relief for traffic congestion is largely ineffective unless the intersections of the street with other heavily traveled streets are made more efficient. The diagrams accompanying this article show the application of a principle to three types of street intersections which simplifies their traffic control and greatly increases their efficiency. The principle is that of traffic storage. Spaces are created at the intersections, where the traffic which ordinarily interferes with through traffic and tends to produce confusion at the intersection can wait, out of the way of through traffic, its opportunity to proceed.

The first diagram shows on its eastern side a simple intersection and, on its western side, shows this intersection with the principle of traffic storage applied. An additional triangular piece of property has been taken from the corners to allow the creation of a space where right- and left-turning traffic can accumulate, awaiting its opportunity to proceed, without delaying the through traffic as it does in the case of the simple intersection on the eastern side of the diagram. In the latter situation the left-turning traffic must await its opportunity to force its way through the street car traffic going in both directions and the vehicular traffic bound in the opposite direction, and the right-turning traffic must await its opportunity to force its way through the pedestrian traffic.

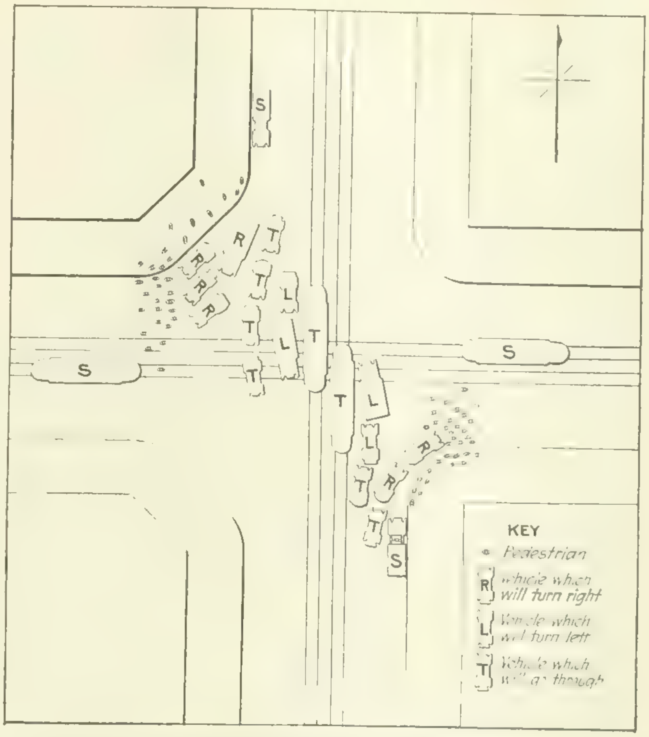

FIG. 1—INTERSECTION SHOWING APPLICATION OF TRAFFIC-STORAGE PRINCIPLE

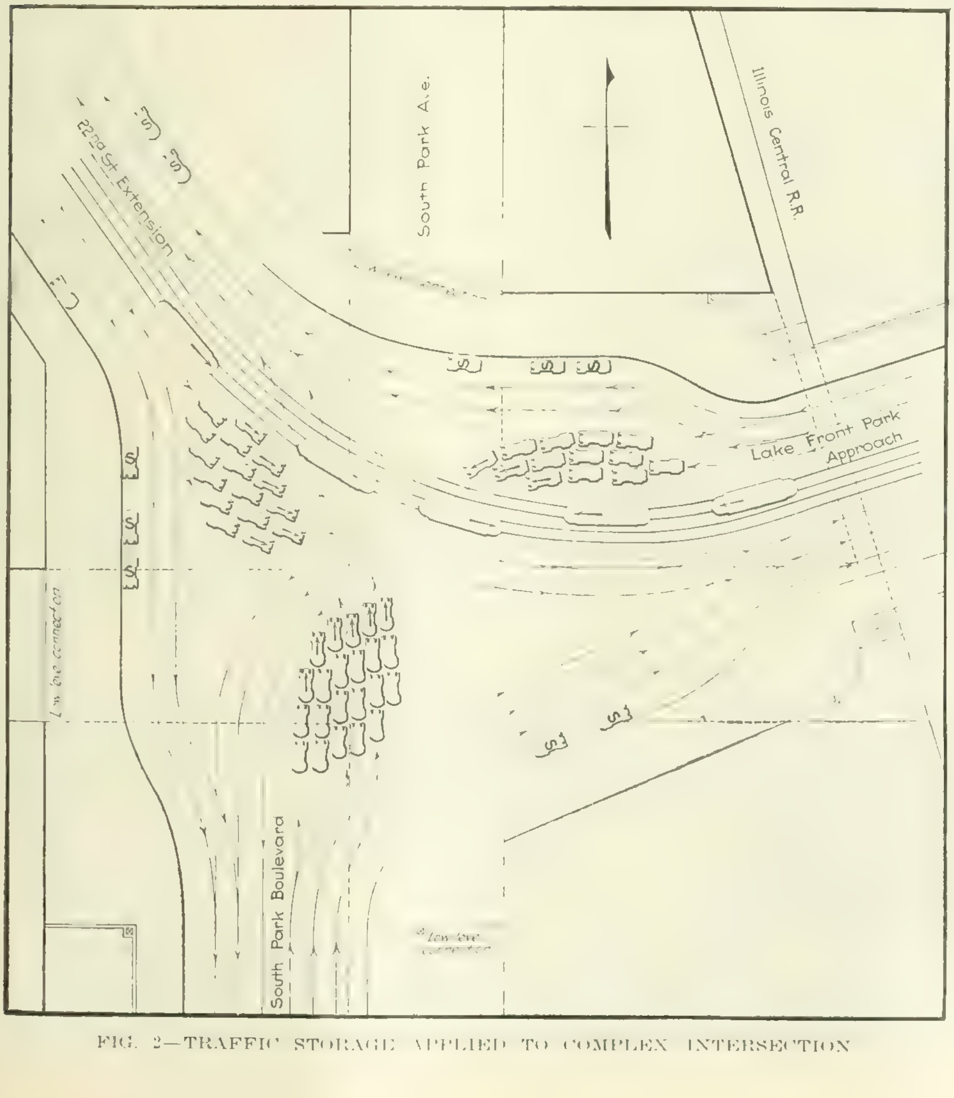

FIG. 2—TRAFFIC STORAGE APPLIED TO COMPLEX INTERSECTION

The extent to which this cutting back of the corners should be carried depends upon the traffic conditions, the value of the property at the intersections and the habits of the pedestrians who frequent the intersection. In localities where the property values are relatively low the corners can be cut back to a point where there will be a minimum of traffic delay due to the turning traffic. It is possible to create sufficient storage space, for any ordinary flow of vehicles, where those turning can wait until the cross-traffic signal is given. This solution removes the chief source of danger to pedestrians, that of right-turning vehicles forcing through the pedestrian line.

and causes the minimum delay to through traffic. In some localities, the habits of the pedestrians put a limit to the extent to which this principle can be applied. If any considerable diversion from the direct sidewalk route is introduced, the pedestrians will not follow it but will cross the roadway directly and merely complicate the situation.

The efficiency of any ordinary street intersection as a traffic carrier, even under ideal conditions, is in the neighborhood of 65 per cent of the efficiency of the street between intersections, because the intersection is closed half of the time by the cross traffic interval.

In carrying out the program of street-improvement work now before the Chicago Plan Commission, the technical men associated in the development of the plans for these improvements have endeavored to increase the efficiency of the important intersections along these streets, by applying this principle, giving due weight to all of the factors of a proper solution of the situation. The diagrams Figs. 2 and 3 show the application of the principle to two intersections which were problems to be solved in working out the plans for the street improvements.

Fig. 2 shows the intersection of a ramp from South Park Boulevard, a ramp from Twenty-second St. and a viaduct approach over the Illinois Central R.R. right of way to the new lake front park. South Park Ave., Twenty-third St. and the low-level approaches of South Park Boulevard pass under this intersection as low level streets. It is expected that a large amount of the rush-hour traffic to and from the south side and the downtown district will pass over this intersection. Some of this traffic will use the South Park Boulevard—Twenty-second St. route, some will use the South Park Boulevard—Lake Front Park route and some will move along Twenty-second St. and the Lake Front Park driveways to the south. This Y-intersection will make necessary three traffic intervals instead of two, as at ordinary intersections. The intersection as designed will, under ordinary conditions, allow the right-turn traffic from all three streets to flow independently of the traffic intervals. The left-turn traffic will be held for two intervals. The vehicle silhouettes show the spaces provided where a large amount of the left-turning traffic can accumulate out of the way of the right-turning traffic which can flow uninterruptedly. The street car movement will take place during the Twenty-second St.—Lake Front Park approach interval. Suitable islands and markers, not shown in this plan, will be provided to guide traffic.

Fig. 3 shows the use of traffic storage space to solve a different problem. Three important heavily traveled streets cross each other, with the intersections a very small distance apart. The street, which is to be widened, is the north and south one. It was found that, in order to bring the efficiency of this street at this point anywhere near the efficiency of the street between intersections, it would be necessary to create additional space between its intersection with the east and west street and its intersection with the diagonal street, for traffic to accumulate which flowed through the first intersection and had to await the opening of the second intersection. If sufficient space were not created for this purpose it would result in one of two evils: Either the traffic would accumulate across the first intersection and delay the opening of the cross street or it would

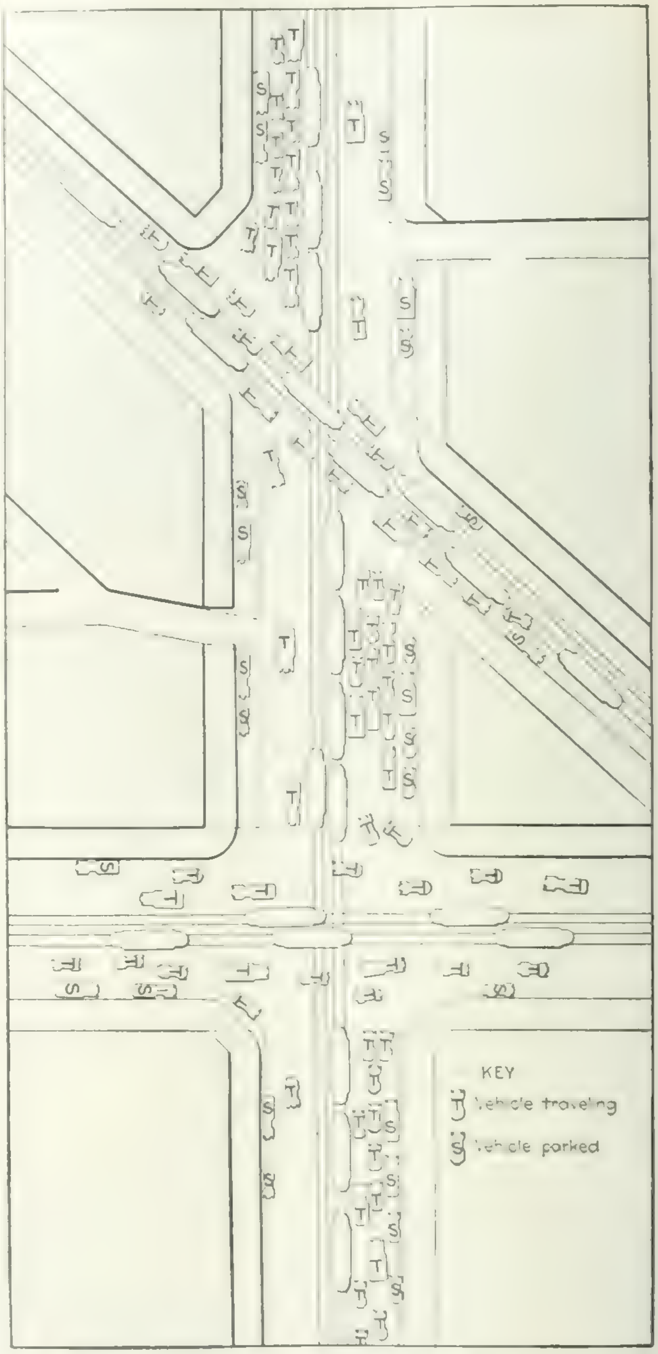

FIG. 3—ARRANGEMENT WHERE TWO INTERSECTIONS ARE CLOSE TOGETHER

Street is widened between intersections to provide a reservoir for vehicles which have passed the first intersection and are waiting for the second intersection to be opened.

have to wait on the near side of the first intersection and be delayed during another traffic interval. Calculations were made from traffic data and it was found that the additional space provided would raise the efficiency of this intersection to approximately that of the other intersections along this street.

No special treatment was made at this point to care for turning traffic because of the predominance of through traffic on all three streets. The additional widening on the east side of the street north of the diagonal was to allow the traffic which had closed up into three lines, to make a quick get-away and sort itself out to accommodate itself to the narrower roadway beyond.

Rules for Rivet-Hole Deductions in Tension Members

Simple Formulas for Equal-Stress and Equal-Area Methods Derived—How They Compare in Practical Application

BY VICTOR H. COCHRANE
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THERE has recently been considerable discussion in regard to the proper deductions for staggered rivet holes in tension members, but it appears that no satisfactory conclusions have been reached. The writer desires to make some further observations on the subject, in the hope that the definite and simple working rules proposed herein may aid in securing general acceptance of the method of fractional deductions.

The so-called theoretical method of allowing for the effect of staggered rivets, proposed by the writer in *Engineering News* of April 23, 1908, p. 465, assumes in effect that transverse and zigzag sections are equal in strength when the maximum tension, considering the effect of shear, is the same in both sections (equal-stress method). Another rule in common use assumes the equality of strength when the transverse and zigzag sections are of equal area (equal-area method). The former requires the greater stagger for equal deductions.

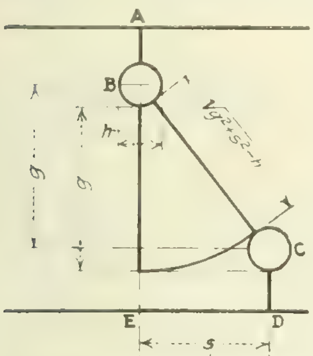


FIG. 1—MINIMUM STAGGER OF RIVET HOLES

There has been some controversy as to whether the equal-stress method is in accordance with experimental results. Edward Godfrey, in your issue of Aug. 31, 1922, p. 366, contends that this rule gives excessively large deductions, and that tests made by him prove the correctness of the equal-area rule. These claims are controverted by Prof. C. R. Young in your issue of Sept. 21, 1922. It seems worth while therefore to show by examples just what the difference in the two rules amounts to, expressed in percentages of the gross section.

Whichever of these two rules may be considered correct, there is no question as to the desirability of making fractional rivet hole deductions when the stagger is less than that required for zero deduction. It will be shown that this can be done with equal facility by either method; a simple formula can be written in either case, a single diagram will suffice for any and all sizes of rivets, and if desired the deductions may be found by a simple graphical method.

Consider first the equal-area rule. In Fig. 1 the net section along the diagonal is $\sqrt{g^2 + s^2} - h$, in which g is the gage, s the stagger and h diameter of rivet holes. If the net area of the transverse section ABE is equal to that of the diagonal section $ABCD$, it is evident that this quantity must be equal to g, whence

$$s = \sqrt{2gh + h^2} \qquad (1)$$

This is the well-known formula given in handbooks to show the relation between s and g required to maintain net section. On the basis of the fractional-hole method of computing the allowance for staggered rivets, as advocated by T. A. Smith and Professor Young, the value of s given by Eq. (1) is that value for which no deduction from the transverse section is to be made.

It can be shown that under the equal-stress hypothesis Eq. (1) gives that value of s for which the deduction is half of a rivet hole, instead of zero as in the case of the equal-area rule.

Let w be the width of strip to be deducted from the transverse section on account of a staggered rivet hole. It is evident that when s is equal to zero, the width w is equal to h. As s increases, w decreases, slowly at first and then more rapidly. It seems reasonable to assume that the decrement of w, as s increases, varies as the square of s, hence we may write

$$w = h - cs^2, \qquad (2)$$

in which c is a constant.

Therefore if in accordance with the above assumption we substitute $h/2$ for w and $\sqrt{2gh + h^2}$ for s in Eq. (2), we obtain the equation

$$h/2 = h - c(2gh + h^2),$$

whence

$$c = \frac{1}{4g + 2h}$$

and

$$w = h - \frac{s^2}{4g + 2h}$$

Since the term $2h$ in the denominator is comparatively small we may for practical purposes simplify the above formula by omitting it, thus reducing the equation to

$$w = h - \frac{s^2}{4g} \qquad (3)$$

This formula gives the width to be deducted on account of a staggered rivet and it is recommended for practical use. Although much simpler than Professor Young's formula, or the substitute therefor proposed by the writer in your issue of July 6, 1922, it gives results in remarkably close agreement with the so-called theoretical formula as derived by Professor Young.

Proceeding in a similar manner the equal-area rule gives the following formula for fractional deductions:

$$w = h - \frac{s^2}{2g + h}$$

Substituting for h in the denominator of the last term an average value of 1, we have

$$w = h - \frac{s^2}{2g + 1} \qquad (4)$$

This is the formula proposed for use in making fractional deductions by the equal-area rule.

Comparing equations (3) and (4), it will be seen that they give practically the same deductions for small values of s; but as s increases, the negative term increases almost twice as fast in the equal-area formula as in the equal-stress formula. Either formula will give consistent results. The maximum difference in the deduction for one hole by the two formulas is nearly half a rivet hole, but it will usually be less than this.

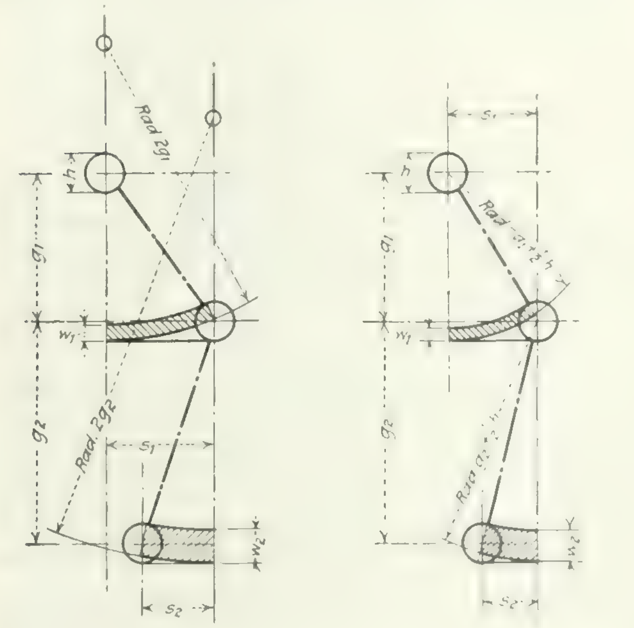
The width w to be deducted in any case can be determined by a simple graphical method. Thus in Fig. 2 the shaded strip w_1 is the deduction for the rivet having

stagger s_1 and gage g_1. The width w_1 is that portion of the diameter h intercepted by an arc of radius $2g_1$ in the position shown. Fig. 3 shows a similar construction for the equal-area method, the arc being concentric with the last rivet and having a radius equal to $g + \frac{1}{2}h$.

A single diagram giving values of the last term of formula (3) or (4), the decrement of h, will suffice for any diameter of rivet, thus making the method of fractional deductions more convenient in practical use than if a separate diagram were required for each size of rivet.

Some examples will now be given showing the difference in net section by the two rules, using equations (3) and (4) to compute the deductions.

First take the case of a 12 x ½-in. plate having two rivet holes on a transverse line, located 1½ in. from each edge, with a staggered rivet on the center line. Assuming ⅞-in. rivets, h is equal to 1. The gage g is equal to 4.5 in. The maximum deduction along the



FIGS. 2 AND 3—RIVET-HOLE DEDUCTIONS BY GRAPHICS

transverse line $= 2h = 2$. The following table shows the deductions along the zigzag line through the staggered hole for various staggers; also the difference in net areas expressed as percentages of the gross area:

Stagger in Inches	Deductions Along Zigzag Line Computed by Equal-Stress Formula	Equal-Area Formula	Maximum Deductions By Equal-Stress Method	Equal-Area Method	Differences Width in Inches	Per Cent Of Gross Width
1.0	0.94	0.90	2.88*	2.80	0.08	0.6
1.5	0.87	0.78	2.74	2.56	0.18	1.5
2.0	0.78	0.60	2.56	2.20	0.36	3.0
2.25	0.72	0.49	2.44	2.00	0.44	3.7
2.5	0.65	0.38	2.30	2.00	[illegible]	2.5
3.0	0.50	0.10	2.00	2.00		
3.5	0.18	0.00	2.00	2.00		
4.0	0.11	0.00	2.00	2.00		

* 1.00 + 0.94 + 0.94 = 2.88

In this case the maximum difference is 3.7 per cent of the gross section.

Consider now the built-up section shown in Fig. 4. By the equal-stress formula (3) the net section is computed thus:

	Gage g	Stagger s			
Angles,	4½	1½	2 x 1⅛ − 0.13 x ½ x 4		4.24 sq.in.
30-in. x ½-in. plates,	First hole		1⅛—0	1.125	
	2	3	do.—1⅛		
and	3¼	3	do.—0.45		
	5¼	0	do.—0	1.125	
	5	3	do.—0.45	0.675	
	5	0	do.—0	1.125	
	5	3	do.—0.45	0.675	
	5¼	0	do.—0	1.125	
				8.780 x ½ x 2	8.78 sq.in.
18-in. x ½-in. plates				3.600 x ½ x 2	3.60 sq.in.
Total deductions					16.62 sq.in.

Net section, 82.00 − 16.62 = 65.38 sq.in.

By the equal-area formula (4) the deductions are as follows:

Angles..............	4.04 sq.in.
30-in. plates	7.66 sq.in.
18-in. plates	2.86 sq.in.
Total...........	14.56 sq.in.
Net section..	67.44 sq.in.

Hence the difference in net section as computed by the two formulas is 2.06 sq.in., or 2½ per cent of the gross section.

The equal-area rule as generally applied requires no deduction if the stagger is as great as $\sqrt{h^2 + 2gh}$, but for any lesser stagger a full hole must be deducted. On this basis the deduction would be as follows:

Angles, 8 holes out	4.50 sq.in.
30-in. plates, 12 holes out	10.12 sq.in.
18-in. plates, 8 holes out	4.50 sq.in.
Total	19.12 sq.in.

This is a greater deduction than that obtained by either of the fractional-deduction formulas. This shows the importance of making fractional deductions rather than counting out the entire hole or none.

The differences in results by formulas (3) and (4) are so small that there seems to be no prospect of conclusively establishing by experiment the correctness of

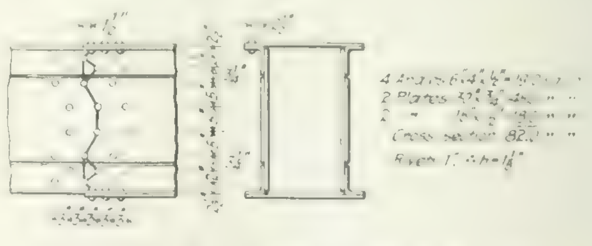


FIG. 4—BUILT-UP MEMBER: A COMPLEX CASE OF COMPUTING NET SECTION

either formula as compared with the other. The equal-stress rule is preferred by the writer because it has some theoretical basis and is somewhat more conservative than the equal-area rule. On the other hand it requires much less reduction of area, or much smaller staggers for the same reduction, than does the common rule requiring 30 per cent excess diagonal area for equal transverse and diagonal strength.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

A Notable Work on Tunneling

By CLIFFORD M. HOLLAND
Chief Engineer, New York-New Jersey Vehicle Tunnel Commissions

SHIELD AND COMPRESSED AIR TUNNELING—By B. H. M. Hewett, M. Am. Soc. C. E., M. Inst. C. E., Director, Jacobs & Davies, Inc., New York, Consulting Engineers, sometime engineer on the construction of the Central London Railway, of extensions to the City & South London Railway, of the Hudson River Tunnels for the Pennsylvania R.R., New York, and of the Laxaxalpam Aqueduct Tunnels for the Mexican Light & Power Co., in the State of Puebla, Mexico; and S. Johannesson, M. Am. Soc. C. E., sometime engineer on the construction of the Islington extension to the City & South London Railway, of the Pennsylvania Railroad Tunnels, New York, and of the Manhattan Elevated Railroad improvements and extensions for the Interborough Rapid Transit Co., New York. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 465. $5.

"Shield and Compressed Air Tunneling" deals with the difficult work of tunneling through soft or water-bearing ground by the use of the shield with or without compressed air. The authors are qualified by years of experience on this sort of work to handle the subject adequately, and they are to be congratulated both as to the plan and scope of the book and on their close adherence to their subject. They have amplified many points in regard to which information heretofore has been meager, and have endeavored to put shield tunneling on a "rational" basis and to eliminate as far as possible the many indeterminate factors that enter into tunnel design and construction. The volume presents many details of tunnel construction which up to the present time have been entirely omitted from the books on this subject. The text is very clear; the thoughts of the writers come easily, and the diction is unusually good; numbered paragraphs in bold face captions make the book easy for reference.

The first few chapters have to do with the general subject of tunneling, in which is included a condensed history of shield-driven tunnels. Here the reader can obtain at a glance a brief summary of each tunnel, which can be amplified, if he is sufficiently interested by reference to the entries in the bibliography at the end of the book. This feature alone makes the book invaluable to the tunnel engineer.

The description of the mining operations involved in driving a timbered heading is very clear and should give the neophyte a ready grasp of the detail operations. The American and English timbering systems are described without unduly complicating the subject. The systems described are typical and sufficient for the information of the reader. The discussion of the size and shape of tunnels is noteworthy. A folder gives at a glance the cross sections and profiles of many tunnels.

The treatment of the design of tunnel linings introduces much new matter which has not previously been available. A number of points have been raised with which all will not agree. The presentation of the theory used in the development of the formulas suffers from the same ailment that has affected many other books of similar character; that is, the authors take too much for granted in assuming that their readers are able to follow their discussion. It would be far better to omit the development of equations for determining bending moments and thrusts than to present it in such fashion that the reader becomes hopelessly puzzled and must go elsewhere for explanation. Such developments should be given in their entirety or not at all. The endeavor to wade through an incomplete presentation, hunting for clues to pick up the thread of its development, not only irritates the reader, but beclouds the question.

The authors assume as a basis for determining the external loads on the tunnel lining the full hydrostatic pressure with the submerged weight of the heavier material. The case might arise in which the material might not be pervious, in which event its full weight should be taken and the water superimposed. This will not affect pressures acting vertically, but it will affect the horizontal thrusts, according to Rankine's theory of earth pressures, which they use. For example, the first case would apply more nearly to the material under the East River, while the second case probably would apply more nearly to the Hudson River silt. The second case would give larger bending moments in the structure, depths and angles of repose remaining the same in each case. The authors state that limiting values of pressures have been used whenever the uncertainties of earth pressures have not permitted a definite value to be assigned. Where is there any certainty of earth pressures in tunneling?

The design of a tunnel lining is very largely empirical, due to the uncertainty of loading both during and after construction. The authors have recognized this, but they very properly have emphasized the value of theoretical analyses based on various assumed loadings. These may never be realized in practice, yet they serve as a useful guide to obtain a consistent design.

There are many points raised in connection with the design of tunnel linings with which the reviewer is not in agreement; for example, in discussing the unit stress in bolts, the authors state that the use of steel with high elastic limit does not decrease the elongation, because the modulus of elasticity is about the same for all grades of steel. They argue, therefore, that in order to keep the elongation of bolts and the deformation of the lining as small as possible, the maximum stress in the bolts should be kept low.

It should be remembered that the function of the tunnel bolts is twofold: first, the bolts are used to draw the segments together so that the iron may be built to a true circle, and, second, the bolts resist the tendency of the ring to deform. The higher the initial stress in bolting, the less will be the allowable stress to resist deformation. If a low carbon steel is used, say with an initial stress due to the bolting of 5,000 lb., the distortion will be uniform up to an elastic limit say of 30,000 lb. Now, in the case of a high elastic-limit steel, say with an elastic limit of 80,000 lb., there is an ample margin for distortion even though the initial bolting stress is 30,000 lb. The use of high-tensile steel for the bolts, with a consequent reduction in diameter, permits of placing them more advantageously in the end flange and permits an initial tightening of the bolts far in excess of anything possible with low-tensile steel. The more advantageous location of the

bolts and the higher initial bolt tightening materially reduce the final stresses in the cast iron, so that aside from the resulting saving in cost there are other decided advantages in the use of bolts with a high elastic limit.

Recent experience in cast-iron tunnel building has emphasized the necessity of strong joints, due to the fact that as the iron leaves the shield it is subjected to eccentric loadings and conditions which cannot be predetermined or definitely provided for in design. In general, the application of formulas given in the book for arriving at the bolt stresses as well as the moments and thrusts in the tunnel lining produces results that diverge widely from those obtained in the detail investigations of the lining for the design of the Hudson River Vehicular Tunnel. One might gain the impression from reading the chapter on design that a subaqueous tunnel may be directly and completely designed by the application of a few formulas.

Considerable space is devoted to tunnel plant and construction, which is extemely well handled and of value to the construction engineer. The data in regard to tunnel costs are of necessity meager, and can be taken only as an indication of relative costs under similar conditions on similar work.

The chapter on surveys contains much of value to the young engineer because of its many valuable lessons in precise surveying. Some of the methods described appear to be unduly complicated, but there is no question as to their giving correct results. The practice during recent years has been to simplify; for example, the method described in the book for throwing lines through a tunnel lock was not used on any of the rapid-transit tunnels under the East River. There the transit was always set up in the lock and ranged into line, the nearer point being immediately outside the lock and just within the focal distance of the transit. This, however, is a mere detail in survey work and is simply another way of accomplishing the same thing. The chapter on surveys is the best presentation of this subject that has yet come to the writer's attention.

The discussion of compressed-air illness contains the latest data on this subject. The great fund of information given in small space is sufficient for the purposes of the engineer. If the reader seeks more, he can refer to the medical and other works listed in the bibliography.

Altogether Messrs. Hewett and Johannesson have rendered a service of great value to the tunnel-building profession. The young engineer will find the book of particular value, for by a careful study of its contents he will acquire a fundamental knowledge of many phases of the work hitherto known only to the experienced engineer.

A Notable Regional Planning Survey

SOUTH WALES REGIONAL SURVEY COMMITTEE. Report to Ministry of Health—[Among others on the committee were Patrick Abercrombie, Professor of Town-Planning and Civic Design, University of Liverpool; D. M. Jenkins, Assoc. M. Inst. C. E., Borough Engineer of Leath; E. H. Swain, Assoc. M. Inst. M. E., Transport Commissioner for Wales. [illegible] Chappell, of the Ministry of Health, was secretary.] London: H. M. Stationery Office. Paper; 6 x 9 in.; [illegible] folding maps. 3s 9½d. postpaid.

The committee mentioned above was created in 1920 to report on "the distribution and location of the houses to be built with State aid" in the South Wales coal fields, with regard to: The "health and convenience of the industrial population"; the physical and industrial conditions of the region and its probable future development; and transit facilities, water supply, sewerage and like services. All these things are considered in a broad and enlightened way. Among the recommendations made are: Location of future housing accommodations in groups, away from the collieries, with a fast train service between housing areas and industrial centers; new arterial roads, carefully planned; readjustment of "local authority boundaries"; a regional water-supply board to supply water in bulk to local authorities; valley trunk sewers with ocean outfalls; linking up of gas and electric supplies; division of whole region into four joint town-planning districts, under supervision of a single regional town-planning board; a regional council similar to the London County Council. Recreational spaces, garden allotment areas, the development of Portcawl as a health center, bathing facilities at colliery mouths and steps to diminish river pollution are also advised.

Among the representatives of 22 local governing bodies examined as witnesses by the committee there were 20 engineers.

Electric Traction for Trunk Lines

RAILWAY ELECTRIC TRACTION. By F. W. Carter, M.A., M. Inst. C.E., M.I.E.E., Assoc. A.I.E.E. New York: Longmans, Green & Co. London: Edward Arnold & Co. Cloth; 6x9 in.; pp. 412. $8.50 net.

This is a textbook on electric traction for trunk line railways, directed especially to the electrical engineer, but nevertheless handling in helpful fashion some of the problems of electrification that concern construction, maintenance and operation. The author has set himself a two-fold task: First, to discuss the methods of electric traction as applied to railways, and second, to expound methods of technical calculation applicable to the subject.

After an introductory review of the state of the art, in the course of which American experience has been freely drawn upon, Mr. Carter takes up the design and characteristics of electric locomotives. The conventional description of types has been supplemented by mathematical treatment of many of the fundamental problems involved in the design of running gear and in determining the forces brought to bear on the track. Next are taken up the electrical and mechanical characteristics of the various types of railway motors, together with a discussion of their performance in service and of the several systems of control.

Under "Distribution System" are discussed the questions of type of conductor, electrolysis, boosters, sectionalizing, collector-gear, and interference with neighboring conductors. The generating station is treated briefly while the substation is considered at length. Considerable attention is given to the mercury vapor rectifier and the automatic substation. In his chapter on "Systems of Electrification" Mr. Carter reveals himself as an out-and-out champion of direct current as opposed to alternating current, and the latter is discussed mainly to recount its deficiencies.

A large section of the book is devoted to the mechanics of train driving, with analyses of tests that have been conducted both in Europe and in the United States to determine tractive resistance. These are discussed exhaustively and methods are developed to estimate energy consumption and motor heating under given tractive conditions. Mr. Carter also offers calculation to determine the performance of a given train with stated motor equipment to ascertain the most suitable

equipment for a particular service. In an appendix the book gives detailed characteristics and dimensions of thirty-two electric locomotives that have been in operation in England, on the continent and in the United States.

For the engineer who is willing to dig into basic principles and to study mathematically the fundamental problems of railroad electrification, Mr. Carter's book will be helpful and stimulating. It is in refreshing contrast with the many books that confine themselves to a purely descriptive treatment.

Principles of Architectural Drafting

ARCHITECTURAL DRAWING—By Wooster Bard Field, Architect, Assistant Professor of Engineering Drawing, The Ohio State University; With an Introduction and Article on Lettering by Thomas E. French, Professor of Engineering Drawing, The Ohio State University. New York and London: McGraw-Hill Book Co. Cloth; 10 x 12 in.; pp. 161; illustrated. $4.

The smallest engineering office and every engineering draftsmen have to make architectural drawings now and then. To such this volume will be useful for reference or self-instruction, besides serving its primary purpose in school and college work. The book will have all the stronger appeal to engineers because it has been prepared by professors of engineering drawing in one of our large universities.

Commendable is the mode of approach. The first plate and text show simply and clearly "the two general methods of representing an object having three dimensions on a sheet of paper which has only two dimensions"—(1) pictorial drawing, including (a) perspective, (b) isometric and (c) oblique drawings, and (2) orthographic projection. From this the work continues with instruments, geometric methods, preliminary sketches (which include pictorial drawing, shades and shadows and rendering), scale and detail drawing, the orders of architecture, the acanthus leaf and lettering. The latter includes inscriptions for tablets, monuments, etc., a matter of occasional importance to engineers, although as a rule best entrusted by them to some specialist where rendering in harmony with other artistic elements of design is essential.

Useful for those who wish to pursue the subject by themselves is an Outline of Study, while for those who wish to go still further there is a classified list of reference books. A glossary and an index complete the volume.

Omissions from the reference list that seem to call for explanation are "The American Civil Engineer's Handbook" (other such books are listed) and Reinhardt's "Lettering." A book dealing with drawing for reproduction, or a reference to a section on this subject in some of the books listed, might well have been given. In fact, this subject deserves more than an entry in the Bibliography even if no more than to call attention to the fact that a drawing made for reproduction should be made with that end in view and that the end may be easily accomplished by following a few simple rules, which could be outlined in a paragraph or two.

The lettering and the illustrations generally in the volume under review deserve praise. The only criticism we venture to make is the too extensive use of capital letters exclusively for long explanatory notes supplementary to the drawings. Where such notes are chiefly utilitarian in character, as they are in most instances in this book, both ease of reading and speed in draftsmanship are better served by the use of caps and lower case.

English for Engineering Students

REVIEWED BY C. W. PARK

Professor of English, College of Engineering and Commerce, University of Cincinnati

TECHNICAL EXPOSITION: A Textbook on the Application of Exposition to Technical Writing, Designed for Students in Scientific, Agricultural, and Engineering Colleges—By Karl Owen Thompson, A.M., Associate Professor of English at Case School of Applied Science, Cleveland, Ohio. New York and London: Harper & Brothers. Cloth, 5 x 8 in., pp. 227. $1.75.

Professor Thompson's book is intended as a guide to the engineering or scientific student in the study and use of English. It is meant to be used as a textbook, and there is evidence throughout its pages that it has been developed and tested in the class room. This does not make the book devoid of interest to the general reader. For those who prefer to ignore the numerous exercises, there is profitable reading in the fifteen chapters of discussion, with their suggestive treatment of topics ranging from the history of language to the writing of specifications.

The author has chosen to treat much of his material broadly and abstractly, on the theory that specific examples are best obtained from current issues of technical periodicals. This view finds justification in the fact that numerous engineering colleges use such journals in the class room as a source of fresh illustrations and as an exemplification of standard practice in the presentation of technical matter. Perhaps out of a spirit of neutrality, the author has refrained from making reference to specific technical journals and has left his questions and exercises general. If there is any considerable defect or incompleteness in the book, it is in this respect. Without unduly lengthening the volume, the author might have cited concrete examples illustrating how journalistic matter drawn from such sources could most effectively be used as an accompaniment to the discussion of general principles. Where special types of writing are discussed, such as the business letter or the advertisement, the illustrations are adequate and effective.

In the main discussion there is much to commend this book both to the college student and to the older reader who wishes to "brush up" on his English by a process of self-instruction. From the standpoint of either, the book is a comprehensive review of the various types of scientific and practical writing and of the rules and principles most often used. As the title indicates, the discussion is limited to "Exposition," but since this form of composition is employed in every variety of technical writing, the range of the book does not suffer by reason of this limitation. The book covers the fundamentals of word study, grammar, punctuation and rhetoric, with emphasis upon definition and analysis. It deals with such types of exposition as translations, paraphrases, summaries, reviews, speeches, letters, articles, advertisements, reports, specifications, contracts, and statistics. The book itself is a good example of exposition. Especially when one considers the scope of its contents and the resulting necessity for a brief instead of a detailed discussion, one is impressed by the judicious selection of standard material covering each topic, and the clear, succinct manner in which the various topics are treated.

Mechanically, the book is well put together. One error in printing should be noted, since it confuses the identity of a man who has written a particularly useful book on English for engineers. The name at the bottom of page 92 should be "W. O. Sypherd" instead of "W. O. Shepherd."

A Field of Higher Mathematics

REVIEWED BY GEORGE PAASWELL
[illegible] Engineer, New York [illegible]

VECTOR CALCULUS WITH APPLICATIONS TO PHYSICS—By [illegible] Shaw, Professor of Mathematics, University of Illinois. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. [illegible]; illustrated. [illegible]

This book treats of a mathematical method that is of growing importance to both pure and applied mathematics. It is essentially a text for graduate students of mathematics and proves to be a sincere attempt to render service in the solution of the many important problems of physical research.

For the student the arrangement of the contents seems to meet the requirements of good pedagogical practice. An excellent historical introduction is followed by both mathematical and physical definitions and includes many well-chosen problems. The author gives with clearness and with brevity the applications of vector analysis to geometry and to the study of the fields of force.

The treatment of quaternions effectively introduces the reader to Hamilton's brilliant conception. Aside from its practical importance, the method is exceedingly interesting reading for its originality. How our mathematical ancestors would marvel at the applications of the imaginary functions—termed by them the impossible quantities! The properties of space are placed in brief symbolic form and the theorems of spherical geometry and trigonometry are compacted into symbols with a simplicity that amazes one familiar with the usual school treatises.

Those interested in the theory of surfaces and hesitating to take up the existing treatises on differential geometry or on the more complex differential equations will find the vector calculus of readier comprehension in the application to such theory.

There is rather complete vector treatment of the mathematical theory of elasticity and of hydromechanics, subjects of enduring importance.

Vector calculus is exceedingly rich in its applications to electrical phenomena but lean in its applications to structural research. The civil engineer must bear the onus of the blame for this condition. His indifference to higher mathematics is proverbial. Nevertheless, the text could have proved of great service to engineers had it analyzed more fully the practical problems of elastic research and dilated in greater detail upon the simpler phases of the vector calculus, such as the study of force polygons, influence lines and the like. There are, again, complicated methods of frame analysis that should receive simpler treatment through use of the vector calculus. The nucleus of all such analysis is contained in the text, but there are few engineers with either the patience or the desire to expand such nuclei. It seems that all advances towards a liaison between engineering analysis and the higher mathematics must be made by the mathematician.

The text is not unreasonably difficult to follow for those mathematically interested, and aside from the practical import of the subject it constitutes an excellent discipline in forming pictures of space properties in a novel symbolism.

Those interested in the theory of general relativity will note with disappointment that no attempt has been made to discuss the tensor calculus of Einstein, nor is any mention made of the absolute calculus. This is all the more unfortunate since these studies remain buried in the proceedings of the foreign scientific societies.

Professor Shaw is to be congratulated upon the publication of so teachable a text, one that is certain to prove helpful to the student. The engineers who can bring themselves to the point of reading it will find much enjoyment and some profit.

Garden City Theory and Practice

TOWN THEORY AND PRACTICE—By W. R. Lethaby, George L. Pepler, Sir Theodore G. Chambers, K.B.E., Raymond Unwin, and R. L. Reiss. Edited with an Introduction by C. B. Purdom. London: Benn Brothers, Ltd. Cloth; 5 x 7 in.; pp. 139; maps. [illegible]

The fact that within two years all municipalities of 20,000 population and more in Great Britain must prepare "town plans" and the consequent desirability of stimulating and directing discussion "about towns and their planning" is given in Mr. Purdom's Introduction as a reason for publishing this book, which is designed "to appeal to the ordinary reader." Continuing he says: "For the purpose of definition the town idea which is implicit in the term 'garden city' has been employed as the basis of discussion."

A garden city, the collaborators agree, is a complete social and industrial municipal unit, including within its geographical limits not only parks but also a permanent agricultural belt, the whole carefully zoned [although that word is used rarely if at all in the book—there is no index] into use districts. Other essential features of the garden city are ownership of the entire area by or in trust for the community; local industries for all the residents and local residences for all the workers; and complete recreational, educational and other social facilities within the city limits. To increase these and the other features "implicit in the term 'garden city'" it is essential that the size of each garden city, both in area and population, be large enough but not too large to ensure a self-contained unit.

The subdivisions and authors are: "The Town Itself: A Garden City is a Town," by Mr. Lethaby; "The Town Plan—planned for industry and healthy living," by Mr. Pepler, president Town Planning Institute; "The Town and the Best Size for Good Social Life—of a size that makes possible a full measure of social life, but not larger," by Mr. Unwin, author of "Town Planning in Practice"; "The Town and Agriculture—surrounded by a permanent belt of rural land," by Mr. Chambers, chairman, Welwyn Garden City., Ltd.; "The Town and Land—the whole of the land being in public ownership or held in trust for the community," by Mr. Reiss, chairman, Executive Committee, Garden Cities and Town Planning Association.

The authors deal chiefly with utopian theories and desires, except for (1) the data about Letchworth and Welwyn, the only towns that the authors present as garden cities actually in existence; and (2) an earnest attempt by Mr. Unwin to discuss in a practical way the optimum size for a city.

Mr. Unwin's chapter and the value of the whole book as a brief, readable, up-to-date presentation of the garden city in theory, with some illustrations from practice, warrant recommending the volume to all who are interested in city planning. Some of the principles advocated are applicable to replanning work and to laying out additions to existing towns, while all are entitled to serious consideration in connection with planning new towns—particularly industrial communities.

Ethics of the Professions and of Business

Engineers seem to agree that if their calling is to be accorded the status of a full-fledged profession it must set up and enforce certain standards of practice generally understood under the term "code of ethics"; and several such codes have been adopted by professional societies. Many engineers however are not thoroughly clear as to the scope of a code of ethics and as to the spirit that breathes life into it.

Everyone interested in the subject will be glad, therefore, to know that the American Academy of Political and Social Science devotes most of the May, 1922, number of its *Annals* (Philadelphia; $1 a number) to a series of contributions on "The Ethics of the Professions and of Business." The discussions cover every profession and several departments of business. Some of them are very practical indeed and describe not only the development of the codes, but also the measures provided for their enforcement.

After an introductory section on the significance of ethical codes for the professions, there are considered, in detail, those of lawyers, doctors, engineers, architects, teachers, librarians, ministers, social workers, journalists and accountants. Commercial and business ethics are then discussed by representative business men who are looking ahead to the day when business may win for itself a professional standing.

The engineers who have contributed are Morris Llewellyn Cooke, consulting engineer; Calvin W. Rice, secretary, American Society of Mechanical Engineers; Frederick Haynes Newell, consulting engineer; Carl Hering, consulting engineer; H. W. Clausen, treasurer, American Association of Engineers; William J. Wilgus, consulting engineer, and A. G. Christie, professor of mechanical engineering at Johns Hopkins University.

PUBLICATIONS RECEIVED

New Books and Revised Editions

THE ALASKAN ENGINEERING COMMISSION: Its History, Activities and Organization—By Joshua Bernhardt—Institute for Government Research; Service Monographs of the United States Government No. 4. New York and London: D. Appleton & Co. Cloth; 6 x 9 in. $1.

A review of the history and activities of the organization that has been carrying on the location, construction and operation of the government railroads in Alaska, together with the collateral operation of coal mines, docks and power plants.

BELT CONVEYORS AND BELT ELEVATORS—By Frederic V. Hetzel, M.A.S.M.E., Member Franklin Institute of Pennsylvania. New York: John Wiley & Sons, Inc. Cloth; 6 x 9 in.; pp. 333; halftones and line cuts. London: Chapman & Hall, Ltd. $5 (25s. net).

THE BUILDING LABOR CALCULATOR—By Gordon M. Tamblyn. Denver, Colorado: G. M. Tamblyn. Flexible binding, containing 58 loose-leaf sheets. $5; monthly service $5 extra.

CEMENTS, LIMES AND PLASTERS: Their Materials, Manufacture and Properties—By Edwin C. Eckel, C.E., Affiliate Am. Soc. C.E.; Fellow, Geological Society of America. New York: John Wiley & Sons, Inc. Cloth; 6 x 9 in.; pp. 655; halftones, tables and line cuts. London: Chapman & Hall, Ltd. $6.50 net.

A COURSE IN ANALYTICAL GEOMETRY—By Paul P. Boyd, Head, Department of Mathematics, University of Kentucky. J. Morton Davis, Professor of Mathematics, University of Kentucky; Elijah L. Rees, Associate Professor of Mathematics, University of Kentucky. New York: D. Van Nostrand Co. Cloth; 5½ x 8 in.; pp. 251; diagrams. $2.40 net.

EXERCISES IN THE ELEMENTS OF DESCRIPTIVE GEOMETRY—By Richard Shelton Kirby, C. E., Associate Professor of Engineering Drawing, Yale University. New York: John Wiley & Sons, Inc. Cloth; 7 x 10 in.; pp. 49; diagrams. London: Chapman & Hall, Ltd. $1 postpaid.

MANCHURIA: Land of Opportunities—Compiled and published by Thomas F. Logan, Inc. New York: South Manchuria Railway Co., 111 Broadway. Boards; 6 x 9 in.; pp. 113; halftones, diagrams and a map.

Contains chapter on railway mentioned above.

THE PETROLEUM AND ALLIED INDUSTRIES: Petroleum Natural Gas, Natural Waxes, Asphalts and Allied Substances and Shale Oil—By James Kewley, M. A. (Cantab.), F.I.C., F.C.S. New York: D. Van Nostrand Co. Cloth; 5½ x 8½ in.; pp. 302; line cuts. $3.50 net.

A British book dealing with the origin, characteristics, uses, etc., of the materials indicated. American materials and literature are freely mentioned

A PRACTICAL TREATISE ON SUSPENSION BRIDGES: Their Design, Construction and Erection—By D. B. Steinman, A.M., C.E., Ph.D.; Consulting Engineer; M. Am. Soc. C.E., M.A.R.E.A; formerly Professor in charge of Civil and Mechanical Engineering at the College of the City of New York. With Appendix: Design Charts for Suspension Bridges. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Limited. Cloth; 6 x 9 in.; pp. 204; 62 line cuts and halftones. $4 net.

RAILROAD CONSTRUCTION: Theory and Practice—By Walter Loring Webb, M. Am. Soc. C.E., M.A.R.E.A., Assistant Professor of Civil Engineering (Railway Engineering) in the University of Pennsylvania, 1893-1901. New York: John Wiley & Sons, Inc. Flexible binding; 4¼ x 7 in.; pp. 845; including two hundred pages of logarithmic tables; halftones and line cuts. $5.

RAILROAD FREIGHT TRANSPORTATION—By L. F. Loree, President Delaware & Hudson Co., Chairman Kansas City Southern Railway Co. New York: D. Appleton & Co. Cloth; 5½ x 8¼ in.; pp. 771; halftones and line cuts. $5.

Reports and Pamphlets in Various Fields

ADMINISTRATIVE CONSOLIDATION IN STATE GOVERNMENTS—By A. E. Buck, National Institute of Public Administration, New York Bureau of Municipal Research. New York City: National Municipal League. Paper; 7 x 10 in; pp. 40; line cuts.

Summarizes and comments on reorganization of the admistrative government of a number of states, both proposed and accomplished. A revision of an earlier pamphlet.

ANALYSES OF MINE AND CAR SAMPLES OF COAL: Collected in the Fiscal Years 1916 to 1919—By Arno C. Feldner, Walter A. Selvig and J. W. Paul. Washington: Bureau of Mines. Paper; 6 x 9 in.; pp. 391.

EXCAVATING MACHINERY USED IN LAND DRAINAGE—By D. L. Yarnell, Senior Drainage Engineer. Washington, D. C.; Bureau of Public Roads. Paper; 6 x 9 in.; pp. 49, illustrated.

Revision of a paper first issued in 1915. Describes types, compares kinds of power available, and has section on analysis of cost data.

IOWA ENGINEERING SOCIETY: Proceedings, 1922—Des Moines: Lloyd A. Canfield, Secretary. Paper; 6 x 9 in.; pp. 150. 50c.

IRRIGATION PRACTICE AND WATER REQUIREMENTS FOR CROPS IN ALBERTA—By W. H. Snelson, Senior Irrigation Specialist. Ottawa, Ont.: Canadian Reclamation Service. Paper; 7 x 10 in.; pp. 59; illustrated.

LE TUNNEL DU SIMPLON: Sa Construction, Son Achévement, 1898-1921. New York: F. Dossenbach, Official Information Bureau of Switzerland, 241 Fifth Ave. Paper; 6 x 9 in.; pp. 47; line cuts.

MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH: Annual Report for the year ending November 30, 1920—Boston. Cloth; 5½ x 9 in.; pp. 393; line cuts.

PAVING BRICK STANDARDIZATION—Simplified Practice Recommendation No. 1 Paving Bricks. Washington, D. C.; Bureau of Standards Paper; 6 x 9 in.; pp. 9. 5c. from Superintendent of Documents, Washington, D. C.

Summarizes Washington Conference of Nov. 15, 1921, called by the National Paving Brick Manufacturers Association under the auspices of the Department of Commerce. (2) Contains Department recommendation for reduction in number of sizes and varieties of paving brick in accordance with a second conference held March 27, 1922, the approval by Secretary Hoover being "subject to regular annual revision by similar conferences."

RESULTS OF SOME COMPRESSION TESTS OF STRUCTURAL STEEL ANGLES; Technologic Papers, Bureau of Standards, Washington, D. C., No. 218—By A. H. Stang, Associate Physicist and L. R. Strickenberg, Assistant Mechanical Engineer. Paper; 7 x 10 in.; pp. 11; halftones and line cuts. 10c. from Superintendent of Documents, Washington, D. C.

SANITATION OF BATH HOUSES—By William Paul Gerhard, C. E., Consulting Sanitary Expert. New York: William T. Comstock Co., 23 Warren St. Paper; 8 x 10 in.; pp. 16; halftones and line cuts. 60c.

STATE DEBTS: A Record and Analysis Compiled and Published by The Bank of North America, New York City—Paper; 11 x 9 in.; pp. 74; illustrated.

Gives gross outstanding debts by dates of issue and maturity, amounts, purpose and interest rate; contains summaries and diagrams.

TREND OF PUBLIC ACCIDENTS IN THE UNITED STATES: Report of the Committee on Public Accident Statistics, Public Safety Section, National Safety Council, for the year 1922—Chicago: National Safety Council, 168 North Michigan Ave. Paper; 6 x 9 in.; pp. 31; line cuts.

Analyses and comments on 1920 figures; also gives automobile and some other statistics for 1921, in comparison with similar figures for England.

UNION SCALE OF WAGES AND HOURS OF LABOR MAY 15, 1921: August Bulletin of the United States Bureau of Labor Statistics, No. 302—Washington D. C. Paper; 6 x 9 in.; pp. 219.

Besides figures of the date named for various cities, gives comparative figures for the years 1907 to 1921.

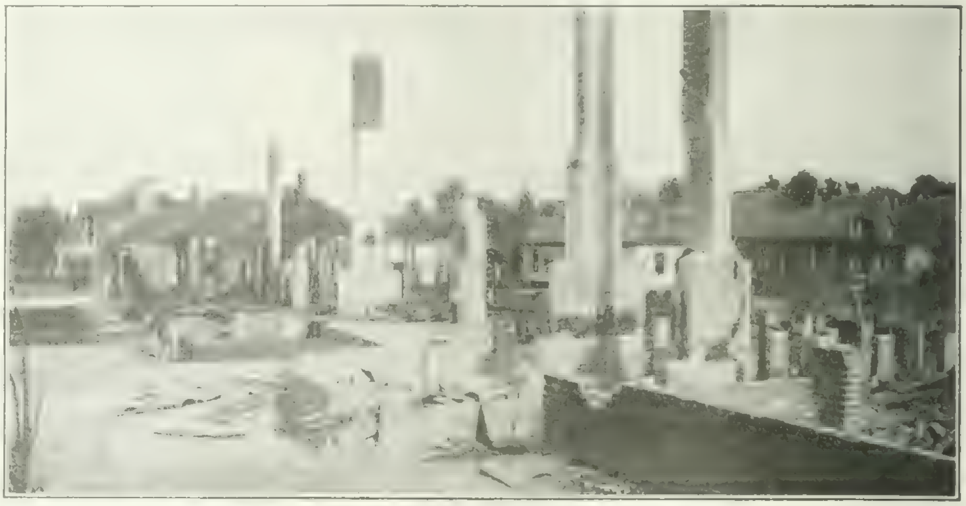
Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Fire Hazard of Wood Shingles and Prepared Roofings

Sir—The discussion under way in your journal dealing with the controversy between the fire prevention interests and patent roofing manufacturers and the shingle industry has greatly interested us. Naturally we feel that those who are using every endeavor to prohibit the use of our product for any and every purpose are quite unjustified in their efforts, since we feel that, generally speaking, their claims are based on theory rather than on actual experience and practice in the use of roofing materials.

In the first place, the standards established by the National Board of Fire Underwriters through tests made at their laboratories (the Underwriters Laboratories, Chicago) are based on purely theoretical lines. The tests, grading the various types of roofing into classes A, B, and C, representing certain degrees of comparative fire-resistance, are made largely upon newly manufactured material, without giving consideration to the durability of these various materials. Evidently it is assumed that the various ingredients comprising the compounds used in the manufacture of prepared roofing material have the same value and durability in combination that they have separately. But experience has developed that this theory does not hold, because under the action of the elements much of the material listed under Classification C, of the Underwriters' tests, has developed after five or more years of exposure to the weather a very definite fire hazard on a roof.



ONE VIEW OF THE ATLANTA CONFLAGRATION

There are four different grades or qualities of prepared roofing today: roll roofing, four-in-one shingles, standard shingles, and jumbo shingles, each of these four being given a certain classification as to fire resistiveness. Then, too, there are culls, or what is known as B grade prepared roofing, which is not included in the four above named grades, which is not approved as being fire resistive in Class C of the Underwriters' rating. The Red Cedar Shingle is graded also in seven standard grades, as follows:

Star A Star	6 butts measuring 2 in.,	16 in. long
Star A Star	5 butts measuring 2 in.,	16 in. long
Extra Clears	5 butts measuring 2 in.,	16 in. long
Perfects	5 butts measuring 2 in.,	16 in. long
Eurekas	5 butts measuring 2 in.,	18 in. long
Perfections	5 butts measuring 2¼ in.,	18 in. long
Royals	4 butts measuring 2 in.,	24 in. long

These represent the seven grades of shingles manufactured today, none of which grades includes culls. Each of these grades has a different degree of fire resistance, largely dependent upon the nature of the grain.

The four grades Star A Star 6/2, Star A Star 5/2, Extra Clears 5/2, and Eurekas 5/2 contain what is commonly known as slash grain material, in different percentages. Slash grain shingles cannot be depended upon to remain flat, because with varying moisture there is a tendency to curl and so lift their corners from the body of the roof that they cause open spaces under the shingle, in which sparks at times may light and, fanned by a stiff breeze, ignite the shingle.

The grades called Perfects, Perfections and Royals contain edge grain material, because of which atmospheric changes in no way affect the flatness of the shingle on the roof and do not cause turning up of the corners with the possibility of holding sparks in spaces. These shingles have a degree of fire resistance required in semi-congested districts in large residential areas. The 18-in. shingles, being somewhat thicker at the thick end, have an increased fire resistance, and so in proportion do the 24-in. shingles, which are ½ in. thick at the thick end. This comparative fire resistance of the wooden shingle has never been taken into consideration by the fire prevention fraternity, who have maintained that *all* shingles, whether thick, thin, flat grain or edge grain, are "the greatest fire menace of the day."

It has been our experience, as well as the experience of many of the best-known and most reliable builders of the country, that a good grade of red cedar shingles carries with it a degree of fire resistance equal to if not more than that of other roofings theoretically given a classification in Class C, Underwriters' rating. The species of wood made into shingles are red cedar, redwood, yellow pine, cypress, white cedar, white pine, and oak. In quality the red cedar shingle represents approximately 85 per cent of the total. In years past the white cedar shingle was used largely in the North and Middle West, while the yellow pine shingle was used to a great extent on cheaper construction in the southern and eastern States. The action of these species of roofs varies materially, and while we do not wish to enter into any discussion of the comparative value of shingles made from these various species, the fact that red cedar shingles are the ones largely used at the present time would seem to indicate that their suitability and adaptability to roofs needs no argument.

The statement made by the Underwriters that "wood roofs are the chief sources of conflagrations" is very much exaggerated, as statistics of the great conflagrations of our age will bear out. We cannot agree that wooden shingles, more than any other Class C roofing, as dictated by the Underwriters, are responsible for what conflagrations may have been recorded as caused by wooden roofs, for most of our conflagrations in the past have covered the congested or business districts of our larger cities, and those which can be at all attributed to the wooden roofs have occurred in the southern states, where red cedar shingles do not predominate.

The fact that many of our older communities have roofs which have been in place for 35 years or more and are in excellent condition should not be overlooked as evidence of the durability of the wooden roof. The fact that shingle roofs predominate in residential districts throughout the

country should also be taken into consideration when we make the statement that there are fewer fires on roofs which are covered with material other than wooden shingles.

The guaranteed life of prepared roofing does not exceed 15 years and were the roofs in North America now covered with wooden shingles covered with prepared roofing, 15 year old or more, the fire hazard presented by these roofs would be something appalling. From this analysis, it is clear that the comparison made by fire preventionists and prepared roofing manufacturers with their own new roofings against an old shingle roof is not only unfair, but an unreasonable comparison. The Red Cedar Shingle Association has made many public tests at different points about the country which have proved that the fire hazard of a good shingle roof as compared to that of many of the products of prepared roofing manufacturers is far less. Many of these tests have shown that a fire brand has burned out on a new shingle roof where it has completely consumed, not only the roofing material, but the boarding underneath the same, of a prepared roofing product.

The Red Cedar Shingle Association feels, and is justified in so doing, that the fire underwriters are very much biased in their attitude toward our product and other products of wood, and are unreasonable in not classifying certain grades of our material in Class C roofing specifications, in which they classify certain grades of prepared roofing, which carries a very plainly evident fire hazard. If wooden shingles, as a class, carried the fire hazard that the fire underwriters claim, it is sufficient to prohibit their use entirely in certain communities, and it is quite illogical for them not to differentiate more between the rates charged for Class C roofing as against those charged for houses covered with wooden shingles, for these rates now vary from 5 to 10 cents in different localities.

Referring to the communication from the National Board of Fire Underwriters printed in your Aug. 3 issue, p. 201, which makes particular reference to the Atlanta conflagration: It is easy to prove anything by photographs. The view herewith shows a photograph taken just one block south of the house illustrated in your magazine, where the hazard was just as great. All roofs shown in this photo are covered with wooden shingles.

R. S. Whiting,
Sec'y, Shingle Branch,
West Coast Lumbermen's Association.
Seattle, Wash., Oct. 5.

Hydraulic Jump Formulas

Sir—In a letter in your issue of June 1, p. 923, Karl Kennison quotes a simplification of the Unwin formula, which he finds convenient and accurate enough in practice. He may be interested in my way of using the Unwin formula itself, which I find more convenient than his approximation.

Substituting h_1 for $V_1^2/2g$, the Unwin formula becomes

$$4h_1d_1 = d_2(d_1 + d_2)$$

To solve this:—mentally multiply by 4 either h_1 or d_1, whichever is more convenient; reverse the slide of a slide rule and bring this product against the other quantity, that is bring them together under the cursor; then if we move the cursor, any other pair of readings simultaneously under the cursor multiplied together will give the same product; and if we move the cursor till we find such a pair of readings whose difference $= d_1$, then the smaller of these two readings will $= d_2$.

Thus, if in an example $h_1 = 1.83$ and $d_1 = 0.75$, we have to set 3 against 1.83 we shall then find that 2 comes against 2.75, so that $d_2 = 2$.

Incidentally, the slide rule can be used in similar ways to solve any quadratic or cubic equation.

Another adaptation of the Unwin formula can be used to give the discharge; but the difficulty of measuring depths of water accurately makes it rough

$$Q^2 = g/2d_1d_2(d_1 + d_2)$$

The Unwin formula referred to by Mr. Kennison and adapted in two ways above applies to standing waves on smooth level floors.

As far as concerns roughness, such observations as I have been able to make seem to indicate that calculation by the formula allows for total loss in the wave, and that any increase of friction loss is balanced by a decrease of eddy loss in the stream.

But the said formula is a simplification of a fuller form containing a term, the drop of a sloping floor in the length necessary to complete the wave. No data that I have seen make it possible to deduce what length of floor should be taken into account. Can any reader of your paper help to fill this gap in our knowledge.

E. S. Lindley,
Research Section, Punjab Irrigation Secretariat.
Simla, India, July 29.

Industrial Sites and Transit Facilities

Sir—Referring to the letter of L. J. Carmalt in *Engineering News-Record* for August 24, 1922, p. 327, entitled "Economics of Selecting Industrial Sites," he truly states, "Freight transportation facilities are generally well studied out but those for passengers are rarely given any attention." There is a glaring example of this oversight right here in the city of Buffalo. Many members of the American Society of Civil Engineers will remember the Pan-American Exposition in 1901. After the closing of this exposition, instead of devoting the entire site to residential purposes, for which it was ideally suited, a large portion was built upon by industrial concerns, the largest being the Pierce Arrow Automobile Co. The vacant land north of the exposition grounds was covered by other manufacturing plants consisting of the Curtiss Aeroplane & Motor Corp., foundries, a large lumber-yard and smaller plants.

Situated farther north is the town of Kenmore, a residential suburb of Buffalo. The building of manufacturing plants in the very heart of a residential district can almost be classed as a calamity, when other sites just as good are available.

Again quoting Mr. Carmalt, "If the workmen have to spend an extra half hour, or pay an extra fare, etc." This is what many of the employees have to do who live on the east side of Buffalo. In many cases an hour each way is required to go to and return from work.

The building of these plants separates two desirable residence districts. It is necessary to cross the plant sites twice daily, creating an everlasting inconvenience.

Where there is a mixed residential and industrial traffic street cars cannot be kept so clean as would be desirable because of the need for so many workmen traveling in their working-clothes. To avoid this, a trial was made in Pittsburgh of separate cars for women, with double fare, but this plan did not prove practicable.

Buffalo, N. Y., Sept. 7. Emile Low.

Too Many Asphalt Grades

Sir—In an editorial in the Sept. 23 issue of *Engineering News-Record*, p. 502, you ask, "Are highway engineers insisting upon too great refinement in their specifications for road work?" Every highway engineer who has thoroughly studied the subject and is fair-minded will, I believe, answer that question affirmatively.

With the enormous paving program which confronts the United States it is high time that the subject of standardizing asphalt paving specifications be given full consideration, particularly as to the hardness requirement. By all means let us return to sanity by establishing a comparatively limited number of degrees of hardness. The national societies and associations whose function it is to standardize such specifications can do a great service to all concerned by so doing.

James M. Owens,
Highway Engineer, Board of Public Works.
San Francisco, Oct. 16.

NEWS OF THE WEEK

New York, November 16, 1922

Highway Research Board to Hold Second Annual Meeting

The Advisory Board on Highway Research of the National Research Council of which Dr. W. K. Hatt is director, will hold its second annual meeting at the headquarters of the National Research Council, 1701 Massachusetts Ave., Washington, D. C., Nov. 23 and 24. On the morning of the first day committee reports will be presented on economic theory of highway improvement, T. R. Agg; structural design of roads, A. T. Goldbeck; road materials, H. S. Mattimore; traffic analysis, G. E. Hamlin; highway finance, J. G. McKay; maintenance, W. H. Root; ways and means, C. J. Bennett.

The evening session will be devoted to technical papers and discussions and plans for the future.

For Nov. 24 visits of inspection to points where research work is in progress by the U. S. Bureau of Public Roads and the Bureau of Standards have been arranged.

Leader of Good Roads Advocates in Senate Is Defeated

Senator Charles E. Townsend, of Michigan, chairman of the Senate Committee on Post Offices and Post Roads, leader of the good roads advocates of the United States Senate, and author of federal-aid road legislation, was defeated for re-election in the general election held Nov. 7. His successor is a Democrat, the first the State of Michigan has had in seventy years.

The original Federal-Aid Road Act whereby a partnership between the federal government and the states in building roads on a basis of profit-sharing was established was enacted in 1916. This bill covered a five-year construction program. When the last of the allotments were made under the 1916 act additional legislation was sought. Against a great deal of opposition Senator Townsend succeeded in carrying through legislation for appropriations for 1921, 1922 and 1923, so that federal aid in the construction of highways could be continued.

Baltimore Adopts One-Branch City Council Plan

A one-branch city council of 19 members in place of the present two-branch council with a total of 39 members was adopted by the voters of Baltimore, Md., Nov. 7, by a vote of about 69,000 to 33,000. Three councilmen will be elected from each of the six districts, and a president will be elected at large. Salaries of councilmen will be increased from $1,000 to $1,500, making a total of $29,500 against $55,250 under the present plan, besides which one set of clerks will be eliminated.

General Election Favorable to Bond Issues Involving Construction Work

New Jersey $40,000,000 Road and Bridge Issue Wins—Election Results From a Number of States

Outstanding features in the election held Nov. 7 of interest to engineers and contractors were the general favorable vote given bond issues for public works improvements, the comparative scarcity of large issues, and the almost universal approval of bond issues involving construction of schools. Though few highway bond issues were voted upon, it is interesting to note that the largest among them—a $40,000,000 issue in the State of New Jersey for roads and bridges—barely received a favorable vote. The unofficial majority cast for the New Jersey bond issue was 14,000, which is considerably under the vote cast for successful candidates.

The New Jersey bond issue makes available $5,000,000 per year for the completion of the state highway system as laid out, and $3,000,000 per year for necessary bridges. Thus a five-year construction program is provided. Approximately 375 miles of the state highway system as laid out previous to the last session of the New Jersey Legislature are to be completed. A permanent type of surfacing will be laid. A sinking fund secured from a general levy of one mill will provide money with which to pay the interest on the bonds and finally retire them.

Colorado also voted favorably for bonding itself for the construction of highways, a $6,000,000 issue having been authorized. These bonds are to run for nineteen years and funds for interest and principal will come from motor vehicle license fees. Yearly appropriations of $1,500,000 will be made from this issue, providing a four-year construction program. As provisions have been made for road work in the 1923 budget, the $6,000,000 will not become available until the succeeding year.

Of chief interest among constitutional amendments is a proposed act (which was defeated) empowering the State of California to create a board which would authorize the issuance of bonds to develop and distribute water and electric energy, and, in general, exercise control over and administration of the state water-power resources. This legislation proposed the issuance of bonds not to exceed $500,000,000, the bonds to be retired from income upon rates accruing from developed resources.

Following is a summarized report upon bond issues and other legislation in the elections in various states:

Ohio—An act authorizing the installation of works to prevent the pollution of the Cuyahoga River was voted upon favorably. Money for the construction of such works is to be provided by an additional tax levy of not more than two-tenths of a mill.

Akron—$3,000,000 sewer bond issue passed.

Lima—$540,000 school bond issue passed.

Cleveland—$5,000,000 school bond issue passed.

Lakewood—$700,000 school bond issue passed.

Dayton—$500,000 issue for streets and sewers lost; $300,000 issue for parks and playgrounds lost; $650,000 issue for acquisition of hydraulic canal for public park lost.

Oakwood—$380,000 issue for high school carried.

Middletown—$210,000 issue for schools carried.

Michigan—Wayne County voted favorably on two bond issues; $1,000,000

(Continued on p. 859)

Steinmetz Runs Ahead of Ticket in State Engineer Race

According to unofficial returns, Charles P. Steinmetz, Socialist-Farmer Labor candidate for state engineer of New York, ran far ahead of his ticket in the election held Nov. 7. It is estimated that he received at least 200,000 votes not credited directly to the general Socialist or Farmer Labor vote. In the five boroughs of New York City he ran only about 75,000 votes behind the Republican candidate, though the Democratic candidate received about double the votes cast for the Republican candidate. In Schenectady, Mr. Steinmetz' home precinct, many Republicans and Democrats laid aside their political convictions and voted for him. In many of the up-state precincts the same thing happened.

A.S.T.M. 1923 Meeting Announced

The executive committee of the American Society for Testing Materials has voted to hold the 1923 annual meeting of the society at Atlantic City, N. J., in the latter half of June, provided satisfactory arrangements can be made for the meeting. Two dates of meeting are tentatively under consideration, the first during the last week of June, that is, from June 25 to 29, the second immediately following the meeting at Atlantic City of the American Railway Association which is customarily held from Thursday to Wednesday, about the middle of June. It is stated that the executive committee has the matter of rotation of annual meetings in different parts of the country under careful consideration, and in the meantime deems it desirable to adhere to the existing policy with respect to meetings.

Engineering Foundation to Study Arch Dams

Committee Has Collected Information on Existing Dams and has Program of Tests

Progress is being made in a study of arch dams by an advisory committee of Engineering Foundation which has recently been formed and which will hold its first formal meeting in San Francisco in December. The committee was organized at the solicitation of F. A. Noetzli, chief engineer, Bissell & Sinnicks, San Francisco, the author of several recent papers presented to the American Society of Civil Engineers on the subject of arch dams. Mr. Noetzli has been made a member and secretary of the committee, the other members of which are F. E. Weymouth, chief engineer, U. S. Reclamation Service, Denver, Colo.; A. B. Fletcher, director of public works, Sacramento (*alternate:* Paul Bailey, deputy chief of public works) representing the State of California; M. M. O'Shaughnessy, city engineer, San Francisco, (*alternate:* R. P. McIntosh, designing engineer) representing San Francisco; H. Robert Porter, member Engineering Foundation, New York City, (*alternate:* Wynn Meredith, of Sanderson & Porter, San Francisco); Silas H. Woodward, member of Engineering Foundation, New York City; Prof. C. Derleth, Jr., University of California, Berkeley, Calif.; H. Hawgood, consulting engineer, Los Angeles, Calif., and D. C. Henny, consulting engineer, Portland, Ore. All members of the committee are members of the Am. Soc. C. E.

Purpose of Investigation

The purpose of the investigation is first to collect all possible information regarding design, dimensions, history and behavior of existing arch dams and second to study by observation on existing dams, or those to be built in the near future or on test dams, the movements under changes of load and temperature, from all of which it is hoped that there may be evolved some more rational and generally acceptable method for the design of arch dams than those now in use. Among the ends sought are economy combined with the degree of security demanded in each case and some assurance as to safety.

Engineering Foundation has appropriated $500 to meet the preliminary expenses of the committee and will act as treasurer for such contributions as are made to the investigation. Several firms engaged in the design and construction of arch dams, and others, mainly power companies owning or contemplating such dams, have already offered assistance in making observations and have indicated willingness to contribute to the fund at the required time. One engineer interested in the study has incorporated in some new contracts a provision that a sum equal to one-half of one per cent of the estimated cost of the dam is to be donated by the owner to the investigation.

Further information regarding the investigation may be obtained by writing to Alfred D. Flinn, director, engineering Foundation, 29 W. 39th St., New York City. The official name of the committee is the Advisory Committee on Investigation of Arch Dams.

To Test Practicability of Joint Committee Specifications

The Joint Committee on Standard Specifications for Concrete and Reinforced Concrete, has accepted a proposal of a committee of contractors representing the Associated General Contractors of America that field and laboratory tests be conducted to determine the practicability of the recommendations of the Joint Committee in its Tentative Specifications for Concrete and Reinforced Concrete especially insofar as they relate to control of the quality of concrete produced under field conditions. It is at present planned to conduct the tests in conjunction with the construction of a reinforced-concrete building in the New York City district, with the possibility eventually of making similar tests on buildings in other cities. The Joint Committee, without expense to itself, will have advisory supervision of the tests under the auspices of a committee of contractors; it will approve the program of tests and the personnel of those who are to supervise and make the tests.

Although final plans have not yet been approved, it is contemplated to divide the tests broadly into field tests and auxiliary and laboratory tests. The field tests will be designed to establish (1) uniformity of workability or consistency of concrete throughout the work, (2) uniformity of the strength of concrete obtained throughout the work, and (3) relation of the strength of field test pieces to the strength of concrete in the structure. The auxiliary and laboratory tests are divided into four series: (1) the relation of strength of field-made test pieces to theoretical strength of mixtures used; (2) comparison of strength of field-made test pieces with laboratory test pieces; (3) relative value of cores of different diameters and heights, and (4) comparative tests of different brands of cement used.

Policy Being Evolved to Govern Inter-Bureau Patent Matters

With the idea of drafting regulations establishing a policy to be followed by the federal government in handling inventions and patents evolved by government employees, and other inventions and patents acquired by the government, regular meetings are being held by the Interdepartmental Patents Board. This board recently was set up by an executive order issued by the President. Any policy proposed by this board is to be presented, through the Secretary of the Interior, to the President for his approval. The regulations also will suggest a plan whereby information concerning patents, applications for patents, licenses and other rights under patents, owned by the government, may be disseminated to all the bureaus concerned.

Dr. Andrew Stewart, of the Bureau of Mines, is chairman of the Interdepartmental Board.

Am. Soc. C. E. Has 10,509 Members

The total membership of the American Society of Civil Engineers as of Oct. 3, 1922, is 10,509. There are 4,622 members and 5,235 associate members, making 9,857 corporate members; 11 honorary members, 461 juniors, 170 affiliates, and 10 fellows.

Iowa Water-Works Men Talk on Operating Problems

Three-Day Convention Devoted to Lost Time Elimination, Publicity and Laboratory Control

How to minimize lost time in construction by load-curve studies, proper publicity for a water-works, and laboratory control problems were topics eliciting lively discussions Nov. 1-3 at the meeting of the Iowa Section of the American Water Works Association—which includes Iowa, Missouri, Nebraska and South Dakota. The plan to hold the first day's sessions in Iowa City and then proceed to Cedar Rapids for the remainder of the convention worked well and materially increased the total registration which was more than 100. Two manufacturers had exhibits and seven associate members were present. Some criticism of the number of laboratory papers was voiced but the onus was put back on the shoulders of the superintendents whose contributions are as difficult to secure for the local sections as for the parent organization.

Homer V. Knouse, assistant superintendent and purchasing agent, Omaha Metropolitan Utilities District, showed load curves of excavators by which the operators were induced to speed up and reduce between-job periods to a minimum. Organization and planning were found larger factors than were anticipated. For filling in the lost-time valleys of a backfiller other work, such as unloading pipe and hoisting concrete to column forms, was done.

Publicity

On publicity, Dow R. Gwinn, president Terre Haute (Ind.) Water Co., indicated that the utility manager should more often approach the advertising department and buy space for his non-news propaganda rather than attempt to palm it off on the editor. R. E. McDonnell, consulting engineer, Kansas City, described the methods used by the Engineers Club to educate the people on the recent $11,000,000 bond issue voted upon favorably.

In one of the laboratory papers, Frank Raab, chemist and bacteriologist of the Minneapolis filtration plant, stated that more than 90 per cent of the gas formers found in 932 samples in the filtered water were harmless spore formers other than B coli, requiring for their destruction 15 lb. of chlorine. A. P. Larned, with Black & Veatch, consulting engineers, Kansas City, noted a similar experience four years ago at Camp Beauregard.

F. C. Mortensen and C. O. Bates, Coe College, described experimental and laboratory studies of hydrogen-ion determination in connection with the use of a new temporary wooden tank.

J. B. Thornell, chemist Council Bluffs (Iowa) water-works, described the process proposed for softening Missouri River water and the preliminary laboratory experiments. Lewis I. Birdsall, General Chemical Co., in discussion, warned against an attempt to produce floc with magnesium precipitate because of the secondary reactions which are almost sure to follow.

The new officers of the section are: Dr. Edward Bartow, chairman; H. F. Blomquist, vice-chairman; and J. J. Hinman, Iowa City, secretary-treasurer.

Italy's New Ambassador to U. S. Is Columbia Engineer Graduate

Prince Gelasio Caetani, a member of the Chamber of Deputies of Italy, graduate of the Columbia University School of Mines, New York City, and former consulting mining engineer of San Francisco, has been appointed Italian ambassador to the United States. Since the war Prince Caetani has been prominent in Italian civil affairs, having been selected mayor of Rome prior to his election to the Chamber of Deputies on the Nationalist ticket. Before the war and after his graduation from Columbia he followed mining operations in the West and in Alaska, finally becoming a partner in a consulting mining engineering firm located in San Francisco.

Prince Caetani, the son of the Duke of Sermoneta, entered the Columbia School of Mines in 1899, and was graduated in 1903. He began work as a miner, trammer, timberman and mill hand at Strattons Independent Mine in Colorado, at the Treadwell in Alaska and at the Bunker Hill Mine in Idaho. In 1910 he became a partner in the consulting mining engineering firm of Burch, Caetani & Hershey, San Francisco. In his consulting capacity he designed the newest of the big mills of the Bunker Hill and Sullivan Co. in the West and won recognition as a metallurgist.

At the outbreak of the war he returned to his native country and was commissioned a captain of engineers in the Italian Army. He was assigned to duty with the 1st Royal Engineers under Col. Pettino Garibaldi, and was stationed in the Dolomite region. During his service there he executed one of the remarkable engineering feats accredited to Italians during the war—the undermining and blowing up of the Col di Lana, where an Austrian force had established a strong position dominating the surrounding territory. This work was carried out at an elevation of 2,464 meters above sea level and constituted in the main the driving of a tunnel over 300 ft. long, its loading with 5 tons of gelatine and 92 per cent nitroglycerine, and its explosion. The driving of the tunnel began in January, 1916, and was carried on under constant dangers from countermining operations. The excavation was completed April 17 and the mine exploded on that day, making a crater 90 by 150 ft., oval in shape, and about 35 ft. deep, and resulting in the death or capture of the entire Austrian garrison.

For his war exploits Prince Caetani was made a colonel of engineers and decorated with both the Italian and the British military crosses.

Waste in Industry to Be Theme of Industrial Conference

Elimination of waste in industry will be the theme for discussion Nov. 22 at the sixth annual New York State Industrial Conference to be held at the Hotel Lafayette, Buffalo, for three days beginning Nov. 21. At that particular session L. W. Wallace, executive secretary of the Federated American Engineering Societies, who has but recently completed a coast-to-coast tour, will deliver the opening address. His topic will be "Wasteful Industrial Habits." H. F. Simmons of the General Electric Co., Schenectady, N. Y., will speak on "How to Prevent Waste of Materials."

F. W. Sarr Dies From Injuries in Automobile Accident

Frederick Winton Sarr, first deputy commissioner of the New York State Highway Commission, died last week at Poughkeepsie, N. Y., following an automobile accident in which the machine, trying to avoid collision with another, crashed into a tree and overturned, Mr. Sarr receiving a compound fracture of the leg and internal injuries. Amputation of the leg was necessary and Mr. Sarr failed to survive the shock.

Mr. Sarr was born in Marcellus Falls, N. Y., in 1867. His early field work was with the Syracuse & Salmon River Water Co. and the Northern Pacific R.R. In 1891 he was chief engineer of the Hoosac Tunnel & Wilmington R.R. in charge of 13 miles of construction; the next year he had charge of 8 miles of construction on the Missouri, Kansas and Texas R.R. The following years were spent in New York in the State Department of Engineering and Surveying, varied by considerable outside work such as engineer in charge of construction of a 700-ft. dam for a pulp and saw mill near Wilmington, Vt.; assistant engineer on reconstruction of five locks of New York State canals, spillways, waste-weirs, aqueducts and culverts; on dams and spillways for reservoirs in the North woods; surveying, mapping and construction of New York State highways; engineer in charge of construction of the Post water-works at Fort Dade, Fla.; and in the chief quartermaster's office, Department of the East, Governor's Island, New York.

In 1915 Mr. Sarr became second deputy commissioner of the New York State Highway Commission, serving until 1918. From that year until 1921 he was with the Asphalt Association and the Portland Cement Association, as field engineer.

In 1921 when a change of state administration resulted in the appointment of the present commissioner of highways, Mr. Sarr returned to the department as first deputy commissioner.

Highway Traffic Association to Meet in Grand Rapids

The joint sessions of the North Central Division of the National Highway Traffic Association and the Michigan State Good Roads Association are to be held at Grand Rapids, Mich., Nov. 21. Papers covering the discussion of regulations on speeds, weights, dimensions of motor trucks, their overloading, and discussions on lights for highway vehicles, both motor driven and horse driven, will occupy the afternoon session. The evening session will be devoted to papers upon the economic and financial aspects of highway construction, maintenance and transportation.

Rivers and Harbors Congress in December

Announcement has been made that the eighteenth convention of the National Rivers and Harbors Congress will be held in Washington, D. C., Dec. 6 and 7, at the New Willard Hotel, that city.

Call for Engineers Generally Continues Strong

Although a lull in engineering employment usually comes with the approach of winter, indications this year favor a continuation of the present upward trend of engineering employment, according to the employment department of the American Association of Engineers. Developments in all engineering lines warrant the belief that this trend has just started and that probably it will continue well into 1923. Practically no engineers are unemployed. Those who are without positions are in remote localities; highly specialized men whose positions may have been just completed, and a few construction men.

The demand for office men, particularly in connection with building construction, is rather acute. Structural designers can command as high as $350 a month. A healthy demand exists for construction engineers and superintendents. The men who are available for employment are those endeavoring to better their situations. Possibly the least active lines are the chemical, mining, metallurgical and mechanical as it pertains to manufacturing. The following table shows the trend of employment:

	Sept. 1922	Aug. 1922	Sept. 1921
Applicants for employment	1,223	1,416	1,749
Positions received	137	167	348
Men referred	1,165	1,140	1,861
Men placed	167	219	213

From a wide variety of sources covering the entire country, the averages of engineering salaries per month at present are as follows: Tracers, $125 to $150; detailers, structural, mechanical and electrical, $150 to $210 (a few companies pay up to $225 a month for experienced men); designers on all classes of work, $225 to $300; structural designers who are specialists, as high as $350; estimators, $300 to $350; rodmen and levelmen, $125 to $160; instrumentmen, $150 to $160; chiefs of parties, $160 to $225; assistant engineers, $200 or more; map draftsmen, $150 to $200; surveyors, $150 to $190; research engineers, $175 to $250; salaries for building superintendents and mechanical engineers vary with duties and company. Pay for temporary positions averages 20 per cent more than the above figures.

Military Engineers Nominate

The nominating committee of the Society of American Military Engineers has placed before the national body its list of nominations. The committee calls attention to the fact that additional nominations may be made if a nominating letter signed by ten members reaches the secretary of the society by Dec. 1. The following nominations have been made: President, Major-Gen. William C. Langfitt, Flushing, N. Y., and Brig.-Gen. William B. Parsons, New York City; first vice-president, Col F. C. Boggs, and Col. William Kelly, Washington, D. C.; second vice-president, Lieut.-Col. Henry C. Jewett, and Col. John Stewart, Washington, D. C. Nominations have also been made for two directors from the regular army, two from the reserve corps and national guard and two directors-at-large.

Election Favors Bond Issues

(Concluded from p. 856)

issue for the erection of an institute for the feeble minded and another of $900,000 for additions to the infirmary.

Voters in the state also authorized an amendment to the state constitution providing for comprehensive port development. By this amendment the state legislature may authorize the incorporation of ports and port districts with power to make internal improvements. This bill, it is believed, will greatly facilitate the establishment of deep waterway terminals in Detroit which are needed for commerce of the Great Lakes and would, it is believed, be greatly overtaxed should the St. Lawrence waterways project open up the Great Lakes to transatlantic trade.

Detroit—A bill proposing a bond issue of $5,000,000 for the extension of the municipal street railways and for the acquisition of new equipment was defeated. Another bill defeated was the proposal that paving costs between car tracks be borne exclusively by a general tax levy instead of by proportionate levies on the city and public service.

Virginia — Arlington County voted favorably upon an issue of $365,000 for school buildings.

Louisiana—The city of New Orleans has been granted authority to issue $5,000,000 of Public Belt R.R. bonds, proceeds from the bonds to be used for the development, extension, additions and betterments to the Public Belt R.R. A bill proposing the issuance of $2,000,000 in bonds for the construction of an auditorium in New Orleans was defeated. Another bill given a favorable majority allows the Orleans Levee Board authority to build a seawall from West End to Seabrook, to construct a driveway along the shore of Lake Pontchartrain, and to reclaim 48,000,000 sq.ft. of land along the lake.

Minnesota—Practically the only large issue in Minnesota was one of $5,000,000 for school construction work in St. Paul which was voted upon favorably.

California—Water and Power Act defeated.

An act providing for a bond issue of $10,000,000 to be used by the Veterans' Welfare Board in assisting California war veterans to acquire farms or homes was voted upon favorably.

An act known as the State Housing Act, which sought to regulate the construction, alteration, maintenance, use, and occupancy of tenement houses and hotels throughout California and of dwellings in incorporated municipalities was defeated. The act defined fireproof, semi-fireproof, and wooden buildings and required roofs of all semi-fireproof buildings and wooden buildings in incorporated municipalities to be constructed of approved incombustible materials.

An effort to impose a taxation upon publicly owned public utilities failed, as did also a bill proposing the regulation of publicly owned public utilities placing them upon the same footing as privately owned utilities.

Maryland—The city of Baltimore, besides voting favorably upon a bond issue which will provide $15,000,000 for school construction purposes, also voted to establish "the one-branch city council plan," details concerning which are to be found elsewhere in these pages.

The Engineer in Public Life

W. W. FINEREN

Participation in the religious affairs of the State of Florida is the outstanding feature of the non-technical service record of W. W. Fineren, U. S. assistant engineer at Jacksonville. For three successive years he has been elected state chairman for Florida of the Laymen's Missionary Movement of the Baptist Church, which carries with it representation on the board of the Southern Baptist Convention. In this work he has addressed thousands of laymen in conventions and churches throughout Florida. He has also spoken before students at the University of Florida and Stetson University on the ideals and opportunities of the professional engineer. Mr. Fineren is a member of the Business Men's Evangelical Club of Jacksonville, an organization of fifty business men who visit all parts of the county every Sunday holding religious services in communities where there are no leaders or teachers. All of this work is done without compensation and at the members' own expense.

Mr. Fineren was born Sept. 11, 1879, at Oswego, N. Y., won a competitive scholarship at Cornell University, and was graduated from that institution in 1902, having specialized in civil engineering. After leaving Cornell he entered the service of the government at Oswego and was attached to the U. S. Engineer Office, his duties relating to dredging and breakwater construction in the lake region. Since that time he has been transferred from place to place in connection with the river and harbor work of the engineer department of the army. In 1917 he was sent from Tampa to Sandy Hook on the construction of defenses for New York Harbor and since 1918 he has served as assistant engineer in charge of coast defenses at Key West, Tampa, and St. Augustine. He holds membership in the American Society of Civil Engineers, Society of American Military Engineers, is a vice-president of the Florida Engineering Society and past-president of the Jacksonville Chapter of the American Association of Engineers.

Ohio Water Purification Plant Operators To Meet

A conference of superintendents of water purification plants in Ohio has been called to meet Nov. 16 and 17, at the Southern Hotel, Columbus, Ohio, by the chairman of the conference, J. W. Ellms, of Cleveland. One of the two sessions of the conference will be devoted to answering questions relating to filtration plants that were raised by the Ohio State Department of Health at the conference held last year. There are 58 water purification plants in Ohio.

To Discuss Steel Stresses

Simplification and co-ordination of allowable stresses in steel is to be discussed at the convention of the National Steel Fabrication Association, which will be held in Pittsburgh Nov. 23. It is believed that arrangements will be made at that time whereby the association will co-operate with the Department of Commerce to carry through a program of simplification along the lines of the program recently adopted by the lumber manufacturers.

The Department of Commerce is meeting with encouraging success in its simplification work in co-operation with automobile equipment manufacturers. Paint and varnish manufacturers are considering the continuation of some of the war-time restrictions on sizes of containers. Salt producers also are joining in a movement to simplify the containers in which their product is handled.

New Bridge Spanning Mississippi to Be Built in St. Paul

St. Paul is to have a new concrete bridge over the Mississippi River. The structure will replace the present steel bridge at Robert St., will be about 1,500 ft. long and will cost about $1,250,000. The width of the new bridge has not been determined. Toltz, King & Day, St. Paul, have been engaged as engineers to draw plans. It is expected preliminary plans will be ready by Jan. 1, 1923. The construction will be under direction of the Board of County Commissioners of Ramsey County. The county already has authority to issue $900,000 in bonds for the project, and an additional authorization will be asked of the Minnesota Legislature this winter.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington D. C., Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City, Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

The North Carolina Section of the American Water Works Association held its annual meeting in Gastonia, Nov. 14-16. Besides the sessions on water-works problems of general interest, there were special sessions devoted to well-works operators and for filtration plant operators.

The Western Society of Engineers' November program includes a paper, Nov. 27, by J. L. McConnell, consulting engineer. Chicago on "Industrial

Plant Design." At a noonday luncheon Nov. 24 C. H. Markham, president, Illinois Central R.R., will be the speaker.

The Four-State Section of the American Water Works Association will be the guests of the Water Department of Baltimore Nov. 18. Automobiles will leave the Baltimore City Hall at 12:30 p.m. for the Montebello filtration plant where luncheon will be served at one o'clock. After lunch a short address will be made by William A. Megraw, water engineer of Baltimore. This will be followed by two papers: "A Discussion of the Finances and Conduct of Business of a Municipally-Owned Water-Works as Segregated from Other Municipal Operations" by V. Bernard Siems of the engineering and construction division of the Baltimore Water Department; and "Recent Developments in Water Purification at the Montebello Filtration Plant" by James W. Armstrong, filtration engineer of the Baltimore Water Department. Those attending the meeting must be provided with tickets which may be obtained from Mr. Siems, local chairman, or from C. R. Wood, secretary, 400 Chestnut St., Philadelphia.

Personal Notes

W. P. CREAGER has resigned his position as engineer of hydraulic structures with the J. G. White Engineering Corp., to accept the vice-presidency of the Northern New York Utilities, Inc., Watertown, N. Y.

E. J. MEHREN, editor of *Engineering News-Record*, addressed the freshmen engineering students at New York University Nov. 13 on "The Importance of English to Engineers."

COL. WILLIAM V. JUDSON and COL. JAMES G. WARREN, Corps of Engineers, U.S.A., have been retired. Col. Judson has been division engineer of the Northwestern Division and stationed in Chicago, and in charge of improvement of the harbors at Chicago and Calumet, Ill., Indiana Harbor and Michigan City harbors, Ind., the Chicago River, Ill., and Calumet River, Ill., and the Illinois River, Ill. COL. WARREN is division engineer of the Lakes Division in charge of operations of power companies at Niagara Falls. He is best known for research and investigatory work in connection with Niagara Falls power development, results of which were published several years ago.

NATHAN WOHLFELD has been made construction superintendent for the Central Contracting Co., Shreveport, La. He was former manager of the Donaghey Co., Little Rock, Ark.

COL. GEORGE M. HOFFMAN, on duty in the office of the Chief of Engineers and resident member of the board of engineers for rivers and harbors, has been detailed as a consultant or a supervisor of construction or repair of any aid to navigation authorized by Congress in the seventh and eighth lighthouse districts. He succeeds COL. HENRY C. NEWCOMER.

H. COLLINS WIGHT, since 1915 superintendent of the Dayton, Ohio, water-works, announces that he has accepted an executive position with the Linden Chemical Co., Dayton. The Dayton officials credit him with many improvements in the city's water-works system.

OTTO WITTEN, civil engineer of Van Wert, Ohio, has been elected to the office of county surveyor in Van Wert County.

A. J. GOODE, county engineer of Fannin County, Texas, has resigned on account of ill health.

F. A. BISBEE, chief engineer of the western lines of the Santa Fé system for the past ten years, has resigned. Mr. Bisbee plans to spend some time at his home near Los Angeles where he owns a large olive orchard. His total service with the Santa Fé was forty-five years. He will be succeeded by M. C. BLANCHARD, superintendent of the Illinois division and stationed at Chillicothe, Ill.

GUY R. JOHNSTON, until recently principal assistant engineer for the Tarrant County Highway Department, Ft. Worth, Texas, has resigned to become engineer for the Hamer Contracting Co. of Ft. Worth.

DR. ROBERT T. HILL has been retained by the City of Dallas, Texas, as city geologist and will co-operate with the city engineering department on water supply investigation.

LOUIS W. B. MANTEL, Uvalde, Texas, was recently appointed city engineer of San Angelo, Texas, vice LOUIS LAGING, resigned. Mr. Mantel was an engineer officer in the army with the rank of major and saw service in France.

N. S. MULLICAN, civil engineer of Walnut Cove, N. C., and county engineer for Stokes and Davie counties, has been employed to prepare plans and supervise the installation of certain sewer works for the town of Cooleemee, N. C. He has also been retained by the town of Walnut Cove, N. C., to supervise certain hydro-electric developments on the Dan River.

VICTOR T. GOGGIN and JAMES H. RIPLEY, formerly contracting engineers with Dwight P. Robinson & Co., Inc., New York City, have formed a partnership under the name of Goggin and Ripley, Inc., with headquarters at 350 Madison Avenue, New York City. Personal service to assist business executives, bankers and engineers in conceiving, financing and developing construction projects will be specialized in.

H. C. WEBSTER, former estimating engineer with H. Schmitt & Son, Inc., general contractors of Milwaukee, Wis., has become a junior member of the general contracting firm of Hartung & Webster, Chicago, Ill. Mr. Webster will assume charge of the office and executive duties of the firm.

G. S. HINCKLEY, city engineer of Redlands, Calif., has been appointed to take charge of the flood-control work to be carried on in the headwaters of the Santa Ana River by San Bernardino, Riverside, and Orange Counties.

THE GEORGE H. COLLINS CONSTRUCTION CO. has been incorporated in Kansas City to do a general construction business. The shareholders are George H. Collins, R. V. Aycock, and Robert T. Stokes.

HENRY A. KELLER, formerly employed by the North Carolina State Highway Department as resident engineer and assistant resident engineer on highway location and construction, respectively, has been appointed district highway engineer of the Samuel Miller District of Albemarle County, Va.

Obituary

EDWARD H. TAYLOR, second vice-president of the Pennsylvania Lines West until his retirement two years ago, died recently at his home in Sewickley, Pa., aged 72 years. Mr. Taylor entered the service of the Pennsylvania R.R. in 1870.

ANDREW J. ROBINSON, head of the New York building-contracting firm of that name, died Nov. 9 at his home in New York City, aged 78 years. He was the builder of many of New York's important buildings, including the St. Luke's and New York hospitals, the Fidelity & Casualty Co. building, the Home Title Insurance Co. building in Brooklyn, the Columbia School of Mines, and the Union Geological seminary.

WILLIAM A. STROTHER, vice-president of the Franklin Contracting Co. of Newark, N. J., died Nov. 7 at his home in Montclair, N. J., aged 45 years.

J. PORTER PALMER, civil engineer of New York City, died recently at Homestead Hall, Greenwich, Conn., aged 55 years. He was born in Salem, Mass., and was graduated from the Massachusetts Institute of Technology. He was engaged in the oil business in New Haven prior to his establishing civil engineering offices in New York City.

ARTHUR JONES ROCKWOOD, a civil engineer and contractor of Rochester, N. Y., died recently in that city, aged 57 years. Mr. Rockwood was born in Enfield, Mass., and educated in the Buffalo public schools and at Rensselaer Polytechnic Institute, from which he was graduated in 1887. Until 1899 he was employed in Buffalo, when he went to Rochester to become engineer of the Western Division, of the New York State Barge Canal. He held that position for nine years, leaving public service to enter the contracting field in highway construction work. He was a charter member and an early president of the New York State Road Builders' Association and was also a member of the American Society of Civil Engineers.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

To Simplify Practices and Products of Industry

U. S. Department of Commerce Reports Progress on its Program in Many Fields

Washington Correspondence

While the Simplification Division of the U. S. Department of Commerce is concentrating on lumber, hardware and containers as immediate objectives in its simplification program it is co-operating with trade organizations representing more restricted fields and is making plans for new efforts in 1923.

Attachés of the division are hopeful that strides toward standardization and simplification of ship construction and equipment, with especial reference to fittings, will follow the meeting on Nov. 10 in New York of representatives of 27 marine organizations and of the Department of Commerce.

Paint and Oil

On Nov. 14, Wm. A. Durgin, chief of the Simplification Division, is scheduled to address the National Paint, Oil and Varnish Association at its convention in Atlantic City to further the work of standardization which has been started by that organization. The association has under way a survey of colors and of containers which is expected to lead to more economical practices. Mr. Durgin will go from Atlantic City to Chicago where on Nov. 16 he is scheduled to address the convention of the Automotive Equipment Association on the same topic. This organization has made considerable progress in a survey covering batteries, spark-plugs, ball-bearings and tires.

Representatives of producers, manufacturers and consumers will meet with officials of the Department of Commerce in Washington, Dec. 12, to perfect plans for simplification of metal lathes. The preliminary survey has been completed and one meeting already has been held.

Hardware Expert Appointed

The Simplification Division recently has added to its personnel an expert on hardware who will devote special attention to carrying forward the work which has been opened in that field. A conference will be held in Chicago at an early date with Herbert P. Sheets, secretary of the National Hardware Association, who has been conducting a survey, with special reference to hammers, axes, hatchets, files, scissors and pocket-knives, which has disclosed an astounding diversity of sizes and types.

One of the largest subjects taken up by the division is that of containers—metal, wood and pasteboard. This affects such a large number of producers and consumers that the division has assigned a special attaché to this subject. A general conference on containers will be held in Washington under the auspices of the Department of Commerce in January, and probably will occupy a week's time.

Winter Buying of Pipe

Discussion continued from last week's issue.

F. A. McInnes
Division Engineer, Water Division, Public Works Department, Boston

I cannot refrain from expressing my appreciation of the idea that water-pipe manufacture should be spread over the entire year rather than be concentrated in a part only of the year. Such an arrangement should result in lower prices and would unquestionably make for a better product, as the manufacturers would have the great advantage of being able to offer continuous employment to their men and would avoid the unhealthy pressure that now obtains during a part of the year.

One reason for the present uneven demand for pipe is the fact that the majority of cities and towns defer action until their yearly budget or appropriation is made available. Consequently, congestion in the foundries is the inevitable result in the spring and summer months, a condition that cannot make for the best results.

Boston, for the first time as far as I know, is advertising now for the pipe for 1923 work with the expectation of getting better results both from a financial and mechanical standpoint than if we came into the market as has been our practice in the spring of 1923.

F. C. Jordan
Secretary, Indianapolis (Ind.) Water Co.

There is no question but what it would be desirable, from the manufacturer's viewpoint, to spread the purchase of pipe over the entire twelve months rather than concentrate these purchases in the summer months. Weather conditions, however, must be considered, and these conditions largely regulate the purchase and delivery of our material.

Our 1922 purchases were made early in the season, and when our pipe laying

(Continued on p. 862)

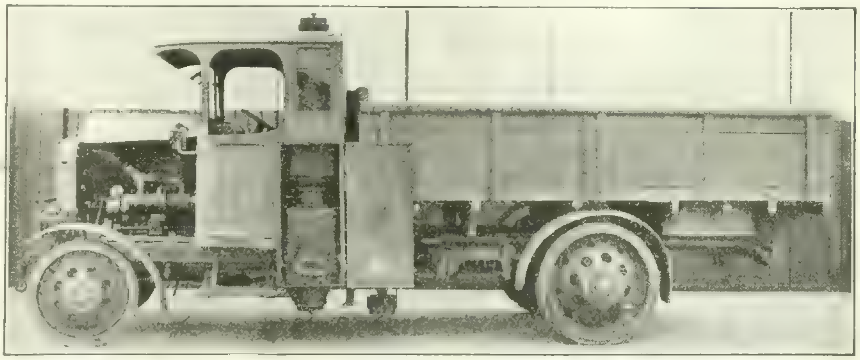
Producer Gas Used as Fuel in British Trucks

Tests Indicate Economies in New Development as Compared with Use of Petrol

London Correspondence

SEVERAL types of motor truck in which producer gas is used as fuel are on the English market. The Thornycroft plant, shown in the accompanying illustration, differs from others in several essential features. Steam, which is passed through the incandescent coal bed, on the grate, to form the gas by combining with the carbon, is generated in a separate generator (not attached to the producer) by the heat of the exhaust gases from the engine itself. The heat of the exhaust gases necessarily is in proportion to the power developed by the engine according to its load; thus the correct amount of steam for the producer can be provided under all conditions. The steam generator can be taken entirely to pieces for cleaning by detaching it from the engine.

One of the difficulties encountered in the running of gas-producer vehicles is the immediate provision of a sufficient quantity of proper quality gas on opening up an engine after the vehicle has been standing for a time, say, in a traffic block in the city. With the Thornycroft plant, special patented arrangements overcome this difficulty, which also occurs in a lesser degree when the vehicle is working on a very light load, or when over-running when going down hill. This arrangement overcomes the necessity of racing the engine when working at other than full power in order that the gas-making process may be continuous.



BRITISH TRUCK EQUIPPED WITH PRODUCER GAS PLANT
Engine is standard petrol machine, 4-cylinder. Compression ratio raised for running on producer gas. Fuel may be anthracite, coke, wood or charcoal

The plant works efficiently with good clean anthracite of the size known as pea, good quality coke and charcoal; but in the case of light and bulky fuels, such as the latter, special hopper arrangements are necessary to enable relatively larger quantities to be carried.

From the report attached it will be seen that the consumption of anthracite per mile is 2.51 lb. on the works vehicle taken over a distance of 1,579 miles in ordinary town-and-country commercial work the consumption worked out at 2.6 lb. per mile on a vehicle, the average speed over this distance being 14.8 miles per hour. The truck does about 7 miles per gallon of petrol.

per gallon of petrol say at 2s. a gallon, and 2½ lb. of anthracite per mile at 63s. per ton, the fuel cost per mile is: Petrol, 3.43 pence per mile; anthracite 0.75 pence per mile. The cost of fuel on a gas-producer vehicle, therefore, is about one-fifth that of a petrol vehicle, on the basis of the foregoing costs. In countries where petrol is scarcer and alternative fuels cheaper still, the economy of the gas-producer plant is even more pronounced.

ROAD TESTS OF ANTHRACITE AND CHARCOAL ON THORNYCROFT GAS PRODUCERS

	Anthracite	Charcoal
Distance	28 miles	28 miles
Time	2 hr. 20 min.	2 hr. 5 min.
Miles per hour	12	13.4
Lbs per mile	2.51	2.9
Water used lb.	45	35
Gross weight	7 tons 10 cwts. 2 qr.	7 tons 9 cwts. 2 qr.
Pulling	Fair	Good
Condition of roads	Dry	Dry
Weather	Fine	Fine
Date of test	6-4-22	26-4-22

The Automobile Club de France has recently conducted a lengthy series of trials of suction gas vehicles, on behalf of the French Government, which is much impressed by their possibilities for colonial service. Among a number of colonial lorries the only British extrant was a Thornycroft 4-ton lorry, which was successful in winning the highest marks.

Winter Buying of Pipe

(Continued from p. 861)

commenced about April 15, we had on hand approximately 40,000 ft. of pipe. Many of our orders for water-main extensions are occasioned by the permanent improvement of the streets, and the purchase and delivery of pipe for such jobs must ordinarily await the receipt of the order from the Board of Public Works. Our weather conditions make it impracticable to lay water pipe during the winter, and in the few instances where we have distributed pipe several weeks in advance of the laying we have lost a few lengths of pipe and some boys have been injured by playing around the pipes.

Our experience in connection with the early delivery of pipe has been such that we make a practice of sending the pipe to the job a very few days in advance of the pipe laying crews.

W. C. Hawley
Chief Engineer, Pennsylvania Water Co., Wilkinsburg, Pa.

I believe that the plan of purchasing cast-iron pipe throughout the year can be partially, but only partially, adopted, and that it is to the interest of both the manufacturer and the purchaser that it should be adopted as far as possible. If the manufacturers will take the initiative and make it worth while for the purchaser to spread his orders over the entire year, they will find the purchaser willing to do so. In fact, it is already being done by some of the larger water companies and water departments.

In most cases plans for large supply mains are not made on short notice, and pipe for these mains could be ordered so that its manufacture and delivery could take place in winter. Most water-works systems are growing at a more or less steady rate, and it should be possible to estimate approximately the amount of pipe required each year. An order for that pipe could be placed so that it could be manufactured in winter. There will be, however, demands for extensions to distribution systems which cannot be anticipated, and orders for pipe for this purpose must be placed when the demand arises.

There are, however, some practical difficulties which will interfere with the delivery of pipe in winter. In the case of a supply line crossing tracts of land which have not been laid out in streets, there may be no objection to delivering the pipe along the route of the main, and leaving it there until it is laid during favorable weather. This cannot be done, however, through streets in built-up sections of a town or city; pipe for such locations must be stored. Not every water company or department has available storage room for large quantities of pipe. This difficulty, however, could be overcome, possibly, by having the pipe manufactured and stored at the foundry.

I believe that an offer to purchasers of a price differential would be an effective way of encouraging winter buying. Our company has for some years past placed an order each year about Jan. 1, for its estimated needs, and we have found the manufacturers willing to quote better prices for pipe which can be made in winter than that made at a later part of the year.

Inspection of Pipe

It sometimes happens that there is a demand for the laying of a pipe line which could not have been anticipated, and when an effort is made to buy the pipe it is found that delivery cannot be made for a considerable period of time, unless the purchaser is willing to take stock pipe—pipe which has not been inspected before it was coated. Some purchasers are willing to take such pipe, but many of those where the water pressure is high, or where the pipe is to be laid under pavement, have learned by experience that they cannot afford to take such a chance.

The solution of this difficulty, and one which would permit the manufacturer to make pipe during the winter, would be for the manufacturer to have the pipe inspected, when made, by a reputable inspector, not an employe of the foundry, and so be in a position to furnish pipe with the inspector's certificate. The cost of inspection should, of course, be added to the cost of the pipe, but the reduction of the cost of the pipe, due to more nearly continuous operation of the foundry, should more than offset this item. There is, however, against this proposition, the possibility that, if it were possible to purchase inspected pipe at any time during the summer, the purchaser might be less inclined to place an order for winter delivery. This could be taken care of, however, by a price differential.

Whether or not pipe can be laid in winter depends not only upon the latitude, but upon the weather conditions. In the vicinity of Pittsburgh it is sometimes possible to lay pipe during most of the winter. During some winters there will be from six to ten weeks when pipe cannot be laid economically. Many municipalities refuse to permit pavement to be taken up from Nov. 15 to March 1, and with some soils there is good reason for so doing, for pavement cannot be replaced satisfactorily during freezing weather.

On the whole, I believe that there is much which can be accomplished along the line which you have suggested if the manufacturers will take the initiative and show the purchaser that it is to his advantage to place his orders for pipe so that the pipe can be manufactured in cold weather.

Business Notes

A. T. Dulfer has been appointed manager of the New York office of the American Mason Safety Tread Co., succeeding J. W. Stodd, resigned.

D. K. Hutchcraft, formerly vice-president of the Indiana Air Pump Co., Indianapolis, and a specialist in air-lift pumping, has been appointed district manager of the Chicago Pneumatic Tool Co.'s branch office recently established at Tulsa, Okla.

H. H. Robertson Co., Pittsburgh, manufacturer of asbestos-protected metal roofing, announces that Johns-Manville, Inc., New York, has been appointed joint selling agent for its product. In future asbestos-protected metal, recently named Robertson process metal, for roofing and siding, will be manufactured and shipped from the Robertson plant at Ambridge, Pa. In its manufacture Johns-Manville asbestos saturated felts will be used. This arrangement, it is pointed out, will afford to customers the advantages of both organizations, one in the manufacture of saturated asbestos felts and the other in the fabricating of the finished product.

Equipment and Materials

Wood Fiber Panels Produced as Lumber Substitute

As a substitute for lumber material in the form of panels designated as Tensil-ite has been developed by the J. P. Lewis Co., New York. The panels are made from hardwood fibers from which the sap, knots and shakes have been eliminated to prevent splitting or checking. The fibers are laid in layers to eliminate grain from the finished product and the laminations are cemented together and built up to thicknesses of from ⅛ to ½ in. by hydraulic pressure of 500 lb. per square inch. Stock sizes of the panels are ⅛, $\frac{3}{16}$, ¼, ⅜, and ½ in., with weights per 1,000 sq.ft. of 500 lb., 800 lb., 1,000 lb., 1,500 lb., and 2,000 lb.

Among the advantages claimed for the material by its manufacturer are its wood-working qualities (it can be cut with a saw, planed, dovetailed, beveled and bored), its rigidity and structural strength. It is said to be adaptable to a wide variety of uses, including sheeting for concrete forms. Both Mr. Lewis, president of the company manufacturing Tensil-ite, and E. E. Whitney, its sales manager, were formerly connected with the manufac-

ture of Beaver board. At the present time the Tensil-ite panels are made only in 4 x 5-ft. sizes, but machinery is being installed to produce commercial building sizes from 8 ft. to 14 ft. long.

Hopper Body Trailer Designed for Road and Street Work

An all-steel hopper-body trailer with a rounded load capacity of 2 cu.yd., designed for use with a Fordson tractor, has just been put on the market by the Miami Trailer Co., Troy, Ohio. It is designed especially for use on road construction and maintenance for hauling crushed stone, sand, gravel, and other material, or for the transportation of aggregates to the concrete mixer. Other uses are in building and excavation work, earth haulage or removal of garbage and refuse in cities.

The hopper body has a rear bottom-

dump door on which the size of opening may be controlled either to dump the entire load or to spread the material to any depth desired. The load dumps behind the rear wheels. The equipment is mounted on Timken roller bearings and rubber tires and may be used with high speed trucks or tractors.

By means of a separate flared top box of ½ or 1-yd. extra capacity a load of greater volume than 2 cu.yd. and weighing 2½ tons may be transported. A special automatic hitch bolts onto the rear housing of the tractor. Both release and winding levers of the trailer are at the right hand of the tractor driver, so that the load may be dumped or spread without stopping.

The trailer weighs 1,960 lb. and is 65½ in. high. When desired the dump body may be removed, the drawbar lengthened and a platform type of body substituted.

All-Steel Aggregate Bins Deliver Measured Batches to Trucks

Among recent additions to the line of construction equipment manufactured by the Blaw-Knox Co., Pittsburgh, are two types of overhead steel bin with batch-measuring device for delivering sand and stone for concrete to trucks or industrial railway cars. The larger unit, named the "Batcherplant," is made in sizes to measure and store from 52 to 116 tons of material, while the smaller unit is essentially a charging bin holding only 6 cu.yd. The accompanying illustrations show the general features of both types.

The Batcherplant (Fig. 1) of all-steel construction consists of an overhead V-shaped hopper with curved bottom mounted on columns with clearance for the passage of a motor truck. Adjustable batch-measuring devices just below

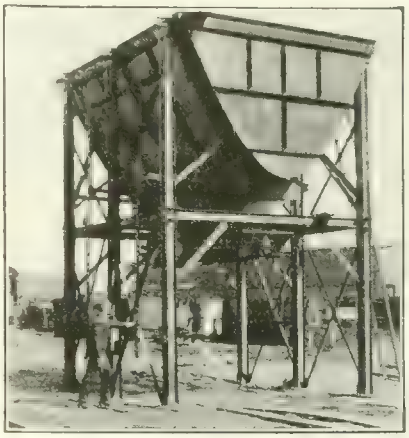


FIG. 1. BATCHERPLANT WITH STORAGE CAPACITY

the hopper enable the contractor to proportion by volume the amount of sand and stone desired in his concrete mix. The mechanism of these batch-measurers allows the batch of predetermined volume to be dumped into trucks of all design, and with various arrangements of compartments, batch boxes and hopper cars. A feature of the mechanism is the strike-off gate which shuts off the flow of material from bin to batcher and at the same time strikes it off in accordance with specifications. These plants are built in standard units and may be used with either motor truck or industrial railway haulage.

The smaller type of bin shown in Fig. 2 is used principally for charging and not for storage. Each unit is furnished with a single batch-measuring

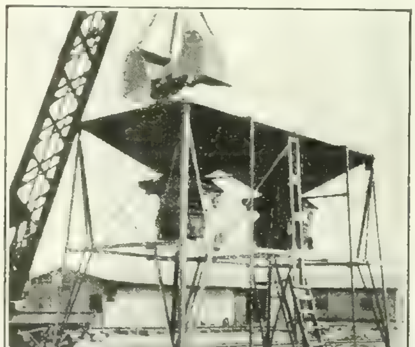


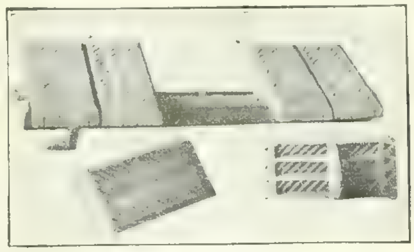
FIG. 2. DUPLEX CHARGING UNITS

device. Ordinarily contractors use two of these units, one for sand and one for stone, in a duplex arrangement, as illustrated.

Dumping Grate for Small Sizes of Anthracite

As an aid in the solution of the problem of burning under boilers the smaller sizes of anthracite, the Mc-Clave-Brooks Co., Scranton, Pa., has developed a new dumping grate with $\frac{3}{16}$-in. diagonal mesh, rabbeted sectional tops. Its general features are shown in the accompanying illustration. This grate is made in a variety of meshes so that coal sizes such as No. 1 buckwheat, No. 2 buckwheat, rice, barley, and even the finest anthracite screenings and culm may be burned.

To secure an overlap between the ends of the sectional tops, one end of



each is beveled. This feature prevents sifting of coal between the bars and takes care of expansion and contraction of the grate. The diagonal slots in the grate, the manufacturers claim, permit the most efficient distribution of air space. With the sectional tops it is not necessary, when a burnout occurs, to replace an entire grate bar as the damage can be repaired by the renewal of one or more of the small sectional tops.

Publications from the Construction Industry

Rolling Partitions—J. G. WILSON CORP., New York, is distributing illustrated folders on its rolling partitions for use in schools, churches and other buildings. These partitions are made of wood slats threaded on tempered steel bands and may be secured in either vertical or horizontal rolling types. In two other leaflets the company's hardware for glass door house partitions and automatic rolling fire doors are described.

Locomotive Shop Design—H. K. FERGUSON CO., Cleveland, in an illustrated four-page folder points out economies in the construction, operation and maintenance of transverse locomotive-erecting shops resulting from the substitution of its Gap-crane for the suspended type of crane ordinarily used. The Gap-crane involves the use of two steel girders placed far enough apart for clearance of a locomotive which, when raised, passes up between them. With this form of construction considerably less headroom is required in the shops than with the suspended type of crane, and savings up to 33⅓ per cent in costs of new shops are claimed by the use of this type of equipment. Due to the need of less overhead clearance it is possible also to place the crane runway at a lower level, resulting in shorter and narrower columns. The Gap-cranes are built for the FERGUSON company by the Morgan Engineering Co., Alliance, Ohio.

Power Shovels—THEW SHOVEL CO., Lorain, Ohio, is distributing a loose-leaf binder containing catalog sections covering its power-shovel equipment. There are separate bulletins on steam, gasoline, and electric shovels, continuous tread mounting, and lubrication. Additional sections for inclusion in the binder will be issued from time to time.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Lumber Showing Steady Increase in Demand

Labor, Not Materials, Principal Factor In Increased Building Costs, According To Manufacturers

"For the country as a whole, lumber has had at least its customary proportion of use in new building," states the Secretary-Manager of the National Lumber Manufacturers Association, in a recent survey of the building situation. "In many locations lumber construction has been particularly favored because of the relatively greater economy in cost.

"The accumulated housing shortage since 1916 up to the present year was equivalent to approximately two and a half full years of new building based on the 1910 to 1915 yearly average. At costs of construction prevailing last spring between five and six billion dollars expenditure would have caught up this building deficit.

"Building costs have increased considerably since last spring in many communities. The general building costs in Washington, D. C., for instance, are about 30 per cent higher than they were last fall and early last spring. This is largely due, however, to high labor costs inasmuch as the demand for skilled labor in the building trades has far exceeded the number of men available. Fifteen dollars a day has become quite customary in Washington for masons, bricklayers and plasters. The carpenters are getting somewhat less. In some building projects in New York as high as $30 a day has been paid for skilled labor.

"There is every reason to believe that the fundamental demand for building materials still maintains and that it will continue for several years, with of course ups and downs. There will be periods of great building activity alternating with periods of semi-stagnation until the building shortage is substantially caught up. These alterations will probably be due rather to the building trades labor situation than to building materials. There is little danger that the comparatively small increases in building costs, due to increases in the cost of building materials, will have much to do with discouraging or delaying building as long as the costs of building labor are so excessive and erratic.

"I look for continued strong basic demand for building materials for a considerable period of years and I believe that lumber will have its full share in the effects of that activity. In fact, the comparatively greater labor costs in installing other materials in buildings than in installing lumber is definitely encouraging the substitution of lumber construction in many large communities, wherever admitted under the ordinances. The National Lumber Manufacturers Association has taken advantage of this opportunity to press its activities on building code requirements to the end that lumber construction be not prohibited in those places where it can safely and economically be used."

Rapid-Fire Survey of Business Conditions

Steel production at 73 per cent capacity during last two weeks.

Plates in large quantities cost 2@2.15c. per lb., Pittsburgh mill, with a softer price rumored for the indefinite future.

Railroad steel ordered in the last ten months aggregates 4,500,000 tons, of which nearly 2,000,000 tons is for car building and repairs.

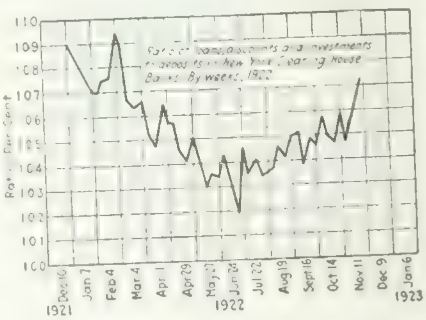
Money on both call and time loans ranged 5@6 per cent last week. The chart shows this year's range of the time loan rate.

Per capita wealth of the country increased 40c. during October, according to the Treasury Department. On Nov. 1 per capita money circulation was $41.44, against $41.04 on Oct. 1.

Business volume for the week ending Nov. 8 totaled $8,213,000,000, which was $1,480,000,000 under the preceding week, due to Election Day, as measured by debits to individual accounts.

Municipal bonds continue to hold interest of financial houses. Fourteen syndicates submitted bids on a $615,000 City of Syracuse loan on Nov. 9. Details of representative public bond sales are presented on the next page.

A new business index is submitted by Richard Hoadley Tingley in the *Annalist*, Nov. 13. It is the ratio between bank loans and bank deposits. He says: "Among all banks, national, State and private, trust companies and savings depositories, the ratio between loans and deposits should remain at approxi-



mately 100. This naturally follows since all money, except the negligible amount of what is termed till money plus such amounts as may be hoarded, finds its way, and this usually over the most direct route, into the deposit accounts of the banks. The loan which one man makes at his bank may be checked out by him to a score or more of creditors, thus reducing the deposit account in the very bank where the loan account has just been augmented, but the recipients of the proceeds of this loan quickly deposit their shares in their banks so that the deposit accounts of these banks are expanded without any compensating expansion of the loan account. No man has yet found it profitable to pay interest on a loan for the privilege of withdrawing the funds from circulation, and there is but one destination for circulating funds and that is the deposit account of a bank." The chart gives the business cycle of the present.

Foreign debt of the United States, per capita, was $209 in October.

Wholesale index numbers for October compiled by D. L. Bissell were as follows: Farm products, 130; orchard products, 161; food, 138; textiles and leather, 191; fuel and metals, 156; construction materials, 178; all commodities, 153.

Additional $40,000,000 capital will be voted on by Consolidated Gas Co. stockholders on Dec. 4 and 5, to discharge floating indebtedness.

Bond market was declining early this week. All Liberty loans dropped, while foreign bonds were notably weak. Low-priced rails and local traction bonds also lost.

Labor bank with a capitalization of $2,000,000 is planned for New York, according to William F. Kehoe, secretary of the Central Trades and Labor Council. This bank, to be known as the Federation Trust Co., is to be opened shortly after Jan. 1, and will be conducted along the lines of the Brotherhood of Locomotive Engineers Co-operative National Bank of Cleveland.

October Steel Ingot Output Highest Since 1920

A total of thirty companies, which produced 87½ per cent of the steel ingot output in 1921, have turned out 23,447,266 tons during the first ten months of the current year, according to the American Iron and Steel Institute. Operations in the steel mills throughout the country, are proceeding at about 75 per cent of capacity at the present time. The pig-iron output is also fairly high, running at an annual rate of about 32,000,000 tons.

MONTHLY PRODUCTION OF STEEL INGOTS

	Tons 1921	Tons 1922
January	2,203,186	1,593,482
February	1,749,477	1,745,022
March	1,570,978	2,370,751
April	1,213,958	2,444,513
May	1,265,850	2,711,141
June	1,003,406	2,634,477
July	803,376	2,487,104
August	1,138,071	2,214,582
September	1,174,740	2,373,779
October	1,616,810	2,872,415
November	1,660,001	
December	1,427,093	
Total	16,826,946	

In the face of increasing production, however, a shortage of cars has impeded shipments of material away from the mills, to the extent that products are now piled up at Pittsburgh, Youngstown, Birmingham and other production centers, beyond usual limitations.

(Concluded on p. 865)

Bond Sales for Ten Months Heaviest Since 1892

Sales of long-term municipal bonds during October aggregated $65,924,323 as against $96,449,885 for the preceding month and $65,911,016 for August, 1922, according to records kept by the *Commercial and Financial Chronicle.* A considerable contraction in sales is shown when the total for October is compared with $114,098,373, the value of disposals during the corresponding period in 1921.

Sales for the ten months ending Oct. 31, reached $975,285,288, a gain of 12 per cent over the same period last year and the heaviest total for any ten months since 1892.

Short-term securities aggregated $61,518,000, of which $59,128,000 was issued by New York City alone.

Among the more important issues were: Philadelphia, $12,000,000 4s at 100.147; Norfolk, Va., $2,000,000 5s at 103.41, a basis of about 4.55 per cent; Merced Irrigation Dist., Calif., $1,800,000 5½s at 102.92, a basis of about 5.28 per cent; Oregon, $1,500,000 4½s at 101.09, a basis of about 4.4 per cent and State of Mississippi, $1,000,000 4¾s at 100.155, a basis of about 4.65 per cent.

Of the thirty-seven representative issues shown in the accompanying table, ten sold at par, twenty-seven above and none below par; the yields ranging from 4.05 to 5.49 per cent. Rates varied from 4 to 6 per cent, with one issue in South Dakota at 7. The 4¼s were all located in New England and the Middle Atlantic States, with the 4½s evenly distributed throughout the country, except the South. No 5s were issued in New England or the Southern States, but all those drawing 6 per cent were in the South and West, with the single 4 per cent issue in Massachusetts.

Steel Ingot Output

(*Concluded from p. 864*)

During the first ten months of 1921, the steel ingot output amounted to 13,739,852 tons, with the total for the entire year at 16,826,946. This tonnage is compared with 23,447,266 for the ten months of 1922, or an estimated total output of over 29,000,000 tons for the current year, at the rate of production existing, Oct. 31.

The steel ingot output has steadily increased since August, as shown in the accompanying table. September advanced 7 per cent above the August total and October exceeded the preceding month by 21 per cent, representing the highest tonnage for any month since October, 1920.

Unfilled steel tonnage on the books of the United States Steel Corporation, as of Oct. 31, totaled 6,902,287 tons, an increase of 210,680 over the preceding month. These unfilled orders represent the largest on hand for any month since February, 1921, at which time the total was 6,933,867 tons.

Car Loadings and Shortages Both Reach New High Records

Freight loadings for the week ending Oct. 28, reached the peak for any single week since 1920 and were .00¾ per cent less than the peak loading for any single week in the history of American railroads, according to the American Railway Association.

A total of 1,014,480 carloads of freight, all classes, were loaded during the week, as compared with 951,384 cars for the same period of 1921, and 981,242 during the corresponding week in 1920.

Car shortage on all roads in the United States, reached a new high record during the week ending Oct. 31, with 187,442 cars, an increase of 12,890 over the preceding week. Shortage of box cars alone touched 91,039, a gain of 9,305, while the coal car deficit totaled 47,273, an increase of 693 cars.

Not less than 3,716 surplus cars, however, are to be found throughout the seven railroad districts. These cars are of all kinds and in good repair.

Railroad buying of equipment continues; the Missouri Pacific, alone, having placed orders with the American Locomotive Works, at Schenectady, for fifty engines for December and January deliveries. The purchase of fifty more, of the heavy mountain type, is contemplated, in replacement of lighter equipment. The estimated value of the fifty heavier engines is placed at $3,000,000.

REPRESENTATIVE PUBLIC BOND SALES DURING OCTOBER, 1922

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Maturity	Dated	Purchased By
Oregon	Highway	$1,500,000	4½	101.09	4.40	1927–47	October, 1922	Security Trust & Savings Bank of Portland.
County								
Albany, N. Y.	Highway	138,000	4¼	101.94	4.10	1923–42	Nov. 15, 1922	N. Y. State Nat. Bank
Allen, Ind.	Road	31,000	5	101.57	4.71	1924–33	Oct. 15, 1922	Dime Savings & Trust Co. of Ft. Wayne.
Boone, Ind.	Highway	5,000	5	100 64	4.86	1924–33	Oct 3, 1922	J. F. Wild & Co. State Bank of Indianapolis.
Dubois, Ind.	Road	38 500	4½	100	4.50	1924–33	Nov. 15, 1922	Huntington Bank, Huntington, Ind.
Hancock, O.	Road improvement	10,000	5½	101 57	5 17	1924 31	Oct 1, 1922	W. L. Slayton & Co. of Toledo
Jefferson, Ind.	Highway	13,600	5	100.03	4.99	1923–32	Oct. 3, 1922	Madison Safe Deposit & Trust Co. of Madison.
Mower, Minn.	Drainage	87,780	4½	100 40	4 73	1928 42	Nov 1, 1922	Northwestern Trust Co. of St. Paul
Shawnee, Kan.	Road	175,000	4½	100 60				Brown-Crummer Co. of Wichita.
Snyder, Pa.	Bridge Road	50,000	4½	100	4 50	1924 43	Oct 2, 1922	
Township								
Center, Columbiana Co., O.	Public road	37,000	5½	100	5 50	1923 26	Oct 1, 1922	First Nat. Bank, Lisbon, O.
Fulton, Fulton Co., Ohio	Road improvement	6,100	6	100	6		Nov 1, 1922	Spitzer, Rorick & Co. of Toledo.
Jackson, Jackson Co., Ohio	Road improvement	66,500	6	100	6			Commercial Bank of Tiffin.
Municipality								
Ashton, S. D.	City improvement	17,000	6	101.61		Due serially	Nov. 1, 1922	Ballard & Co. of Minneapolis.
Barnesville, O.	Sewer	220,500	5½	106 10		1924–43	Sept 1, 1922	Otis & Co. of Cleveland
Boston, Mass.	City improvement	560,500	4	100	4 00		Oct. 1, 1922	To Trust and Sinking Funds
Bristol, Va	Street improvement	50,000	5¼	101.07			Sept. 29, 1922	Caldwell & Co. of Nashville and others
Central City, Neb	Paving	108,500	5¼	100.50	5 22	1923–38	Dec. 1, 1922	Omaha Trust Co.
Cold Springs, N. Y.	Waterworks	12,500	4¼	100	4 25	1927–51	Nov. 1, 1922	Nat. Bank of Cold Springs
Duluth, Minn	School	75,000	4¼	101.52			Nov. 1, 1922	Hamilton A. Gill & Co., N. Y. C.
East Cleveland, O.	Street improvement	143,000	5	100.87	4 81	1923–32	Oct 1, 1922	Guardian Savings & Trust Co of Cleveland.
Everett, Mass	School	18,000	4¼	101.257	4 05	1923 41	Sept 1, 1922	F. S. Moseley & Co., Boston.
	Macadam	10,000	4¼	101.257	4 05	1923–27	Nov 1, 1922	
	Sidewalk	34,000	4¼	101.257	4 05	1923–27	Nov 1, 1922	
Flint, Mich	Paving	25,000	5	100	5	1923 26	Oct 18, 1922	Industrial Savings Bank of Flint
Fullerton, Cal.	City improvement	160,000	5	103 68	4 53	1923 42	Dec 1, 1922	Blyth, Witter & Co.
Garfield Heights, Ohio	Street	9,044	6	103.27	5 40	1924–33	July 1, 1922	Milliken & York Co. of Cleveland.
	Drive	7,349	6	103.08	5 32	1923–32	Sept 1, 1922	
Kingsport, Tenn.	Public improvement	20,000	6	106.17	5 49	1942	Oct. 17, 1922	Seasongood & Mayer of Cincinnati
Lincoln Park, Mich.	Sewer Water	40,000 30,000	5	100.15		1952	Nov. 1, 1922	Matthew Finn.
Mandan, N. D.	Park	9,000	6	102 50				....
Merced, Cal.	Sewer	70,000	5	102.89	4 71	1923	Nov. 1, 1922	California Company.
Mt. Vernon, N. Y.	Sewer	15,000	4½	102 11	4.30	1935–37	Nov 1, 1922	Lehman Bros., N. Y. C
	Drainage	30,000	4½	102.18	4.29	1933–38	Nov 1, 1922	Sherwood & Merrifield, N. Y. C.
	Highway	75,000	4½	100 34	4.42	1923–30	Nov 1, 1922	Sherwood & Merrifield, N. Y. C.
Muskegon, Mich.	General improvement	50,000	4½	100 037	4.49	1923–32	Sept 1, 1922	Harris Trust & Savings Bank of Chicago.
Newton, N. J.	Street improvement	20,000	5	163.228	4.61	1924–42	Aug. 1, 1922	Newton Trust Co.
Northampton, Mass.	Pavement	12,000	4¼	100 171	4.20	1923–28	Nov. 1, 1922	R. M. Grant & Co. of Boston.
Port of Astoria, Ore.	Improvement	55,000	6	100 077			Oct. 31, 1922	Freeman, Smith & Camp Co. of Portland.
Sand Spring, Okla.	Sewer extension	90,000	6	100	6	1947	Aug. 1, 1922	W. A. Brooks, Oklahoma City.
Wall, S. D.	Water	17,000	7	100	7 00		Sept. 18, 1922	Security Savings Bank of Rapid City.
Woburn, Mass.	Water	11,900	4½	100 78	4 19	1923–27	Nov. 1, 1922	Old Colony Trust Co. of Boston
	Macadam	33,500	4½	100.78	4 19	1923–27		
	Sidewalk	6,100	4½	100.78	4 19	1923–27		
	School	13,000	4½	100 78	4 19	1923–35		
	Sewer	23,700	4½	100 78	4 19	1923 45		

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 251 to 265, are the following:

Store and office building at Philadelphia, Pa., for Cunningham Piano Co., $1,000,000.

Shrine at St. Louis, Mo., for York Rite Temple Association, $3,000,000.

Theatre and office building at Philadelphia, Pa., for Stanley Co. of America, $2,000,000.

U. S. Levies Duty on Cement From Canada

The Treasury Department is preparing instruction to collectors of customs to collect a duty of 8 cents per 100 pounds on Roman, Portland and other hydraulic cement from Canada. Cement is on the free list of the new tariff act but with a proviso imposing a retaliatory duty equal to the duty imposed by any country on cement from the United States.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 251 to 265, are the following large projects:

Hotel at Chicago, Ill., to Paschen Bros., 111 W. Washington St., $2,250,000.

Office building at Chicago, Ill., to H. Erickson, 139 North Clark St., $1,000,000.

Passenger liner at Seattle, Wash., to Todd Dry Dock and Construction Co., Hylebos Waterway, Tacoma, $1,000,000.

Weekly Construction Market

This limited price list is published weekly, for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover only the chief cities are quoted. Very [illegible] on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 2; the next, on December 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.14	$3.65	+$4.40	$3.02½	$3.15	$3.85	+$3.30	$3.80	$3.75
Structural rivets, 100 lb.	3.85	4.00	4.00	3.75	4.00	4.80	4.50	5.00	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.04	3.85	4.00	2.92½	3.05	3.85	+3.30	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	61.1%	45%	59½%	57-5%	41%	39.2@51.8%	40%	30.00
Cast-iron pipe, 6 in. and over, ton	55.30	50.00	51.50	48.70	55.50	63.00	54.00	53.00	55.00
Concreting Material:									
Cement without bags, bbl	2.60	2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd.	2.00	2.00	+2.52	2.25	1.75	1.90	2.25	1.00	1.50
Sand, cu.yd.	1.00	1.35	1.57½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.10	1.65	2.25	2.25	3.50	2.25	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	[illegible].00	42.00	40.00	51.00	+41.00	39.75	35.00	22.00	50.00
Lime, finishing, hydrated, ton	16.80@17.17	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	16.90@19.10	12.00	9.90	11.00	18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	.0796	.065	....	.11	.08
Hollow partition tile 4x12x12, per block	.1230	.0776	.115	.0808	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	.93	.97	1.07	.95	1.00	1.08	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	[illegible]	.35	....	......	......	.50@.55	.56¼	.50@.60	......
Common labor, non-union, hour	.45@.60	.30	.30@.40	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 10c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net. and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks", gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars; other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 1.00¾.) Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Mill price of steel shapes and reinforcing bars firm at $2 per 100 lb. on ordinary tonnages. This quotation, however, is subject to shading of $1@$2 per ton on large inquiries. Some of the more attractive orders on structural shapes have been taken as low as $1.90, but special or undesirable plate business is quoted as high as $2.10@$2.15. Warehouse prices in the principal cities are fairly firm. Dallas, however, reports advance of 20c. on shapes and San Francisco, 30c. per 100 lb. on bars, during week.

Dallas quotes $2.52 on ¾-in. gravel as against $2.25 per cu. yd., following price rise, due to freight difficulties, in New York, Chicago and Denver.

Lumber prices generally firm. Minneapolis, however, quotes advance of $1.25 per M. ft. on Douglas fir. Lumber production in 394 mills reporting to the National Lumber Manufacturers' Association, for the week ending Nov. 4, fell off about 5 per cent; with a drop of 7 per cent in shipments, due to car shortage. Orders increased 3 per cent in volume during the week, leaving the status of the industry a little over 1 per cent below normal as to output; with orders 20 per cent and shipments nearly 30 per cent below normal.

Industrial conditions throughout the country are steadily improving but not without danger of labor shortage. New York building laborers' unions, however, have been involved in serious controversies for several months. Bricklayers and other mechanics, affiliated with the American Federation of Labor, have refused to use materials handled by members of independent laborers' unions. A proposal on the part of the New York Building Trades Employers' Association, to maintain the present wage scale but to permit individual agreements between unions and contractors, was rejected by the New York Building Trades Council, representing union building trades mechanics. Although these disagreements are a menace to building operations, nothing definite has transpired up to the present time.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

Volume 89 NEW YORK, NOVEMBER 23, 1922 Number 21

Fighting Anti-Highway Feeling

RECKLESS advocacy of road building of the type made notorious some years ago in the "good roads" propaganda is ill-advised and *Engineering News-Record* would never be a party to it. The systematic and scientific construction of a road system throughout the country is, on the other hand, held to be a necessary step forward in the development of transportation and an essential element in economic progress. For that reason any tendency which promises either to restrict the national building of roads or to return to piecemeal construction by local agencies is dangerous and should be first recognized and then opposed. This is the reason for the editorial review on another page outlining the current reaction against highway expenditure. It is important that those responsible for our road building programs should understand the situation and on the basis of such understanding set out to remedy it.

Clearing the Streets

WHILE we have been putting passenger travel in large cities underground and overhead so far as possible, we have kept freight traffic on the surface, and now find it constituting a fair half of the alarming congestion which is the biggest problem of city engineers and planners today. Chicago alone has an underground freight transportation system, a development unique in its history and construction as well as its general type. To judge from an account of its working, as given on p. 877 of this issue, the freight tunnels are by no means fully utilized; yet even so the system has done a great deal toward limiting the congestion in the narrow streets of the Loop district to a passable degree. New York or Philadelphia suffer more from traffic congestion than Chicago in spite of the fact that they have less intense crowding of business and relatively more ample street facilities. If the freight tunnel system is to be credited for this result in part, its possible application elsewhere than in Chicago invites thought. City traffic congestion cannot long continue to grow at its present rate without radical relief.

Research in Practice

AS WE build we learn. Tests of structural elements are now being carried out to guide in the detail designing of the Philadelphia-Camden bridge, and as in every such case the tests will yield fully as much information for other work as for this one enterprise. In each large and bold piece of construction there are new problems, for progressive engineering work is never far from the frontier of the sciences and arts on which it depends. Research to solve these problems is an excellent investment, since it helps to make the construction efficient and dependable. In the past such research based on the immediate requirements of practice has brought forth some of the most important contributions to engineering progress. Future progress will be firmly assured if we continue to make each problem of construction the occasion for further study and test. Enterprises of unusual magnitude present the most obvious opportunities, but the problems arising in ordinary work, though they may be smaller, are not less worthy of an attempt to find their solution. It is not customary to include a research item in the estimates or appropriations for the engineering cost of a piece of work, but ultimately, we may hope, such an item will have an acknowledged place; the expenditure will never fail to pay a profit.

Occasional Use

SHIPS drawing more than 35 ft. and in lengths approaching 1,000 ft. will pay only on the comparatively short ocean run between New York and Europe but because the special demand on that route warrants such abnormal vessels they continue to be built and, what is more, they influence the design of ports and port facilities everywhere. The locks at Panama, for instance, are 1,000 ft. long, not for the traffic they pass but because room must be provided for any ship afloat. Dry docks, too, rarely see a ship over 600 ft. long but because there must be places where "Leviathan," "Aquitania" and their like can be docked, we see "1,000-ft. drydocks" spotted around the world, in Liverpool, in Boston, in San Francisco, at Panama, and in the St. Lawrence at Quebec. Once in a great while do they justify their great size. Just now, for instance the 1,140-ft. dock at Boston, built by Massachusetts and sold to the federal government, is occupied by the British "Majestic," largest ship in the world. The Boston dry dock is several years old but this is the first time anywhere near her total capacity has been required. It might be interesting to figure out how much more it costs to provide for this very occasional use.

The Roadbuilding Season

HOW long is the roadbuilding season? Obviously it is not as long in Dakota as it is in Arizona and it is longer for gravel surfacing than it is for concrete paving, yet most textbooks and many engineers speak of it as some definite period. All computations in the old textbooks on macadam road construction are based on a 200-day working season. This figure has in some way been carried on into modern paved road practice and has led to common error in reckoning progress in road construction programs. It is interesting, therefore, to observe the statistics recently collected by the Bureau of Public Roads of the periods considered practicable for road construction in the different states. Allowing for Sundays only, there are 313 working days in the year and three states only report that grading is possible on 300 days. Florida, Louisiana and Texas report 265-, 260- and 275-day working seasons. In the North there are Maine with 110 working days, Wisconsin with 153 and Oregon with 100. In 14 states grad-

ing is considered to be impracticable after Nov. 1. Gravel surfacing, it is stated by ten states, can be placed during a season exceeding 200 days, but most states set the period as between 120 and 200 days. In 26 states concrete pavement can be laid on from 100 to 150 days and in 16 states on from 150 to 200 days. In 28 states all construction has generally ceased by Nov. 1. These figures, it should be remembered, register prevailing practice. They should be supplemented by others showing the possible extension of the roadbuilding season for the several types of roads in the different temperature zones. With a roadbuilding season so brief, perhaps half the working days of the year as the statistics indicate, the problem before highway engineers is to determine means for extending road work over a longer period of the year.

Public Works and Competition

IT IS commonly believed that public improvements are constructed in response to public needs, and that the demand resulting from such needs is the impelling force that causes the improvements to be built. This belief is no doubt true in a broad sense, although, as everyone knows, public demand is often quite inarticulate. But other influences are sometimes the immediate motives for public works construction, by arousing if not creating the demand. A case in point is found in the Hudson River bridge situation. The 150-mile length of river from Albany to its mouth has always been without a highway bridge, and traffic has contented itself with slow, awkward ferry service. Even a city as large as Poughkeepsie never seemed to feel the need for better means of crossing; at any rate no loud demand for a bridge came from that city. Some months ago, however, a group of enterprising engineers conceived that a bridge could be built to advantage at Anthony's Nose, which is some distance below Poughkeepsie, and proceeded to form a company and obtain a charter for its construction. This project apparently revealed to Poughkeepsie its own need for a bridge, for at once active agitation began, first to block the Anthony's Nose charter and, when this move failed, to develop an independent bridge project. In consequence careful engineering studies were entered upon, and if the men back of the proposal retain their faith it is reasonably certain that the bridge will come into existence. There can be no doubt that the traffic demands and warrants its construction, but the traffic demand in itself would have remained silent for years. If the bridge is built it will be due to the spur of competition. Thus it appears that our old friend of the economics primers has an important meaning even for the engineer, and should be worth cultivating.

Economics of Logging Railways

THE economic aspect of railway projects assumes special and very practical importance when such peculiar conditions as the following must be taken into consideration: (1) A definite and predetermined total amount of traffic, which will be handled in a period of years, after which the railway will have only a salvage value; (2) paying traffic all in one direction and decreasing gradually from the outer portions of the line; (3) possible suspension of traffic during two or three winter months. But these are actual governing conditions in logging railway practice, as explained in an article on another page. It will be evident that the engineer who has to provide a railway for the removal of timber from a certain forested area or property in mountainous country has very special problems to consider in the economics of location, construction and operation. With the economic aspect of such large importance, it is evident also that work of this kind cannot be entrusted simply to a construction foreman. There is a somewhat general opinion that logging railway work is of a crude and pick-and-shovel quality, involving little or no engineering skill. But from the article noted above it will be seen that most careful consideration is required to produce a line that will provide economically for adequate facilities for its owners in getting out their timber during a term of perhaps ten to fifty years. Furthermore, it is encouraging that several of the larger timber concerns now recognize this condition and realize the economic or direct money value to themselves in putting their logging railway work into the hands of engineers.

Widening the Laborer's Opportunity

ONE effective answer to the trade union closed-shop apprentice restriction is the establishment of trade schools. Aside from the many private ventures a few cities like Cincinnati have initiated public schools. Chicago has recently established one under the Citizens Committee to enforce the Landis award. The movement has grown directly out of the fight by the local unions against opening up the decidedly restrictive working rules and regulations. Basicly the union idea of restricting the number of skilled mechanics to the lowest possible number of workmen is unsound. It smacks much of the old world special privilege classes, of the caste system of India. Freedom as to choice of work and equality of opportunity is a fundamental of American life and thought.

A year ago the average young man in Chicago with an aspiration to learn one of the closed-shop trades had neither freedom as to the choice of the trade he would like to enter nor equality of opportunity. If he were the son of a carpenter he could learn the trade of a carpenter, but it was practically impossible for him to become a plumber's apprentice. This condition could not go on. The inexorable law of supply and demand has a corollary that is almost as active in operation as the law itself, viz., demand will create an ever-increasing supply until the remuneration approaches the average. For only a limited time can artificial barriers to economic laws dam the flood of public opinion and urgent necessity.

Perhaps nowhere in the country have the constitutional privileges been flaunted and these economic laws been more disregarded than in Chicago. But Chicago is on the way toward economic freedom and equal opportunity of its skilled labor through the operations of the Citizens Committee to enforce the Landis award. Judge Landis gave a new, simple and practical expression to what Americanism means. His decision as arbitrator in the controversy between the building trade unions and contractors associations largely had to do with present working conditions. Day-to-day and year-to-year practical operation of the decision has been the burden of the committee which bears the judge's name.

In the solution of the supply-demand feature the com-

mittee has borrowed men from its sister cities. At the best this is an expedient measure. A transfer of money from pocket to pocket does not make one richer. Ten million people with ever-increasing needs are added to our population every ten years. Accordingly the existing proportion of skilled mechanics must more than keep pace with the natural increase, which means that Peoria cannot lend men to Chicago permanently. Formation of trade schools open to everyone is the logical development.

The Citizens Committee has opened the first class in an intensive training of plumbing apprentices. The course as arranged will take for completion two and one-half to three years for the average youth instead of the four years under the former union conditions. Instruction is free. Each apprentice is assigned to Landis award contractor under pay after three weeks intensive training. Then he returns to the school for from four hours to one day per week. Courses in other trades are being added. The opportunity is also given for advancement by those already in the trades. Already many men in the helper class have brought up their skill to that of journeymen and a number of competent foremen have been developed from the journeymen. Naturally the men have been pleased to move ahead in their trade. The contractors have found the school has not only improved the skill but also the morale of their men. Problems of the day's work are brought up and discussed; thus defects are eliminated.

Provisions for trade schools should receive more attention from public school officials. At best citizens committees are ephemeral as to duration. Close cooperation of the schools with the contractors and ultimately with revamped, new-visioned labor unions (if any are to exist) will always be necessary to make the system a success. Unwittingly union resistance to the enforcement of the decisions of labor's own arbitrator has widened opportunity in Chicago.

Emphasize the Practical

ENGINEERS are fond of thinking and saying that the public does not appreciate them and that from this lack of recognition spring most of the ills of underpayment, that crystallized grievance of the profession. There is not perfect continuity in this reasoning, because the analogy does not hold in other lines of work. No one especially admires the straw hat wholesaler nor goes out of his way to praise the great work done by the corporation lawyer. Yet both of these men are paid a large and disproportionate wage, because each in his own way can take advantage of the economic necessities of those to whom he sells. The engineer, on the other hand, rarely has to deal with an individual or compact group of individuals over whom he can exercise this economic advantage. His customer or his client is the people because no matter with whom he deals at first hand, in the end it is the public who benefits by his work. This public, then, controls his reward, and in proportion as he has its regard will he himself profit, taking the mass of engineers and not the individual as a measure.

It follows that this growing desire to inform the people of the importance of the engineer in the world's affairs is well grounded and deserving of serious study and promotion, but in so doing one thing must be remembered: the engineer is a practical and not a romantic figure. Already the world has altogether too high an appreciation of the romantic possibilities of engineering. The application of the forces of nature to the uses of man has a great hold on the imagination. It is easiest to picture it in its outward aspects, to see only its high spots—Eads throwing the Mississippi to clean its own outlet, Marconi picking a wave out of the ether to carry the human voice, Goethals driving thirty thousand men to dig a ditch across Panama and, in its simplest terms, Kipling's Findlayson, a lonesome superman struggling far from civilization to bridge the Ganges. There is no danger of the public underestimating this phase of engineering. Next to the soldier and the fast disappearing cowboy the engineer is the most romantic figure of the times.

But the great and enduring everyday work that the engineer does in bettering the economic and physical conditions of life are not properly evaluated. Toward changing this the publicity efforts of engineering societies can well be directed. Citizens can be shown how the rearranging of traffic routes save life, how the improvement of the water supply reduces disease, how the development of a better type of paving lowers taxes—not as generalities but as specific instances in which the citizen himself is interested. Stockholders can be told how the engineering control of the business has increased profits—and if it does not when properly applied all of us who are in engineering and believe in its principles had better get into something else. In both public and private enterprises the practical must be emphasized and the khaki clad romantic left as far as possible to the scenario writer and the weekly fiction magazine.

Two weeks ago in New York State there was a good example of how great is the emotional appeal. For state engineer the Socialists ran Steinmetz, the electrical genius, a romantic figure in engineering if there ever was one. Against him the two major parties put up good engineers, each a man of experience in the administration of state office and either one superior to Dr.Steinmetz in the detail qualifications necessary in the office of state engineer. What happened? He was not elected but over 200,000 of the voters of the state of New York scratched their party tickets and voted for the man who leads the world in the knowledge of electrical transmission, not because that and his numerous other talents were desirable in the state engineer's office but because he has become, justly no doubt, the romantic embodiment of engineering genius. What the state needed before election was some good publicity as to just what the state engineer had to do, what were the qualifications of each of the candidates and how much more important for this particular job were qualities of what might be called average engineering ability than exceptional genius which can be used to greater advantage where it is now occupied.

In hammering on the practicalities of engineering there may be danger of setting up in the mind of the public a cold dollar-and-cents individual who has no vision beyond the immediate material job in hand. That would be a misfortune which can be avoided by proper publicity methods, but even such a figure is better to present than the adventurer, whom the world may love but not necessarily reward, or the superman, who is both respected and rewarded but who in real life is rare and therefore untrue as a representative engineer.

Building Concrete Bridge Around An Old Steel Bridge

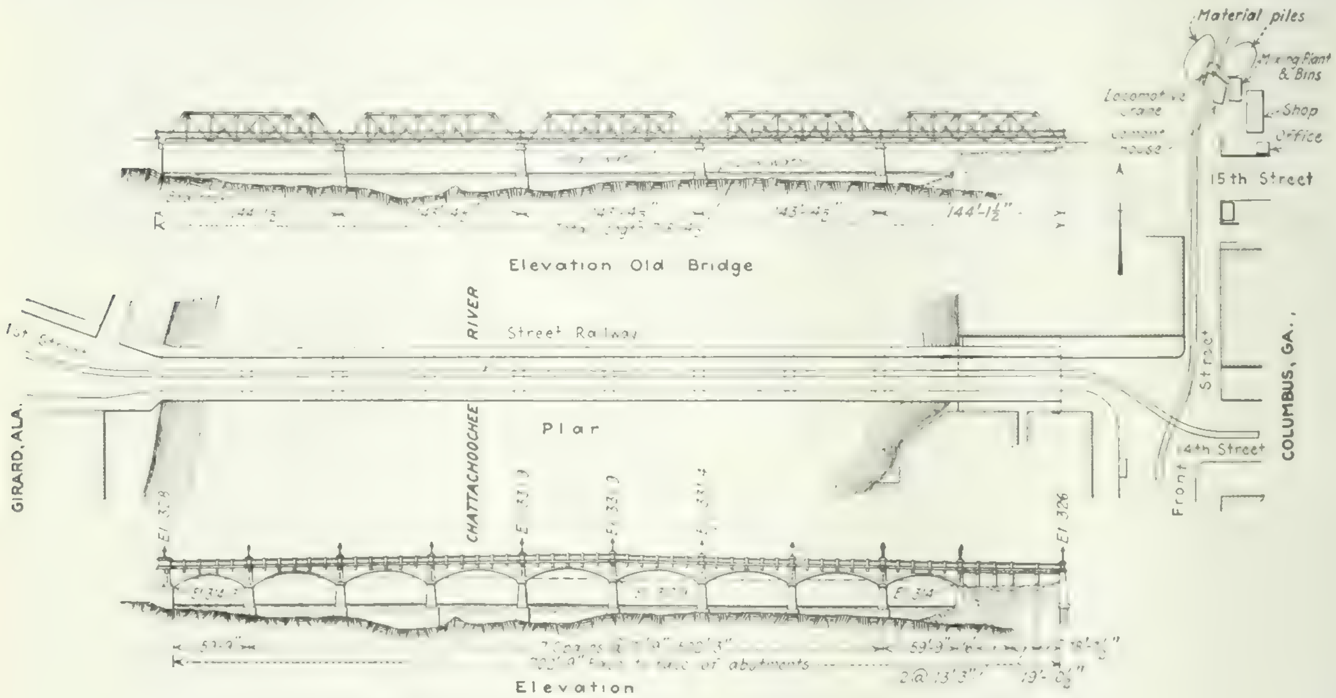
Old Piers Utilized and New Ones Placed Midway of Old Spans in Bridge Across Chattahoochee River in Georgia—Steel Trusses in Service During Construction

By Searcy B. Slack
Bridge Engineer, State Highway Department, Atlanta, Ga.

In the construction of a new concrete arch bridge replacing an old steel bridge over the Chattahoochee River at Fourteenth St., for the city of Columbus, Ga., there were two main problems: first, the utilization of the old bridge (substructure and superstructure) to best advantage and second, the minimum inconvenience to the heavy foot and wheel traffic which uses this bridge. The bridge connects Columbus with Phœnix City and Girard, Ala. The solution involved the construction of the concrete arches under the trusses and the utilization of the old piers.

The old bridge consisted of five 140-ft. through Pratt, pin-connected trusses with a 24-ft. roadway and two 6-ft. sidewalks. The bridge had a wood floor and originally carried a street car line but of recent years, due to bad condition of floor system, street cars have not used the bridge. The substructure consisted of four concrete piers with round ends 6 ft. by 27 ft. 6 in. under coping and gravity type concrete abutments. All the piers and the west abutment are founded on solid rock (gneiss). The east abutment is on piling. Between the east abutment and the first pier the bridge extends 62 ft. between two cotton factories before reaching the river bank. The factories are connected by a walkway under the bridge and a large number of pipes, wires, etc., and one of the requirements of the new bridge was to provide as much space as possible underneath this approach for use by the factories. The old bridge was built in 1901 and a careful inspection of the concrete piers showed them to be of good material and in excellent condition. The trusses of the old bridge were in fair condition but the floor system was very much weakened by corrosion of the steel.

Several alternate plans were considered before finally deciding upon the filled spandrel arches. One of these alternates contemplated the use of through concrete arches with bottom chords, the arches to be built just outside of the old steel trusses as the centering for the arches supported by the trusses. This plan was abandoned as the roadway would have been made 2 ft. 6 in. narrower and sufficient room was not provided on top of the old piers for proper detailing at the ends of the arches. The plan adopted required the construction of four new piers between the old piers and the counterforting of a concrete retaining wall between the cotton factories so that it would serve as the east abutment. Between the new piers and the old piers nine filled spandrel barrel arches were built and a slab approach supported by column bents connected the east abutment and the improvised abutment pier. The west abutment was strengthened by adding a new concrete wall in front of the old abutment.



OLD AND NEW BRIDGES ACROSS CHATTAHOOCHEE RIVER, COLUMBUS, GA.

The suggested method of construction set forth in the specifications was as follows: "In the opinion of the engineers the logical method of construction of this bridge is as follows: Cofferdams be constructed for piers "D," "F," "H," and "J"; these cofferdams to be floated in place and the piers erected therein, placing concrete through floor of the existing bridge; abutment "B" be constructed; bents Nos. 1 to 5 be constructed; additional concrete for abutment "K" be placed."

"The existing steel spans can be raised so that the bottom flanges of the floorbeams will clear sidewalk elevations of the new bridge. These spans can be raised by cribbing on top of the present piers and after proper height has been reached shoring from the bases of the

existing piers to the bottom of the shoes of the spans leaving no crib work on top of the old piers. By raising the spans in lifts successively traffic can be maintained during this operation. After the old spans have been raised the existing piers can be cut off to the proper elevations and new caps placed. Centering for the arches can be planned so as to be supported from the floorbeams of the old spans. The centering for the arches can be placed and the arches concreted through the floor of the old bridge. After the centering has been removed the spandrel walls can be built, omitting sidewalks; spandrel fills can then be made and the old bridge removed, traffic being permitted on the spandrel fill of the new bridge. The sidewalks can be constructed and one-half of the brick pavement laid, traffic can then be diverted from the spandrel fill to the new pavement, and the bridge can be completed. The east approach span can be constructed beneath the old bridge, the first span of the old bridge being raised to sufficient height to clear the new slabs, traffic being handled to the old span by means of a short runway on grade not exceeding eight per cent."

In the actual construction this method was carried out as outlined except placing bents against old piers to support the steel trusses while the piers were being cut off and capped for the arches. The method used was more satisfactory as it did not require placing bents against the piers. The central portion of the piers (about 20 ft. long) between the shoes of the steel trusses was cut down to the proper elevation and the middle 18 ft. of the new cap and arch skewbacks poured. The old piers were cut down by drilling hol s in from both sides with compressed-air drills. The holes were from 6 to 12-in. centers depending upon the accuracy of cut desired. The holes were feathered and wedges were driven splitting the concrete out in blocks. After a little practice the crew became very expert and the necessary cuts were made with ease and surprising accuracy. Cutting out concrete from one of the old piers is shown in one of the accompanying illustrations.

After the central portion of the new pier caps and skewback had set, lifting beams, consisting of two 24-in. I-beams 29 ft. long connected by plates, were cribbed up on the new concrete work. The beams were so placed that they overhung the shoes of the two adjacent trusses. Holes were burned through the cover-plates of the end posts and straps were passed around the end pins of the trusses and over the lifting beams. Four 75-ton hydraulic jacks were then placed and lifting the old bridge began. It was necessary to raise the bridge 8 ft. 6 in. at the center and 4 ft. at each end so that the floorbeams of the old bridge would clear the extrados of the new arches at the cr wn.

ARCH BRIDGE UNDER CONSTRUCTION BENEATH THE OLD TRUSS BRIDGE

Traffic was maintained over the central part of the bridge and both sidewalks during the lifting, runways provided at each end being shifted as the trusses were lifted. After the lifting was finished the lifting beams were cribbed up on the new concrete skewback, leaving the ends of the piers clear so that the old concrete could be cut down and the new cap and skewback for the arch ribs completed. The new bridge required a counterfort at the ends of the piers bracing the spandrel walls. At the ends of the old piers contractors enlarged these counterforts somewhat and poured them up to a suitable height to carry the old trusses. As soon as the concrete had set, the trusses were lowered until the shoes rested on the counterforts and the lifting beams and cribbing were removed to be reused.

After the old steel spans had been raised and set on the counterforts, ce tering for the arch rings was constructed under the old spans. The centering was

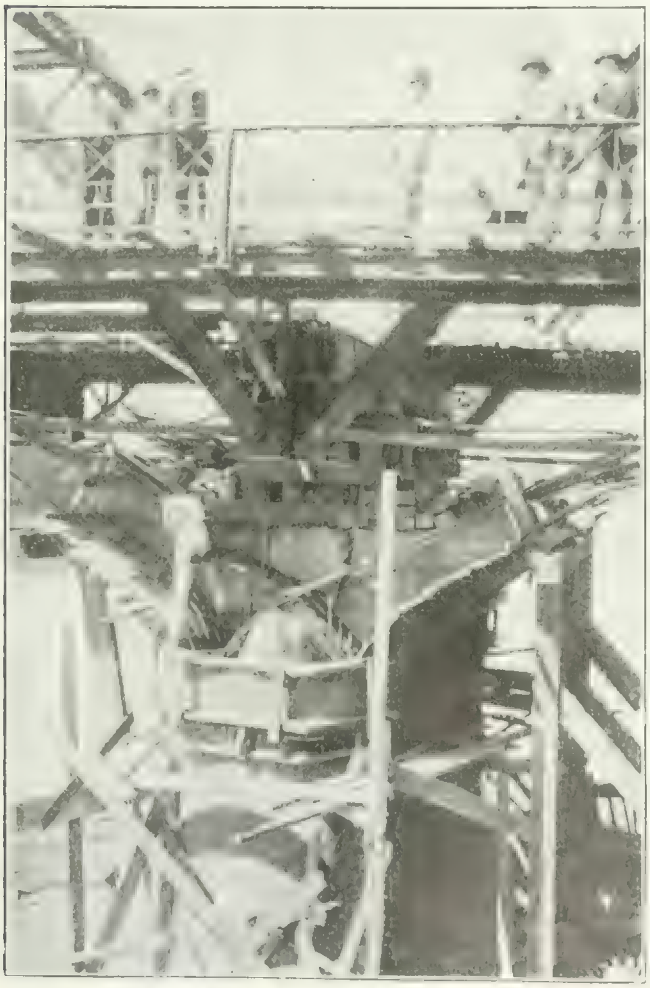
THE COMPLETED NEW ARCH BRIDGE

supported by fastening rods to the floorbeams of the old trusses. These rods were wrapped with tar paper where they passed through the concrete arch ring so that they could be withdrawn as soon as the arch rings had set. To prevent overloading the old trusses the arch barrels were poured in three sections each 9 ft. wide. The downstream sections were poured first from abutment "B" entirely across to abutment "K." As rapidly as these sections set the centering was released and set for the upstream section. As soon as the upstream sections had set the centering was released and the center section poured, completing the arch barrels.

Forms for the spandrel walls, cross walls and sidewalk brackets were constructed between the arch barrels and the old trusses and this portion of the new bridge was completed. The spandrel fill was made by dumping through the floor of the bridge. A rather coarse sand with a small amount of loam was used for this fill and the material was wet down in layers as it was placed. The stone drains along the backs of the spandrel walls proved very effective in carrying off the water used for packing the sand. When the spandrel fill was completed the floorbeams of the old bridge were blocked up on the fill and the old trusses were taken down. The spandrel fill was then made up to the level of the floor system and the floorbeams were removed, the floor and stringers resting directly on the sand fill.

The old floor was cut, leaving a width of from 12 to 15 ft. directly against the upstream side of the bridge and a 9 ft. strip of the concrete paving base was poured between the edge of the old floor and the downstream curb. After this paving base had set, traffic was diverted from the floor of the old bridge to the 9 ft. base, the old flooring was removed and after setting street-car tracks the paving base was completed. The vitrified brick paving was placed from the upstream street-car track to the upstream curb and as soon as completed traffic diverted from the downstream concrete paving base to the finished brick paving and the remainder of the brick surfacing was completed. An asphaltic filler was used in making the brick pavement.

INTERMEDIATE PIERS BEING PLACED



TURNING TRUSS PIER INTO ARCH PIER

Construction Methods—The equipment and methods used by the contractors were very well planned. All materials were delivered by rail to a yard about 500 ft. from the east end of the bridge where they were unloaded and stored by a crane. The same crane used for unloading was also used to fill the material hoppers of the central mixing plant. All concrete was mixed at this plant and hauled to the bridge in trucks with dump bodies and handled by chutes from the truck bodies to the forms through trap doors and holes in the floor of the old bridge. In spite of the heavy traffic over the bridge, which greatly hampered the concrete trucks, as much as 100 cu.yd. of concrete was frequently handled in a day.

All drilling was done by air which was furnished by a compressor located near the east end of the bridge. Electric power was also available for lights, pumping, etc. A woodworking shop equipped with a band saw, cutoff saw, planer drill press, etc., driven by electric motor was set up near the material yard and all necessary wood work for the frame was done here. Work in the river was done from a barge equipped with hoisting engine and stiff-leg derrick, dredging in the cofferdams being done with an orange-peel bucket.

Under terms of the contract 14 days' interruption to traffic was allowed during the removal of the old bridge and laying of the paving base. By constructing a traveler, for removing the old bridge, through which traffic could pass and by cutting the floor so as to permit laying the paving base in sections, the contractors maintained traffic with only a few hours' interruption during the entire construction.

This work was done by Hardaway Contracting Co. for the city of Columbus, Ga. B. H. Hardaway, Jr., and Guy Jones were in charge for the contractors. George Hardaway was engineer for the contractors. Garrett & Slack were consulting and designing engineers.

A Low-Head Hydro-Electric Plant of 84,000 Hp. in Norway

Development Illustrative of Modern European Practice Involves Large Roller Dam and Novel Timber Chute

By W. Francis Lloyd
London, England

Recent European practice in the design of low-head hydro-electric plants is well illustrated in the new 84,000-hp. development recently completed at Raanaasfos, on the river Glommen, 50 miles from Kristiania, Norway. The scheme presents many unique features which are of particular interest. In consequence of several other water-power developments on the same river, the total daily discharge of the river at Raanaasfos is guaranteed at a certain amount—varying with the time of the year. To provide for the guaranteed daily discharge and also for the best available head in the various seasons, it is necessary to use a roller dam and two sector dams, by the manipulation of which it is possible to adjust the head and discharge to a nicety.

Timber Chute—Owing to the enormous quantity of timber passing down the river the government required the power company to construct a timber chute to provide an adequate passage for the timber in the low water period. The chute is designed to deal with about 180,000 logs a day, the necessary water amounting to from 15 to 30 cu.m. per sec. The chute is 800 m. long, 200 m. of it taking the form of a tunnel, the remaining portion being an open concrete canal.

The section of the tunnel is trapezoidal to secure a large area for the logs with the minimum loss of water.

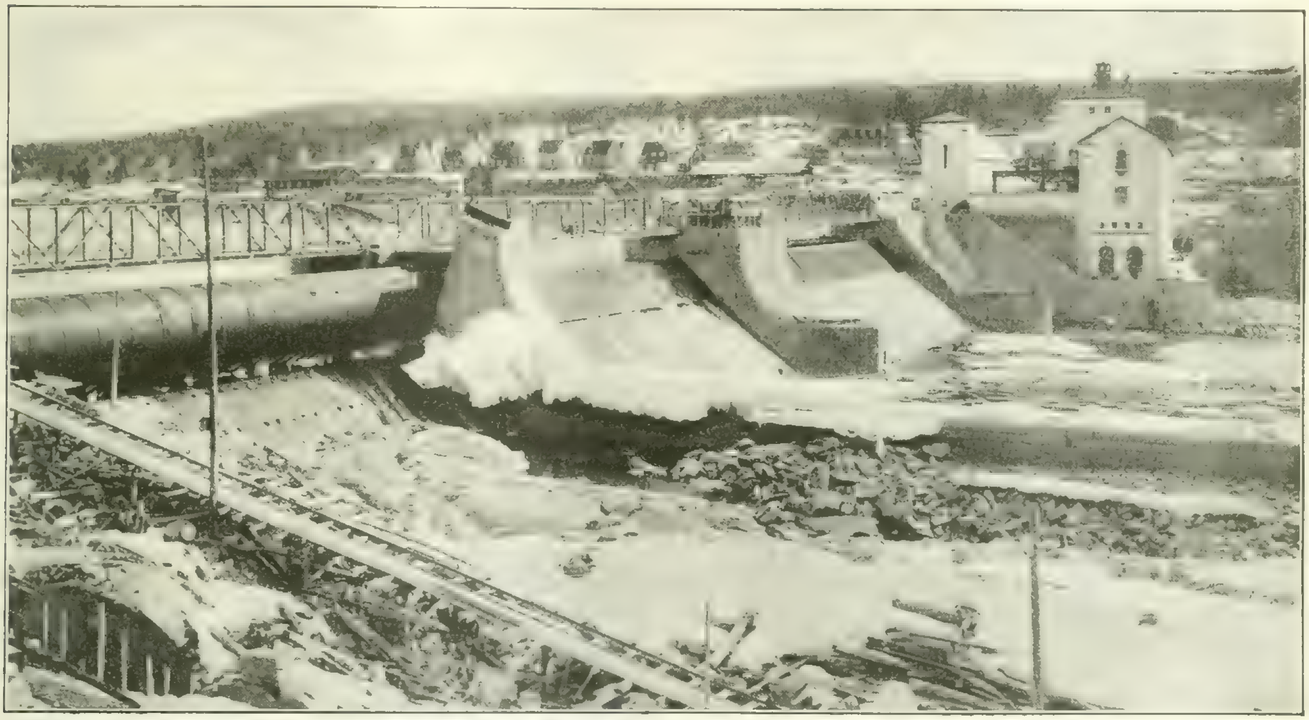
The cross-sectional area and gradient are designed to give the water an ever-increasing speed, thereby eliminating the possibility of the logs jamming. Booms of steel construction are laid across the river to divert the timber toward the chute.

The intake is provided with a sluice gate, in front of which is laid an adjustable bottom plate which regulates the water supply to the chute.

The Dam—The dam comprises a spillway, discharge sluice gates, two sector dams and a roller dam.

The spillway is designed for discharging masses of ice which accumulate in winter above the power station intake. The spillway is 3 m. long and is provided with a sluice gate which may be quickly opened and closed to get rid of the ice blocks.

Surplus water is discharged through six sluice gates situated at the bottom of the dam, each 2 m. wide by 4 m. high. These gates were designed to discharge sufficient water to facilitate work on the foundations of the dam and turbine intake during construction. The gate hoisting gear may be controlled either by electricity or by hand.



LOOKING ACROSS THE DAM TO THE POWER HOUSE IN NEW RAANAASFOS DEVELOPMENT IN NORWAY
Roller dam in foreground has 21.3 ft. diameter. View taken in April and shows late ice conditions.

The sector dams—which are a new departure for Norway—are each 50 m. long and are capable of regulating the head to an extent of 3.75 m. They can be opened or closed in 10 min. When completely closed, opening is facilitated by the injection of compressed air into the interior of the sectors. Thawing out, in the winter, is effected by steam supplied by a boiler accommodated in the middle pier.

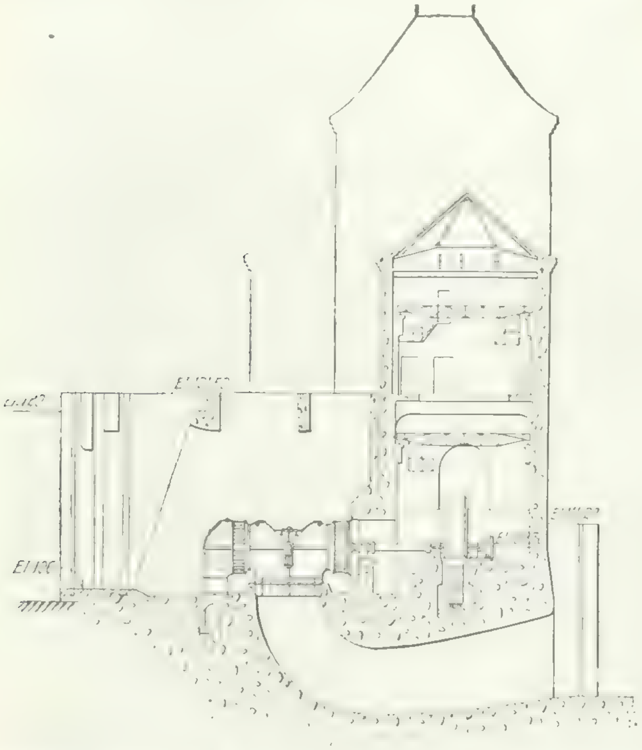
The roller dam, seen on the left in the above view, is 45 m. long, the diameter of the cylinder is 6.5 m. and the weight 500 tons. It can be lifted to the full open position in 65 min. by a 50-hp. motor working through a gearing of 4,200:1, the largest gear wheel weighing 10 tons. The operating gear at the ends of the cylinder is heated electrically to insure operation in the most severe frost.

The roller dam is capable of adjusting the head to an extent of 6.5 m.

Power Station—The power station is built on an ex-

tension of the dam on the left bank of the river. The turbine pits consist of six open flumes in which the turbines gates and trash racks are installed. During the winter the racks are electrically heated to prevent ice formation. The gate operating machinery is housed in a special building which is heated by hot air from the generators.

The six turbines are of the horizontal, twin runner, Francis type, each capable of developing 12,500 hp. at 13 m. head or 14,000 hp. at 14 m. head. The speed is 107 r.p.m. corresponding to a specific speed of 388 metric units. The diameter of the runners is 3.5 m. and the guaranteed efficiency 85 per cent. Three of the turbines are of Swedish and three of German manufacture.



SECTION THROUGH POWER HOUSE SHOWING ONE OF THE GERMAN TURBINES

A great point of difference of design between the German and Swedish turbines lies in the arrangements for supporting the main shaft. The Swedish turbines have no middle bearings, the shafts being of hollow design and of sufficiently large diameter to keep the maximum deflection within the prescribed limits. Such an arrangement eliminates the heavy cost of the middle bearing with the consequent necessity of providing an inspection shaft.

The drawing shown gives the general arrangement of one of the German turbines directly coupled to the generator. A section of the plate steel inspection shaft to the middle bearing is indicated in this drawing. This shaft runs down from the bearing at an angle of about 45 deg. to meet the communication tunnel running out from the generator room below ground.

The governing arrangements of all the turbines are of the automatic oil pressure double servomotor type, the oil being supplied under pressure by separate oil accumulators. The regulating movement is communicated to the guide vanes in the usual way by means of a horizontal regulating shaft supported by bearings on the turbine casing.

LOOKING UPSTREAM TOWARD THE PLANT
Trapezoidal concrete timber flume shown at left foreground.

The six direct-coupled generators are designed to develop 12,000 kw. each at 7,500 volts a.c. They are of the totally enclosed type and are air cooled. The air is drawn from the tail race side of the power station and driven through the generator coils by vanes fixed on the rotors. The discharged hot air is led through ducts to the sluice gate house.

An auxiliary 250 hp. hydro-electric unit is installed at one end of the generator room, for excitation purposes and station service.

The bulk of the power station output will be transmitted to Kristiania at 50,000 volts, three-phase, 50 cycles, the remainder supplying the surrounding country at a line voltage of 17,000.

Work on this scheme was commenced in 1919, and the chief engineer in charge of the whole construction, August Paus, is to be congratulated on having the turbines running according to schedule, in spite of

LOOKING DOWNSTREAM TOWARD POWER HOUSE
Timber boom in right foreground and bridge over dam at right background.

many unforeseen difficulties. The total cost of the development is estimated at Kr. 40,000,000 which is equivalent to Kr. 476 per maximum horse-power.

Weight and Cost of Rondout Creek Bridge

Supplementing the information on the 705-ft. suspension bridge over Rondout Creek at Kingston, N. Y., given in our issue of Sept. 14, p. 424, the following figures on cost, weight and capacity can be given: The total cost of the structure is about $700,000. The design loading is a continuous line of 15-ton motor trucks in both directions, which represents the heaviest trunk-line highway traffic. The cables and suspenders weigh 300 tons, and the structural steel of towers, trusses and floor system 1,430 tons.

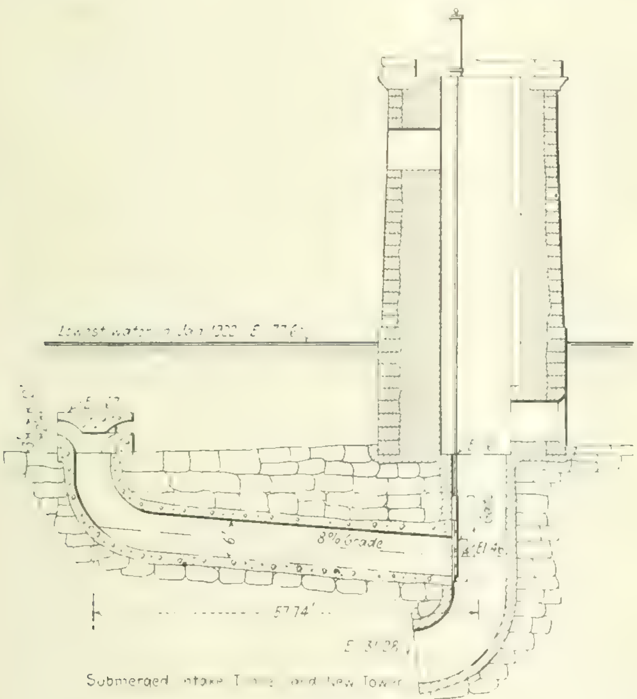
Auxiliary Submerged Intake Alongside Tower

Experiments with Model of New St. Louis Water Tower Indicate Sand and Ice Must Be Handled by Different Means

By C. M. Daily
Engineer in Charge, Supply and Purifying Section, Water Division, St. Louis, Mo.

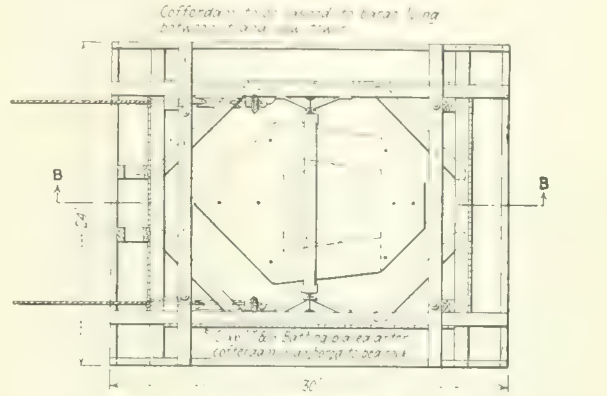
FROM an experimental model of the new St. Louis water tower it has been concluded that the best arrangement is to have a submerged intake alongside for use only in the winter to prevent the entry of ice. Permanent nose pieces or deflectors will not effectively keep out both ice and sand.

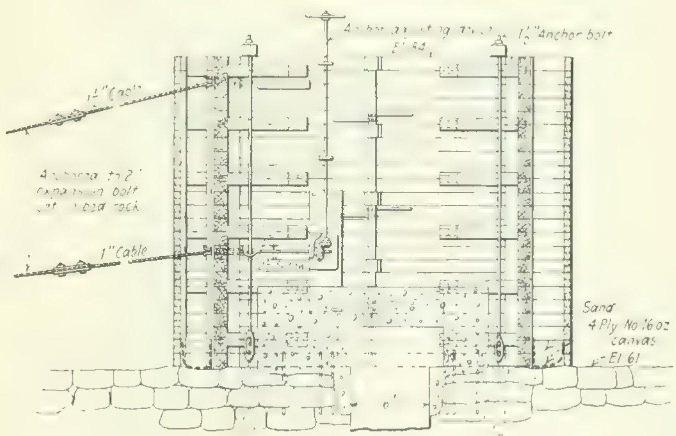
The water supply for the St. Louis water department has been taken from the Mississippi River for nearly 100 years and for more than one-half of that period was drawn through intake towers located in the channel. The Bissell's Point intake tower, which was built about 1870 and abandoned in 1895, was located close to shore in the channel. Our files show that various ice booms, ice deflectors and other devices were designed and built to prevent ice from entering its ports. The old tower at the Chain of Rocks was built in 1894 and has to its credit many such devices designed and built for the same purpose. All of these expedients were more or less unsuccessful, due to the varying direction and velocity of the current when carrying large quantities of ice. The latest and perhaps the most successful measure undertaken for the purpose was the rebuilding of Homer's Dike, which caused a cross-current to deflect the main ice-bearing current away from the tower.



The new tower, which was built at the Chain of Rocks in 1915, has lower ports than the old one, but it has been less effective in excluding the ice, due unquestionably to its location closer to the center of the channel, in a stronger current, where more ice strikes the tower and is crushed by the impact into small particles, which are carried by the swirls and eddy current to the bottom of the river and into the ports.

Over a year ago an experimental intake tower and tunnel were constructed on a 1/30 scale of the new tower and various experiments were conducted with floating ice at velocities equal to the velocity in the river multiplied by 18/100. $\left(\frac{1}{\sqrt{30}}\right)$. The water was maintained at a depth corresponding to the depth of the river during low stages in winter. It was found that the eddy currents carried the ice to the bottom of the model channel and into the ports. Various deflectors were placed in front of and behind the tower; it was found that when the deflector did not cause the water to pile up ahead of the tower no ice was carried below the surface.





SUBMERGED INTAKE FOR USE IN WINTER TO PREVENT ENTRY OF ICE

In connection with the model tower several submerged intakes were placed close to the tower and determinations were made of the amount of floating ice which would enter them, also of the amount of sand which would enter when sand bars of various heights passed. The results of the experiments are given in the Water Commissioner's annual report of last year as follows:

> The model nose piece or deflector in front of the tower, while efficient for preventing ice from entering, is very inefficient in preventing the sand from entering the gates when a bar of any height is passing.
>
> The submerged intakes are efficient for preventing the ice from entering the tower and also for preventing the sand from entering when a low bar, under 3 ft., is passing.

When a bar of more than 3 ft. in depth is passing a great deal of sand will enter.

The tower as designed is very efficient in preventing sand from entering the tunnel when a low bar is passing, but with a high sand bar, say over 4 ft., sand and gravel will be lifted to any of the higher gates by the eddy caused by the sharp nose piece.

It is very evident that if ice is allowed to pass undisturbed little will be drawn into a port a few feet below the surface, but if the port is on the side of a tower at the bottom of the river a blunt nose piece is necessary to cause a side current to force the sand from the side of the tower. In consequence it is impossible to place any sort of a permanent deflector ahead of the new tower to meet both conditions. The two conditions must be met separately. A submerged intake, as shown in the illustration, is suggested as a solution for the ice troubles. It is intended to use the submerged intake only during the winter months, keeping it closed the remainder of the year. The accumulation of sand during the summer months in the short tunnel from the submerged intake to the down-take shaft will be easily washed into the main tunnel and carried to the pumps each winter without any difficulty.

The tunnel work may be done from the down-take shaft and the gate erected before breaking through the outer end within the cofferdam previously anchored in place. An air-lift pump on shore, of more than 5-m.g.d. capacity, will care for the leakage.

It is estimated that the cost of this work under the most adverse river conditions will not exceed $40,000 and that under favorable river conditions the cost may be only $30,000.

Seattle Fills Land with Garbage, Ashes and Refuse

For Thirty Cents a Ton Sanitary Fills Are Being Made at Sixteen Points Within City Limits —Three Destructors Scrapped

FOR about seven years Seattle, Wash., has been disposing of its garbage, ashes, and other refuse within the city limits by the "sanitary fill" method—that is, by dumping it on low land and covering it with earth. The earth covering is only a few inches deep and is but a small percentage of the total volume of the fill which may be as much as 18 or 20 ft. deep. In contrast to popular objection that was at first raised to this method of disposal, it has now been demonstrated that these fills can be made so as to be entirely free from nuisance. The present attitude of the people of Seattle is shown by the fact that the Health Department has on file continually a waiting list of property owners who desire to have lots filled by this method.

The development of the sanitary fill is held by the Seattle authorities to be cheaper and more satisfactory than incineration. The use of Meldrum destructors (a British type) was discontinued, city officials state, on account of the high cost of operation. These were all duplicate installations, each having a capacity of 65 tons per 24 hours. The first was built in 1908 and was used five years; the second and third units, built in 1911 and 1912 respectively, were each used for three years. These destructors are reported to have been very effective, the only objection being cost of operation.

Records kept by the engineering department give costs that average about 60 cents per ton, exclusive of depreciation, interest on the investment, or other overhead charges. The actual total cost, in the opinion of city officals, was about $1 per ton. At that time the average wage paid men working at the destructor was only $3 per day. Under present conditions it is estimated that the cost per ton would be about double the previous figures.

One of the three destructors was retained by the city for some time as a place to burn paper and other waste material of an inflammable nature but since 1915 individuals have been allowed to pick paper, cardboard, etc., from the fills and they also assist the city to some degree by sorting out other inflammable material. All three destructors have therefore been disposed of. One of the buildings was razed, a second remodeled for a carpenter shop, and a third leased for storage purposes.

In contrast to disposal by incineration the cost of making the sanitary fills, exclusive of delivery costs, is about 30 cents per ton, or less than one-third the cost of incineration as practiced at Seattle a few years ago. The 30-cent charge includes no allowance for the increased value of filled land. Dwellings have been built on sanitary fills 20 ft. deep.

Collection and Delivery—Delivery is now being made to sixteen fills widely distributed over the city. This wide distribution materially reduces delivery cost by shortening the haul. A total of ninety-three teams with two men each collect garbage from the entire city (except hotels and restaurants) which now has a population of about 315,000 and covers an area of about 66 square miles. Collections are made once a week from dwellings, every three or four days from apartment houses on the outskirts of the city, and six or seven times per week, as required by sanitary conditions and freedom from alley obstruction, from factories, docks, department stores and throughout the business district generally.

The hotels and restaurants have contracts with the owners of a hog ranch who take all garbage from these places that can be used as hog food. The collection of garbage and refuse by the city is made without charge, the cost of this service being met by taxation. In making the household collections there is no restriction on what will be accepted. Everything classed as refuse is included and anything from old bath tubs to tree trimmings is taken without objection. In fact, "garbage" in Seattle is taken to include kitchen wastes, ashes, tree prunings, boxes and other packing materials discarded by department stores, commission houses and factories. Practically everything wasted in the city except sewage and the debris from buildings that are razed, is accepted by the scavengers.

Sites preferred for garbage disposal under the present plan are areas where a fill 10 to 14 ft. deep can be made adjoining paved streets. As a new fill is started it is brought up to the desired level and then maintained at that level by dumping the garbage over the edge of the fill instead of on top of it. As fast as the area of the finished level is extended it is covered with a few inches of sand, and planks are laid as a runway for the garbage wagons.

Loads of sand or other material used for covering the garbage are delivered on top of the fill at the point where the garbage wagons dump over the edge. One attendant paid at the rate of $5 a day is kept on each fill. He shovels earth over the edge as required to cover

the freshly dumped garbage, rakes some of the garbage down the dump to get the desired arrangement, and does a limited amount of sorting and piling up wooden boxes and other objects of a large size at the foot of the dump.

Method of Filling and Covering—The covering is done as soon after dumping as is consistent with the separation of material that can be burned readily. The picking over is done largely by persons who come for the paper and cardboard they can glean from the piles. This salvage nets them about $3 per day and as they aid in clearing the material that can be burned, it has been found cheaper for the city to allow them to salvage this material for their own benefit than to have it removed at the prevailing laborer's wage. Boxes and other bulky objects that will burn are piled up near the foot of the dump and the attendant occasionally sets fire to these piles.

Garbage delivered at a fill recently visited by a representative of this journal amounted to an average of twelve wagon loads a day or about 96 cu.yd. This was adequately covered by 8 cu.yd. of sand per day, spread on as the garbage was dumped over a 12-ft. embankment. This was in August when there were practically no ashes in the garbage. During winter months, when seventy or eighty tons of ashes are collected daily, some of the fills are entirely covered with the ashes without requiring any filling material brought in expressly for the purpose. The total amount of garbage now collected daily by the city varies from 400 tons in summer to about 500 tons in winter.

The sand or other material for the covering is delivered by two teams which do nothing else and two trucks which devote part of their time to this work. Thus far it has never been necessary to excavate material expressly for this purpose or to haul it for distances greater than about $1\frac{1}{2}$ miles. Usually suitable covering material is available close to the garbage fill. Often this comes from public or private grading or excavating operations. A large supply of waste is taken regularly from a gravel washing plant which is conveniently located. Often the department has on file applications for the disposal of more material than can be utilized for covering.

Experience has taught the men that the best means of making an effective fill is to work the wet material or "garbage" proper down to the bottom of the dump slope and then get the dry, coarser refuse over it. After the sand covering is shoveled on, which is done immediately, from piles kept at the edge of the dump for that purpose, there is practically no offensive odor or gathering of flies. As the top of the fill is kept level and is covered with earth, it has the same appearance as any fill made entirely of earth and only the outer end of the dump at the time of dumping betrays the true nature of the fill.

Fills 10 to 14 ft. in depth increase in area rather slowly and are compacted to some extent by the wagons that drive over them daily. After several years of experience it is asserted that these fills do not settle much more than a fill made entirely of earth and they are approved by the city building department as suitable foundation for light structures.

Garbage disposal operations in Seattle are carried on by the Health Department under the direction of C. L. Murray, superintendent, who supplied the data on which the foregoing notes are based.

Foundation Excavation Removed by Tunnels at Chicago

Shafts on Building Site Chute Material to Cars of Narrow-Gage Underground Railway for Disposal on Lake Front

REMOVAL of excavated material from building sites by tunnel trains and thus eliminating much truck haulage and dropping of dirt in crowded city streets is an unusual method which has been in operation in Chicago for several years. This method is made practicable by utilizing the network of 62 miles of small tunnels which underlies the central portion of the city and carries an electrically-operated freight railway system of 2-ft. gage. These concrete-lined tunnels are of oval section about $7\frac{1}{2}$ ft. high and 6 ft. wide, with the rail level approximately 45 ft. below the surface. One of the numerous intersections of the east-west and north-south lines is shown in Fig. 1.

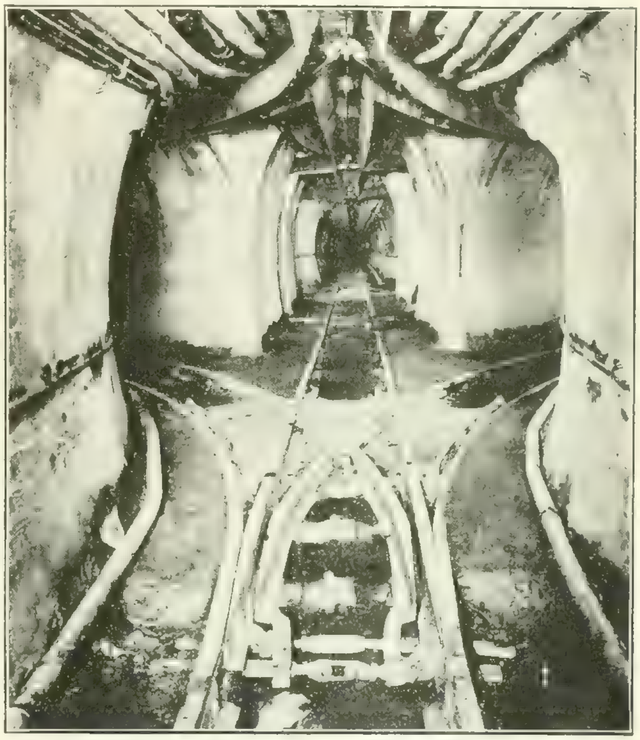


FIG. 1. NARROW-GAGE TUNNEL HANDLING FREIGHT AND EXCAVATED MATERIAL AT CHICAGO

There are two intersecting tangent tunnels at this point, connected by four junction curves.

In deep foundation work and in excavations for basements and sub-basements of large buildings it is common practice to sink an inclined shaft or chute to the tunnel under the site, the tunnel being enlarged or having a spur built for a siding to enable a car to be set under the chute. The upper end of such a shaft is shown in Fig. 2. Surface dirt is excavated usually by steam shovels and removed by motor trucks owing to the rapidity and cheapness of making the excavation and removing the loose materials. But for the slower work of excavating and handling the underlying stiff clay the tunnel system has many advantages. In wrecking old buildings in the business district much of the débris is removed by the tunnel cars.

This tunnel system was built particularly for freight handling service and connects numerous railway freight

stations with commercial houses, department stores, warehouses and office buildings. Spurs are run into the basements and at freighthouses the cars are raised to the surface in order to avoid handling the freight to and from elevators.

For waste material there is a disposal plant or dump on the lake front near Sixteenth St. where the cars are raised in shafts and hauled to the dump by gasoline locomotives. Cars for this service have removable bodies with hinged bottoms, the bodies being handled by a locomotive crane and a fixed derrick at the dump. The latter is shown in Fig. 3. In the past eight years about 1,500,000 cu.yd. of ashes and excavated material have been deposited at that site, filling about fifteen acres of land for the new lake-front park without any expense to the city. This filling was described in *Engineering News* of April 6, 1916, p. 658, and the work is still in progress.

Tunnel traffic averages about 10,000 cu.yd. of excavated material monthly, 7,500 cu.yd. of ashes from buildings and power plants, 4,000 cu.yd. of coal to these plants and 45,000 tons of merchandise handled to and from railway freighthouses. The coal business was formerly much larger but of late years the larger coal companies have maintained fleets of motor trucks for the delivery of coal. Cars of 3½-cu.yd. capacity are used for hauling excavated material, refuse and ashes. Trains of 6 to 8 cars of such material and 12 to 15 cars of freight are handled at an average speed of 8 m.p.h. by electric locomotives, of which 110 are now in daily service. The average haul to the disposal station is 2½ miles.

Contractors make agreements for this service on each job at a charge per cubic yard, the price varying according to the haul, the quantity of material and the conditions under which the work is to be done. These charges are about the same as those made for wagons or motor trucks, since all this business is competitive. The entire movement of motors and cars in the tunnel

FIG. 2. CHUTE FOR DUMPING INTO TUNNEL CARS

Chute is marked by white cross. The vertical shafts are for foundation piers.

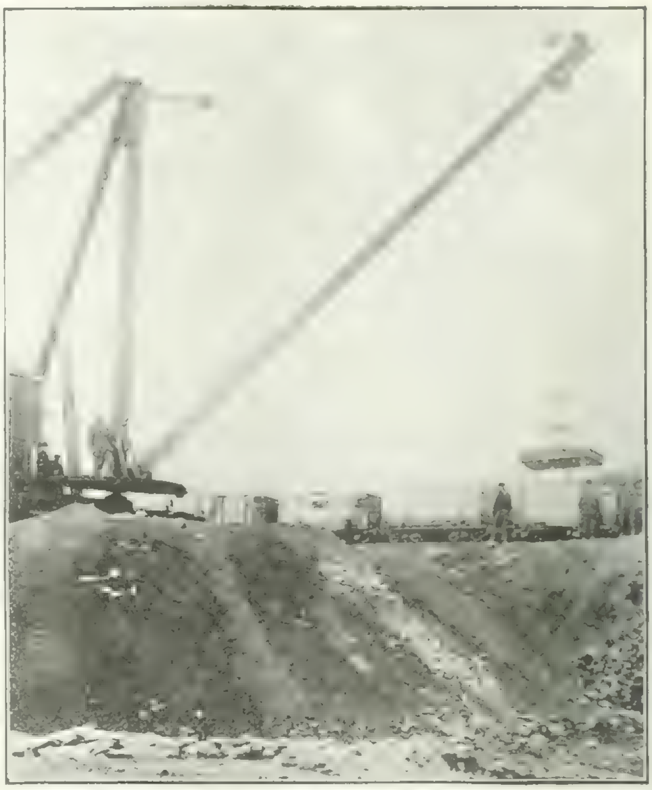


FIG. 3. DUMPING CARS AT FILL

is under the direction of a dispatcher who is continuously receiving telephone reports of business available for movement and the motors available for use. In freight service, when a motorman finishes with a train he is instructed by the dispatcher where to pick up another train. The handling of excavated material and ashes is largely a schedule proposition, the motormen reporting to the dispatcher at the end of each trip. This tunnel system is owned and operated by the Chicago Tunnel Co.

Tastes and Odors from Chlorine

TASTES and odors of water as affected by chlorine applications arising from conditions created by modern factory practice and habits of domestic life have been studied in the laboratory at the Iowa State University. Dr. Edward Bartow and R. M. Warren reported recently the conclusions of their experiments as follows before the Iowa section of the American Water Works Association:

Chlorinated water may have a taste other than that given by excess chlorine.

Taste and odor may be developed by other oxidizing agents than chlorine, and they generally increase with the amount of chlorine absorbed.

By further oxidation aeration may increase rather than remove taste.

The oxygen-consumed method of control is good only when taste and odor are due only to excess chlorine.

Water should have access to air to give a chance for odors developed to escape.

For any given water there is an oxygen-consumed value about which chlorine will give taste and odor. When this limit is reached some method of oxidation should be used before sedimentation and filtration, so as to give an opportunity for dissipation of taste and odor during treatment, before final chlorination.

The colorimetric method is not accurate if the water contains any appreciable amount of phenol or cresol.

Logging Railway Practice in the Northwestern Forests

Engineering Skill Made Necessary by Economic Conditions—Large Projects—Methods of Location, Construction and Operation

IN planning logging railway systems for the development of large timber properties, governing economic and operating conditions are involved which differ in many respects from those which govern ordinary railway work. For example, the lines are comparatively temporary, serving for periods of perhaps five to fifty years; the loaded traffic is all in one direction, and the value of the line decreases steadily as the timber is got out and the total traffic to be handled grows less. The traffic also decreases with the increase in distance from the shipping terminal. In location, property lines become an important factor, since a logging railway is usually not a common carrier and cannot condemn land for right-of-way. Therefore, unless the railway can be kept within the boundaries of the timber company it may be compelled to pay high prices for right-of-way across other property.

FIG. 1. EARTH CUT IN TIMBERED LAND ON RUTLEDGE LOGGING RAILWAY

On the other hand, the fundamental principles of railway location remain the same. Thus, it is essential to have the main line as direct as possible, on the minimum economic grades, passing as nearly as possible through the center of gravity of the prospective tonnage and with grades descending in the direction of the tonnage. Branches must leave the main line as soon as possible in order to develop the area served. Their grades may be steeper than those of the main line but always, or as far as possible, descending with the loads. The cost of these branches must be proportionate to their total anticipated tonnage. For logging lines the total tonnage is known in advance as the amount of timber in the areas served has been determined. But for ordinary new railways the prospective tonnage is largely an assumption based on many factors, some of which are beyond the control of the railway company.

Engineering in Logging Work—Engineering skill is now applied more than formerly in the planning of logging operations, since the days are past for easy logging along streams or by crudely constructed railways laid out as the work proceeds. The large bodies of timber remaining in the Northwest are high up in the mountains, involving heavy and expensive railway construction for means of access, but as the prices of timber increase it becomes economically practicable to build these lines. For large logging projects, therefore, careful study and detailed plans must be made before development is undertaken. For the locating engineer, the economic location of lines in heavily timbered country is no easy task.

Many of the large timber companies now plan the development of their properties far in advance of requirements, so that when the project is commenced every move made is based upon the relation of that move to the general comprehensive scheme. This detailed advance study may bring to light unsuspected possibilities that would be overlooked in a general inspection. It may also develop unexpected difficulties, with the result that special methods may be prepared to overcome them, thus avoiding losses which might occur if these difficulties were discovered only during the progress of the work.

Certain and continuous transport of the timber is demanded by the amount of capital invested in logging operations and timber mills, and such transport is considered to be provided in the highest degree by railway communication. But to extend railway lines to the tops of mountain ranges involves difficulties both in engineering and in the economics of logging operations. Further, there is a ratio between cost of line and cost of logging which must be kept in mind continually. The method to be used in logging or getting the logs to the railway has a direct bearing upon the location, and the topography in turn governs the logging methods.

Rail and Cable Logging—On a logging railway project the main line is that portion that will be maintained throughout the duration of the entire project. A branch line may be of almost any length but is of a more temporary nature, as it will be taken up as soon as the territory close to it has been logged off or cleared. A spur is a short track, usually up to a mile in length, built out from the main line or a branch in order to give more ready access to the timber and permit logging operations to be conducted without blocking the major avenue of transportation. A setting is the point on a spur or elsewhere at which the logging equipment is installed for bringing the timber in to the track. As a rule, the same equipment operates over all lines and spurs, excepting that lighter locomotives may be used on the branches and spurs.

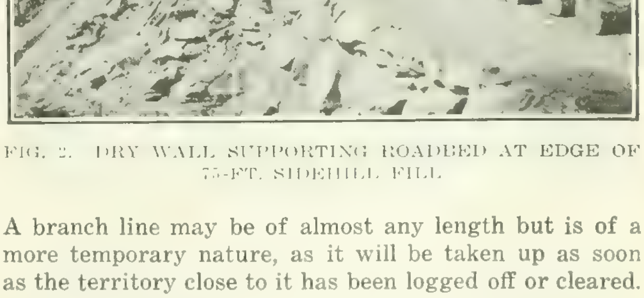


FIG. 2. DRY WALL SUPPORTING ROADBED AT EDGE OF 75-FT. SIDEHILL FILL

On the Rutledge property described below the logs are in most cases brought to the track by various designs of cableways operated by powerful donkey engines designed especially for logging service. The simplest of these cableways are for ground logging, which consists in attaching the log to the cable by a noose or choker and dragging it in over the ground. They range up to cable spans of 2,000 ft. with carriage; and cable lines up to a mile in length supported on posts. There is a great variety of method and equipment used and steam logging with cables requires a high degree of mechanical ingenuity and judgment, as all installations are more or less temporary and must be moved as soon as the timber within reach has been landed.

Between cable and railway transportation there is co-operation on the main line and main branches. But when it comes to secondary lines there is direct competition, as then it is a question as to which will be the most economical for the last half-mile to two miles. The answer depends upon the nature of the country and the kind and quantity of the timber. On some projects that are prohibitive for railways as many as three donkey engines and cable lines are used, each one hauling in logs and delivering them to the next donkey until the track or river is reached. In addition to much other equipment the Rutledge Co. has a skidder with a reach of 3,000 ft. Logs brought up to the track by the main cables are picked up by the loader and put on the cars.

Rutledge Logging Railway—A typical logging railway system of the modern type is that built in 1921-1922 to serve a forest area of the Edward Rutledge Timber Co. in northern Idaho. This railway includes about 30 miles of main line and 37 miles of branches, and in addition many miles of logging spurs from the branches. The timber area extends northeast from Clarkia and includes the Elk, Childs and Marble Creek basins. These basins are separated by mountain divides 5,000 to 5,500 ft. above sea level and in the form of a Y, so that access to the basins involves the crossing

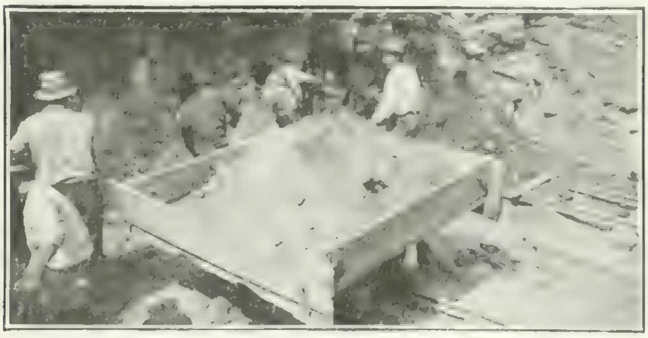


FIG. 2 GRADING BY STATION GANG

of the ranges. The country is very broken and the drainage is in deep valleys and ravines or gulches. A rail outlet for this district is afforded by the Ste. Maries River branch of the Chicago, Milwaukee & St. Paul Ry. which passes through Clarkia, at the foot of the Elk basin, El. 2,800. The passes to Marble Creek and Childs basin are at elevations of 4,050 and 4,780 ft. respectively. With short air-line distances between controlling points, considerable development was necessary to avoid the use of heavy grades, but as the timber lies in a compact body the entire railway is kept within the company's property.

Flat cars furnished by the Chicago, Milwaukee & St. Paul Ry. are operated over the logging railways and its spurs by 70-ton geared locomotives taking loads of about 550 tons. For these engines there is a machine shop and a 4-stall roundhouse at the Clarkia terminal. The trains are hauled 40 miles from this point by the C., M. & St. P. Ry. to unloading works on the St. Joseph River below Ste. Marie, the logs being floated down the river and Coeur d'Alene lake to the timber company's mill at Coeur d'Alene.

For convenience of logging operations it was desirable to have the logging spurs about one mile apart

FIG. 4. TRACK GANG WITH TRACKLAYING MACHINE

and above as much timber as possible. All the spurs are operated by main line equipment. In this way there would be a maximum cable haul of only half a mile to skidways or loading points on the railway. For such a location the spurs must be directly across the drainage, involving a crooked alignment and fairly heavy grading, together with a considerable number of bridges or trestles. The problem was to locate the main line in such a way as to permit the building of the branches and spurs in their proper positions and at the same time to cross the drainage to best advantage and to go through the heaviest belt of timber. It was found that the best timber was high up on the slopes, where the gulches are relatively shallow, and that if the line was sufficiently high the tops of the ridges could be utilized for the spurs.

Grades and Curves—To gain the necessary height a rapid ascent was necessary at the start and this was made with a grade of 3.5 per cent for about four miles in logged-off or cleared land. This arrangement gave more favorable grades through the logging area to Davies Pass and thence northeast to the limit of the timber. At several points the line had to be held within narrow limits to enable spurs to be located. Beyond Davies Pass the problem was to get a branch line down into the Bussel Creek and Marble Creek basins with fairly light grades, since the grades would be against loaded traffic.

High ground beyond the pass enabled a supported line to be run along the face of the mountain. The gulches and ridges are very long and would be objectionable in ordinary location, as they necessitate a lengthening of the line and much heavy curvature. But in this case they proved an advantage since the long loops would bring the railway closer to more timber and would reduce the length of the spurs without increasing the cost of operation, owing to the lighter grade. Under these conditions the descent was made on a 1 per cent grade, which gives a good balance for

traffic, since a geared locomotive can handle the same number of loaded cars up the 1 per cent grade as empty cars up the 3½ per cent grade.

Maximum grades on branch lines are 5 per cent and are in the direction of loaded movement. One 5-mile branch over an air-line distance of two miles rises from El. 3,710 to 4,780. In other cases 11- and 14-mile branches were necessary for air-line distances of six and four miles, respectively, but the swings were wide and gave access to a great amount of timber. The complete system serves the entire area without switchbacks, with no main-line and but one branch grade against the loads. In the total 67 miles of main and branch line 85 per cent is level or has grades with the loads and 15 per cent has a 1 per cent grade against the loads.

Loops were employed both to gain distance and to lower bridges and develop country. In one case there is a 20-deg. curve to the right for 230 deg. and then

FIG. 5. TRESTLE 60-FT. HIGH ON 20-DEGREE CURVE

to the left for 110 deg. Other cases include 19 deg. curves for 173 and 205 deg. and a 20-deg. curve for 192 deg. Swings of 100 deg. and more are not unusual. Grade compensation of 0.04 per cent per degree is used on all these loops. For the first 12 miles the maximum curvature is 20 deg. and then increases gradually to 30 deg. As the traffic is all one way, the quality of construction was gradually reduced as successive spurs were passed until at the far end the line was an ordinary logging spur without ballast and with very heavy curvature.

Earthwork and Bridges—Grading was fairly heavy, ranging from 15,000 to 40,000 cu.yd. per mile and with considerable bridging on many sections. About 40 per cent was solid rock, the remainder being all classed as "other material." Only a narrow right-of-way was cleared, in order to save timber. Fig. 1 shows an earth cut and Fig. 2 a 75-ft. sidehill fill with a dry wall to support the roadbed.

Bridging is considerable since the lines are continually crossing the drainage. A height limit of 60 ft. was set, even at a sacrifice of curvature, since pile structures could be used up to that height. There is a high fire risk on logging railways and as the burning of bridges must be anticipated only simple structures are allowable. A typical trestle is shown in Fig. 5. It is 60 ft. high and on a 20-deg. curve, with 75-ft. piles 30 and 14 in. diameter at butt and small end respectively. The batter of outer piles is ½ in. per foot.

In the standard trestle design, 5-pile bents are spaced 15 ft. 9 in. c. to c. on tangent. All stringers are lapped, except that in the line under each rail they are butted. Piles that were over 40 ft. long were driven with the butts down. This was considered to give the structure a better balance, to reduce bracing and to permit the use of heavier sticks so that piles could be used for heights which otherwise would require framed structures. Further, as 70-ft. piles are 24 to 30 in. in diameter at the butt, they have a much greater resistance to fire and decay.

Surveys and Construction—A map of the entire property on a scale of 4 in. to the mile and with 50-ft. contours was available and on this a paper location was made after an inspection of the country. A regular railway location party then ran preliminary lines, took topography at 10-ft. intervals, projected the line and then made the final location, which was marked with heavy stakes.

On completion of the surveys, a report was made on the cost of each branch line and the amount of timber upon it, the total property being divided into logging areas tributary to these branches. In this way it was determined what branches were best for working in hard times and in easy times. Average haul for each area was calculated on the basis of "1,000 ft. B.M. miles" instead of the usual ton-miles. This method is much more comprehensive for logging railway service and was devised by the engineer in charge of this work.

Construction was done by the company's organization, with camps two miles apart, the work being let on a yardage basis to stationmen who rented tools and equipment from the company. A station gang on excavation work is shown in Fig. 3. Two light steam shovels were used in grading. Instead of the usual camp foreman in charge of the work, each camp had a foreman-timekeeper who had charge of camp and local minor matters only, the superintendent of construction visiting each camp every day. Track was laid with a Norby track-laying machine (see *Engineering News-Record*, Feb. 19, 1920, p. 373). This machine is shown beyond the spiking gang in Fig. 4. It can lay and pick up track with equal facility, the latter being important in logging operations on account of the numerous temporary branches or spurs. The track has 60-lb. rails on locally-made ties and 10-in. of basalt ballast is used on the main line. When ten miles had been built the line was well in the timber and logging was commenced.

Organization—Surveys, location and construction work were under the direction of J. A. Chamberlin, chief engineer, and O. V. Humason, superintendent of construction, who are at the head of an engineering and construction department which serves various properties of the Weyerhauser Co.'s interests. Surveys and plans are continually being made for various projects, in order to devise economical methods of transportation. If the property is to be opened at once, enough railway trackage is built for about two years' work. Then the logging department extends the line as needed, but according to the original plans for the entire project. At the present time plans are being made for a 50-mile railway in difficult country simply to reach a large timber area of the Clearwater Timber Co. at Orofino, Idaho. This will be followed by the construction of a main line and branch line system of several hundred miles for logging operations that may continue for 40 years.

Construction Plant and Methods On Ohio Stadium

Winter Steel Erection and Summer Concreting Cut Lost Time—Carefully Planned Track System Saved Labor

By W. S. Hindman
Principal Assistant Engineer, Columbus, Ohio

A DEFINITE plan of construction based on the design of the structure, secured unusually rapid erection of the new stadium for the Ohio State University at Columbus, Ohio. A wide flung structure containing 4,300 tons of steel and 25,000 cu.yd. of concrete, much of it very thin sections for seat banks, railings and floors, was substantially completed in 14 months including the winter period from Dec. 1, 1921, to April 1, 1922, when no concrete was placed. However, because of the combination in the design, as described in *Engineering News-Record*, Oct. 19, 1922, p. 640—of a self-supporting steel structure and a concrete encasement, the four winter months were not lost time. During this period all the steel structural work was erected and construction bracing and crane trackways placed for the travelers which later were to handle the concrete. While primarily the combination of steel skeleton and concrete integument was adopted for other reasons than to facilitate erection and permit cold weather construction operations, it also accomplished these essential objects and deserves especial attention for that reason.

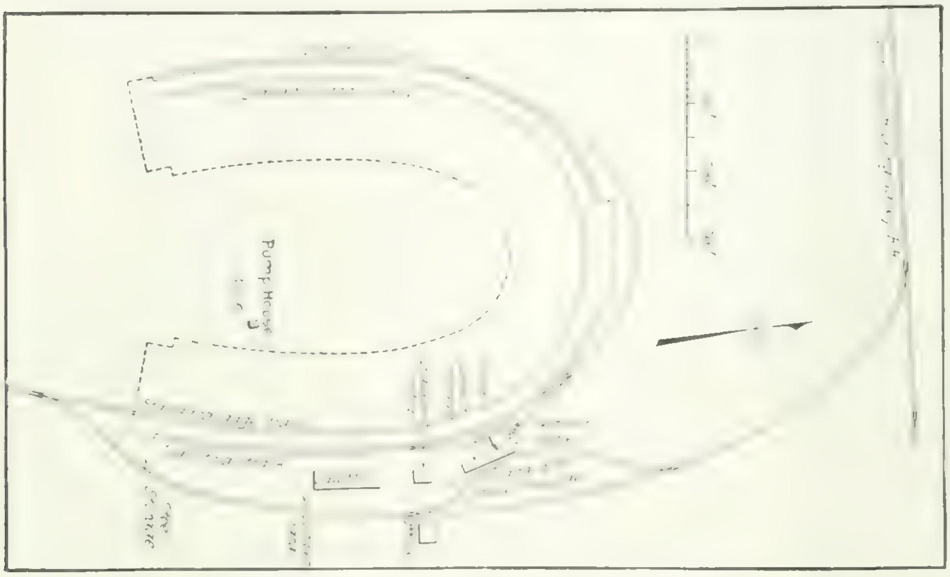


FIG. 1—TRACK SYSTEM AND PLANT ARRANGEMENT FOR CONSTRUCTING OHIO STADIUM

Plant and Track Lay-out—As indicated by Fig. 1 and described in detail in the previous article referred to above, the stadium is in the shape of a horseshoe. A well studied plant and track arrangement for transporting and then handling the materials to place was absolutely essential if the area of construction operations was to be covered without needless rehandling. As shown by Fig. 1 a spur from the Hocking Valley R.R. came into the University grounds just beyond the toe of the horseshoe and about at right angles to the longitudinal axis of the stadium which extends substantially north and south. A standard gage siding from this spur was swung south outside the east leg of the horseshoe and then turned into the east heel of the horseshoe and continued entirely around it to the end of the west heel. All construction materials were brought in on this track and on it were operated also the locomotive cranes for handling the steel and the concrete for footings.

The mixing plant and other buildings—sawmill, lumber yard, office, etc.—were constructed about at the middle and outside of the east leg of the horseshoe and between it and the siding track which swung south from the main spur track. From the mixing plant as a locus, narrow-gage service tracks were carried in two directions so as to parallel the entire outside arc of the horseshoe. These tracks were used almost entirely for transporting concrete from the mixing plant to where it was wanted in the structure. Almost every part of the stadium area, it will be observed, was reached by both the standard gage and industrial tracks.

A mixing plant which was exceptionally well equipped for mechanical operation was installed by the contractor. It consisted of elevated sand, stone and cement bins located over a 1 cu.yd. mixer which in turn was high enough to chute directly into buckets on industrial railway cars. The sand and stone bins were open-top bins and were kept filled by bucket conveyors, into the boots of which the material was discharged from hopper-bottom railway cars. The cement bin was enclosed and weatherproof. It was filled by screw and bucket conveyors from the cement house. Cement was received in bulk and stored in a cement house having three compartments holding a carload each. The mixer was charged by chuting from the bins in the ordinary manner except that the cement was proportioned by weight and was chuted from the bin into a weighing box before being delivered to the batch hopper of the mixer. Fig. 2 is a view showing the weighing box set on the platform of a scale having a dial permitting quick and direct reading. Water was measured by means of a tank and gage calibrated to show the number of gallons used.

Foundation Construction—The foundations consisted of column and wall footings on gravel. About half of the footings were below the low-water level of the river and had to be sheeted and pumped but otherwise involved only simple operations. With a locomotive crane on the standard gage track every footing practically could be dug by clam shell and the same crane could handle the concrete buckets to all footing forms from cars on the industrial tracks.

Perhaps the most complicated task was to locate the footings and more particularly the footing anchor bolts for the columns. Along the axis of the stadium there was an old channel of the Olentangy River and a base line here was impracticable. Two base lines parallel to the axis, one on each side and 250 ft. away, were laid out and the footings were located by co-ordinates from

them. A calibrated steel tape under a constant tension of 25 lb. was used and all measurements were corrected for temperature.

Constructing the Superstructure—Prior to suspending concreting operations on Dec. 1, 1921, about all the column footings had been concreted. From Dec. 1, 1921, to April 1, 1922, the steel was erected ready for the concreting of walls, seat banks and column encasements. Also most of the form panels had been made up and stored.

The principal concreting items were the outside column encasements, the field and other walls, the seat banks and floors, ramps and stairs. Mostly the sections were thin and a large footage of forms was required for a small volume of concrete. For example, in the upper seat bank 100 sq.ft. of forms were required for 1 cu.yd. of concrete. Incidentally it may be noted that there are 21 miles of seat in the structure.

All concrete was delivered from the mixer in buckets on industrial cars. The trains were run to the points on the railway whence a direct lift into the forms could be made. To lift the concrete four travelers carrying stiff-leg derricks were mounted on a track on top of the upper deck steelwork, as shown by Fig. 3. There were two travelers on each leg of the horseshoe and concreting was carried on at four places at the same time.

For the outside walls and columns the concrete was lifted by the travelers and poured directly from the buckets into the forms, in five lifts averaging about 20 ft. each. The seat banks were concreted in 60-ft. sections between expansion joints and in three sections radially for each deck. The concrete was deposited by chutes carried on travelers and having trap doors 5 ft. apart. All forms for the concrete were simple panels carried directly on the steel framing. The aggregate for the superstructure was crushed limestone and limestone screenings which give the concrete a very uniform color. Local gravel and sand were used for the foundation concrete.

The E. H. Latham Co., Columbus, Ohio, was the contractor for the stadium. Prof. Clyde T. Morris was engineer and W. S. Hindman principal assistant engineer.

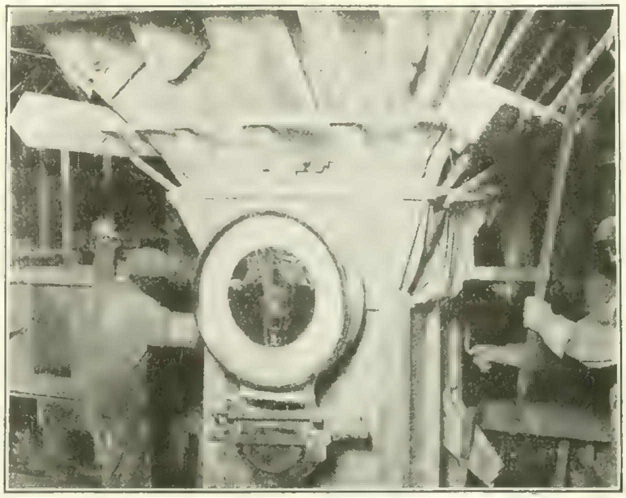


FIG. 2—WEIGHING BOX AND SCALE FOR PROPORTIONING CEMENT

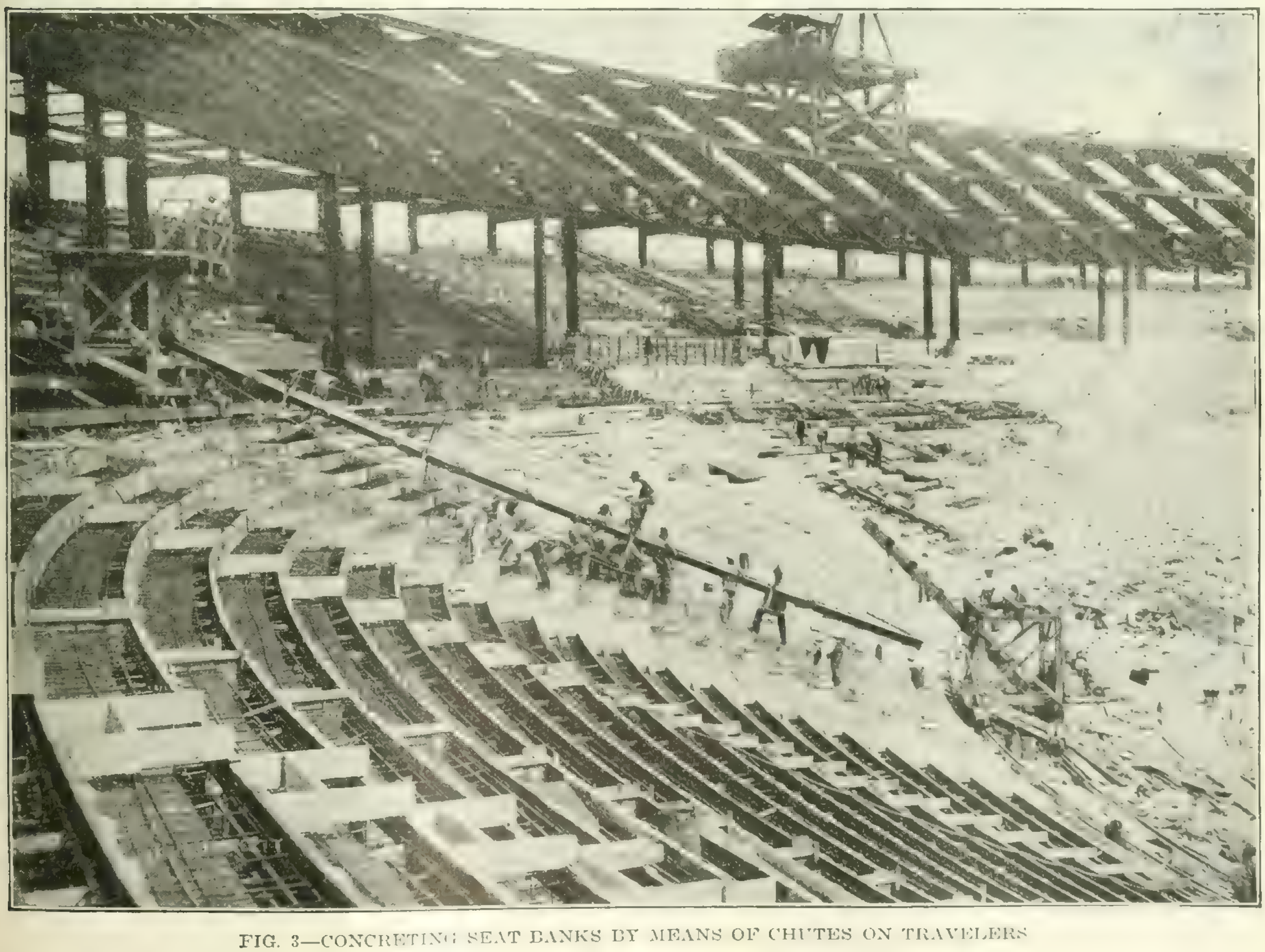


FIG. 3—CONCRETING SEAT BANKS BY MEANS OF CHUTES ON TRAVELERS

Bridge Protected from Shifting Channel: B. & O. R.R.

Permeable Dikes Build Up Sand Bar Where Indiana River Threatened to Cut New Course Through Bridge Approach

PROTECTION of a railway bridge and embankment on the Baltimore & Ohio R.R. against threatened erosion due to a shifting river channel has been effected by the construction of retards or permeable dikes built up of anchored trees and so arranged as not only to check the eroding current and cause silting but also to divert the current in order to cut a direct channel to the bridge. This work was at Washington, Ind., where the railway crosses the west fork of the White River just below a sharp bend in the channel. There are two truss spans of 211 ft. with pile and riprap bank revetment adjacent to the abutments. The situation is shown by Fig. 1 and the plan and sections in Figs. 3 and 4.

FIG. 1—CURRENT RETARD TO CORRECT CHANNEL OF WHITE RIVER, IND.

Anchored trees check current and cause silting so as to divert channel to bridge. Shifting channel eroded river bank at left and threatened to cut railway embankment behind bridge abutment. Note rock revetment on fill.

The original course of the river was a long hairpin bend to the north, between *X* and *Y*, Fig. 3, but this was changed a few years ago by the cutoff in the narrow neck above the bridge, as shown. This change diverted the current so that it attacked the east bank just above the bridge. The erosion encroached on the railway right-of-way and in the spring of 1922 there was danger of destruction of the east bridge abutment and approach embankment, as in nine years the east bank had been cut back nearly 400 ft. Rock riprap had been placed on the slope of the railway fill at intervals for several years, but while this would protect against wash it did not prevent undermining. In March, 1922, about sixty carloads of derrick-size stone were placed, but in August this had all disappeared.

FIG. 2—CABLEWAY PLACES TREES FOR DIKES

Solid dikes to check and divert the current were considered impracticable because a whirlpool which had scoured out the channel just above the bridge, as shown in sections *A*, *B* and *C*, Fig. 4, would probably undermine any such structures. A system of permeable dikes was adopted, therefore, the dikes being composed of whole trees lying horizontal and held in position by cables anchored to concrete piles sunk below the bed of the river and to deadmen on the bank. These dikes or current retards do not stop the flow but check the velocity and thus cause the deposit of sand and silt to build up a bar or shoal which protects the bank and diverts the current to a channel of less resistance.

These current retards are similar to those employed at several points on the Missouri River as described in *Engineering News-Record* of Dec. 15, 1921, p. 966. Concrete 40-ft. jet piles of the Bignell type were used for the anchors, being sunk with their heads about 25 ft. below the bed of White River in order to provide against future scour. These piles were placed by a derrick barge 18 x 80 ft., equipped with pump, hoisting engine and boiler and having at one end an A-frame 30 ft. high. In each retard the first pile was about 10 ft. from the bank and the others about 25 ft. apart. The depth of water at the time was from 2 to 15 ft. To holes in the head of each pile were attached six cables about 100 ft. long. Trees hauled to the work were lashed together in groups and attached to the anchor cables.

One of the difficulties in this work was in getting equipment to the site, since the river is not navigable. For this reason also the trees were not floated into position on scows for launching, as is done on larger streams. Instead, they were hauled out from shore by a steam hoisting engine on the bank operating a cable led over sheaves on a gallows frame set in the water, as shown in Fig. 2. The retard was built about 10 ft. high on the bank to prevent eddies from cutting behind it, and the average height above low water was 15 ft. The trees would sink readily to the bottom and were held in position by the action of the current and the cables. This process was repeated until the retard was of the desired length and reached to the surface of the water. Silting commenced as soon as the trees were in place.

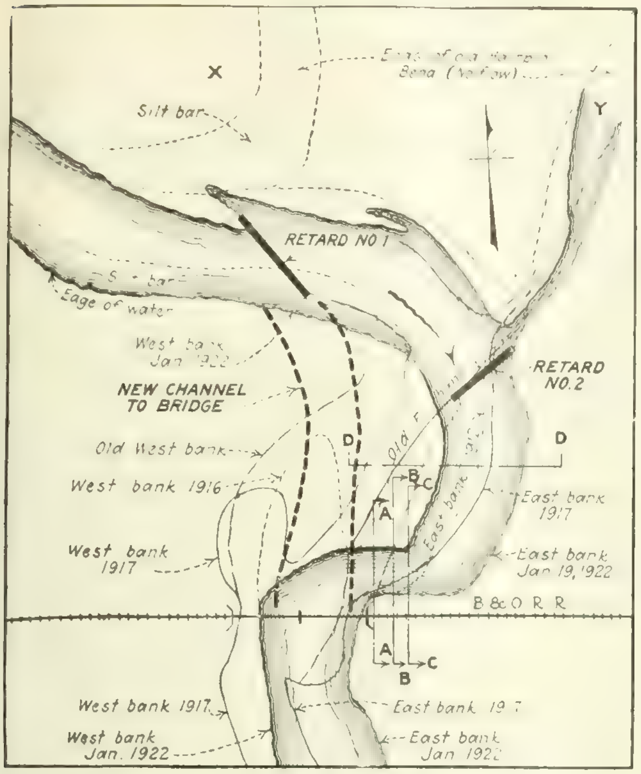


FIG. 3—SHIFTING CHANNEL OF WHITE RIVER NEAR WASHINGTON, IND.

Only two retards were required; the upper one 350 ft. and the lower one 250 ft. in length. Experience has shown that a positive inclination with the current is desirable for the upstream retard in such a situation as this, in order to prevent back eddies above the retard and to provide an easy deflection of the current while the sand bar is being formed. In this case also it was desired to divert the current against the projecting point of the old west bank and thus cut a direct channel to the bridge. The second retard, however, was placed practically at right angles to the current in order to form a bar or shoal that would replace the eroded land and form a protection for the railway embankment.

Cutting of the opposite bank due to diversion of the current began in ten days after completion of the retards. Within thirty days this cut had advanced about 50 ft. and a fill of 8 to 10 ft. had been formed at the retard. The relative conditions at retard No. 2 on June 13 and July 27 are shown in Fig. 5. With high water the formation of the new channel will be more rapid. The river has a current velocity of about 2 m.p.h. at low water and 8 to 10 m.p.h. during floods.

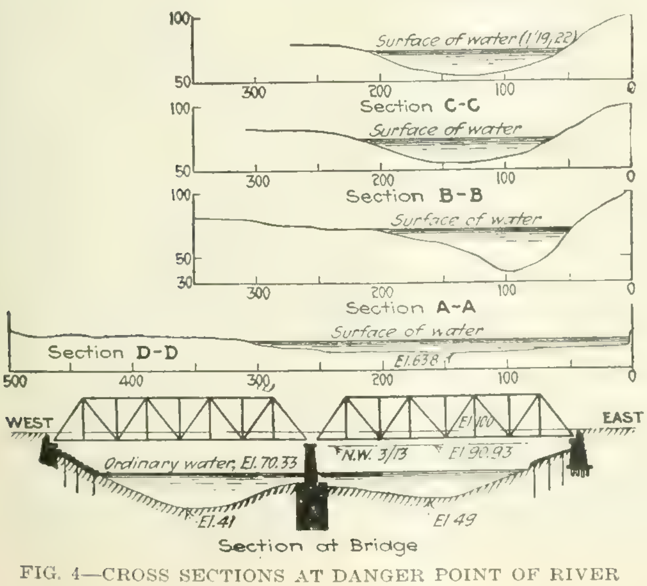


FIG. 4—CROSS SECTIONS AT DANGER POINT OF RIVER

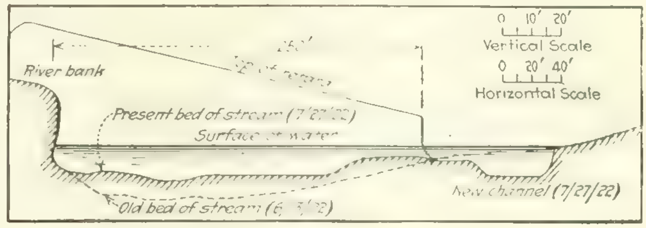


FIG. 5—CHANNEL CHANGES AT CURRENT RETARD NO. 2

The patents on this system of bank protection and river regulation are held by the Woods Brothers Construction Co., Lincoln, Neb. This company was the contractor for the White River work, with a force of about fifty men under Wayne Pringle, chief engineer, with W. E. Bilhorn assistant chief engineer in direct charge. The work was done under the general direction of A. H. Griffith, district engineer of the Baltimore & Ohio R.R. Construction was commenced June 9 and completed Aug. 22, 1922.

Fertilizing Value of Activated Sludge

EXPERIMENTS on the fertilizing value of activated sludge conducted by H. D. Brown, assistant, Experiment Station, Division of Sanitary Engineering, Provincial Board of Health of Ontario, led to the following conclusions, as given in the report of the board indicated for the year 1920, just made available:

(1) The nitrogen in activated sludge was readily available for plant food and was in assimilable form. (2) The sludge was very beneficial when applied immediately prior to planting. (3) Activated sludge gave a rapid early growth which exceeded that of any other commercial fertilizer used. (4) The maturity of the plant was hastened by sludge, so that its value was greater [because it could be marketed earlier].

Altogether eleven different crops were tried, including flax, potatoes, peas, beans, tomatoes, cauliflower, cabbage, carrots, onions, lettuce, tobacco. The plots were about 0.01 acre in area. Various other fertilizers besides activated sludge were tested and all the tests were reported on in considerable detail, with an introductory statement by F. A. Dallyn, chief of the Division of Sanitary Engineering, Provincial Board of Health of Ontario.

Mr. Brown calls attention to the desirability of further investigation with particular reference to finding "an exact measurement of heterogeneity" of crops raised on "soils which appear uniform during preparation and cultivation," but which give "wide variation in results." He specifies these subjects for further investigation:

(1) Variations in chemical composition of surface and substratum soil. (2) Infection of local areas by disease producing organisms. (3) Differences in requirement of food by plants. (4) Physical properties of the soil which vary locally in the size of soil particles, their compactness and resultant variation in aërobic condition and drainage (5) Lack of uniformity in depth of planting. (6) Drainage at time of planting and during the growing season.

Reaction Against Highway Expenditures

Public Shows Disposition to Retrench on Highway Expenditures—Various Reactionary Influences at Work—Highway Officials Must Organize to Promote Roads

Editorial Review

HIGHWAY construction in the United States is threatened by the danger of a popular reaction against increased expenditures. It is even within probability that in some instances this reaction may proceed so far as to curtail programs now regarded as fixed. A menacing possibility, also, is that it may unseat the policy of centralized engineering direction by state departments and put in the saddle the old practice of district control and local determination of route and type.

This situation is entirely in harmony with the trend of events. Road expenditures have for some time been due for a review by the people. They have been more enormous in the last three years than history has recorded in a similar period for any public work. More than a third of the outstanding bonded indebtedness of all the states is for highways. No such sums of money were spent by the railways even in the years of their greatest extension. The Panama Canal during the ten years of its construction, cost less than half the amount that has been spent for improved roads each year of the last three years. Every such extreme in public expenditure has been followed by a pause to appraise the situation, and there is no reason why highway expenditures should be an exception.

> In four years the United States has spent nearly $2,000,000,000 for improved rural highways.
>
> Today one-third of the outstanding bonds of all states are highway bonds.
>
> Does the country need to continue to buy road improvement?
>
> In the opinion of Thomas H. MacDonald, Chief of the Bureau of Public Roads, the production of serviceable highways is not keeping pace with the need.
>
> Statistics compiled by the Bureau show that, even with the last four years of intensive construction, there is a sharp lag in the expenditure for roads of modern type compared with the expenditure for motor vehicles.
>
> This fact indicates that roadbuilding cannot be retarded if we expect in the future as complete highway service as we now have.
>
> Public reaction against heavy expenditures threatens continued roadbuilding unless state highway departments take steps to eliminate and counteract influences now at work.

While the condition that has been outlined exists and cannot safely be ignored, its character should not be misunderstood. There is a spirit of questioning in respect to increased highway expenditures, but there is little material evidence that the public mind is turning away from the conviction that highway improvement is needed. Indeed no pronounced general movement has been made to curtail expenditures. As yet public thought is too unformed to express itself widely in action. It is a feeling rather than a formulated conviction, which exists, that spending money for highly improved highways has gone to about as great lengths as can at present be afforded. Recent action, however, is significant of an approaching agreement of opinion.

More than a thousand taxpayers in central Indiana met a month ago and formed a permanent organization for the purpose of reducing taxes by suspending all road improvements for a period of three years. There was a strong sentiment at the meeting for a modification of the automobile license law so that the money from this source will be distributed among the various counties of the state rather than go to the support of the Indiana Highway Commission. In California a request for extended highway expenditures has been challenged by criticism of the efficiency of the present administration of state highways and the election on Nov. 7 of a governor committed to a program of retrenchment. Highway costs are being publicly criticized in other states. The proposed road bond issue in New Jersey was barely carried at the recent election, although the successful candidate for governor advocated its passage in his pre-election campaign. In general, throughout the country, the people are disclosing a questioning attitude toward highway expenditures. Inquiry and observation by the engineers of the Bureau of Public Roads in practically every section of the United States pronounce the situation to be serious. This opinion is confirmed by a survey by *Engineering News-Record* of public sentiment in a number of the leading road building states. Indeed the conclusion cannot be escaped by anyone who conducts any very wide inquiry.

Public Feels Poor—The controlling reason for a reactionary sentiment toward highway expenditures is that the people feel poor. Prices have declined; wages have gone down; there have been many who have not been able to get work; strikes have depleted savings and increased debts. Just which of the curves of wage and price decline, or what unemployment chart, one elects to employ for specific figures, does not signify. Everyone who labors for hire or produces for sale has a painful consciousness of the main fact. Farm and forest products have dropped in value. The great producing industries are slowly recovering from the "hardest times" of years. All trafficking and manufacturing has reflected the hard times of the producers. The people feel that they must retrench and economize. No one needs any better proof of this than the feeling that is in his own bosom.

With the feeling of not having money, there have come a number of other influences tending to make people discontented with their recent and current generosity in giving money for roadbuilding. They may be enu-

merated and briefly defined as follows: (1) High taxes, (2) economy propaganda, (3) antagonism of the railways, (4) indifferent highway service, (5) original design faults, (6) poor maintenance, (7) automobiles and (8) selfishness. Each of these influences deserves careful consideration. They indicate the objectives which must be aimed at in the counter-attack which state highway departments are called upon to launch.

Increased Taxes—With the people working less and getting less pay for their labor and products, taxes have increased. Besides all the taxes known of old, people are just beginning to feel the hard pressure of state and federal income taxes, gasoline and automobile license taxes, war taxes and taxes on surplus profits. Also there are beginning to come along the taxes to pay for the bonds which have been sold for the roads which have been constructed in the last three years. Again in this instance, no purpose is more perfectly served by taking any of the various tax charts from which to quote specific increase—every man has his own tax bills by which to prove the general fact and for him they are a more potent demonstration than any chart however authoritatively sponsored.

There is a fact of importance, often overlooked, in the last statement. The individual does not segregate his tax payments, generally, nor does he draw average curves of tax increase as does the engineer who thereby finds, perhaps, that the true facts are that road taxes are a small percentage of the aggregate. The individual is conscious that his tax burden is beginning to gall him and he refuses to accept further load and this is the end of his reasoning. It is the error of the highway engineer that instead of individual appeal he presents curves of the trend and allocation of taxes using the figures of a state or the nation. No such error is made by the politician who is striving to bring back the old condition of decentralized direction of highways. He harps diligently on the strings of individual expenditure and saving.

Economy Propaganda—With the individual taxpayer's desire to save and the argument of the local politician that taxes may readily be reduced by different policies and practices, comes the call for nation-wide frugality sounded so persistently by the federal government. In two ways (1) cutting down federal aid appropriations and (2) counseling as a first duty retrenchment in all expenditures, economy propaganda have had a discouraging influence on highway expenditures. They have upheld the hands of every influence acting to discredit all that has been done and planned in highway improvement and the system by which all has been accomplished, and there are many just causes for the criticism of both practices and policies. This has been a natural result following an entirely praiseworthy purpose of stabilizing commerce and industry.

Railway Antagonism—Jealousy by the railways—particularly the electric railways—of highway traffic development by motor-truck freight lines and motor-bus lines for passenger traffic is an influence against extended paved road construction which has to be reckoned with in numerous instances. The circumstances in this case are not clearly differentiated. In general the steam railways, at least those of greatest importance, support the construction of paved roads as traffic feeders to the railway. This attitude is not invariable among the steam railways and is rare on the part of the interurban electric roads.

In instances the attacks of the electric railways have been decidedly venomous; ordinarily they have been no more violent than might reasonably be expected from a private enterprise which anticipated injury to its business by public expenditures which strengthen a competing enterprise. In the question before us, however, the effect is to prejudice in a measure a considerable body of employers and stockholders and their friends against paved road programs.

Just what the measure is of the sentiment to retrench which is being created by the growing rivalry of electric-railway and bus transportation cannot be told precisely. It should not be overestimated but just as certainly it cannot be ignored.

As a matter of fact in many instances steam and electric railways have charged that individual paved roads were potential competitors and have fought their construction. In some states where "railway influence" is powerful, opposition has been offered to road improvement programs which provided to any considerable extent for routes which paralleled the railways. Briefly, the railways cannot altogether escape the charge that they have been one of the influences acting to create a reactionary attitude toward highway development. At the same time that this is said, however, it has to be kept in mind that in some states and by leading companies in most states, railway support of road construction has been unqualified.

Indifferent Highway Service—The natural anticipation by the public that, when money was provided, improvement in transportation conditions would be prompt has often been disappointed by highway officials. Often also they have been indifferent about handling travel during improvement. Both actions have helped to arouse sentiment unfriendly to extended expenditures. It may, indeed, be assumed without much error that no two other faults of direction have been so provocative of discontent.

In the last three years much more attention than previously has been given to the location, marking and maintenance of detours and to preventing the isolation of a farm or a group of residents by closing off construction on unnecessarily long stretches of road. As a matter of fact, however, really careful detour practices are followed only in a few states. The majority of road-construction operations the country over are managed with so little care for the convenience and comfort of the people whose natural line of travel is obstructed by the work that complaint is universal and bitter. An irritable temper toward road improvement is created.

Public discontent because of inconvenience due to construction operations is a zephyr compared with the winds of wrath following protracted delay in commencing improvement. With a large sum appropriated for highway improvements the public expects to see better road conditions immediately. It does not satisfy the situation to explain that a system of paved roads cannot be furnished overnight. And it should not, because the explanation is, bluntly, an evasion. Immediate improvement is always possible preceding permanent improvement. There are sections of states in which great bond issues have been voted, where the people have waited five years, paying taxes all the time on the

bond issue, for the work of improvement to get around to their neighborhood. Ultimately they will have all that they have paid for and waited for, but meanwhile patience has been worn to a frazzle and enthusiasm has died. Indeed reaction has often set in.

Indifference in serving the public with traffic conveniences during the period between voting the appropriation and getting the paved road has done more to estrange the public from extended good roads programs than perhaps any other dereliction of highway officials, although poor design and poor maintenance are close up in the race.

Original Design Faults—Wrecks of broken pavements have created distrust of engineering sufficiency in providing roads worth the money paid. This assertion is made with full appreciation of the truth that the vast majority of road improvements are not failures. It is not forgotten that most of the failures which have occurred are due to service required of the roads which was not anticipated when they were planned. While these explanations are sufficient for the engineer, they do not carry the same conviction to the taxpayer who lives along the road that has gone to pieces. Ordinarily the taxpayer has never been told, and this is the fault of the highway department, that the reason for failure has been a traffic condition whose development could not be foretold when the road was built. Generally he has not been told anything. Having only the evidence of failure, he convicts the road builder without further question.

There have been some bad mistakes in road building. It is reasonable that there should have been. Every highway engineer can point to some example. The original system of a whole state has in instances been inadequately planned. Roads, which, when they were built, the people were told would be permanent are now being rebuilt wholly or in part. These are indisputable facts. The engineer knows them and is not alarmed because he also perceives the reasons. The public knows the facts but it does not also perceive the reasons and it is alarmed by the suspicion that it has been cheated out of its money. In California this suspicion was the foundation of a clear-cut issue in the recent gubernatorial election. On its decision by the people rests the fate of highway department heads long in service and the fate of a bond issue badly needed to maintain and extend the state highway system.

Poor Maintenance Practice—It is, as previously indicated, in not keeping up the roads in the period between the time when the system is taken over for improvement and the time when the actual improvement is accomplished that maintenance practice has been most at fault. Routine maintenance after improvement has often been defective also. Most highway departments have done better with their construction than with their maintenance. In any event good roads in numerous communities have gone to pieces solely because they were denied the upkeep which is the right of any structure doing work. The public witnesses the wreck and concludes that it has been cheated.

Individualism—It appears paradoxical to list the automobilist and the man who already has a paved road going to market as influences against extended highway expenditures. The automobilist, however, is individually fighting increased license fees and other taxes, and even limitations on his truck weights. He is being instructed by his associations in arguments against special taxes on motor car owners and against the use of motor car taxes for road construction. Altogether he has an antipathetical attitude of mind toward highway practice as it exists which is not encouraging to the expansion of highway expenditures.

An even more individualistic influence is the disinclination of the taxpayer who has his improved road, to regard with favor an increased expenditure to provide an improved road for the man several counties removed. Most men vote for good roads because they want a good road from where they live to where they go most often. Having got this road they do not cheerfully assume a greater tax burden to get a similar road for some one else. As improved roads increase, this influence against extending expenditures for road improvement also increases.

Organized Educational Work Required—In the aggregate the influences mentioned have become a great force. That this force cannot be expressed in figures does not render it less dangerous. Indeed its dangerous character is thus increased because it presents the highway engineer with the task of combatting a mental attitude in which he is the least proficient of all classes of skilled thinkers. This task, however, is the responsibility of highway engineering for some years to come and if it is accomplished it will have to be undertaken immediately. Briefly the influences named as acting to bring about an inquiry into highway expenditures and practices have to be counteracted by a campaign of information.

The situation is squarely before state highway departments of being obliged to wage battle for their policies and practices. To do this they must organize for attack. They must make educational promotion of road improvement as much their purpose as are construction and maintenance. A special division or bureau is required to do the work and it may not wisely be stinted in financial support or character of management and personnel. The lines along which the promotion organization may well act at the start suggest themselves:

1. Liaison work with country and township highway officials.

2. Detour administration including news bulletins and periodical route maps as well as location, maintenance and marking.

3. Interim maintenance of the whole road system while permanent improvement is progressing. This comprehends the secondary road system as well as the mileage planned for intensive improvement.

4. Cultivating tourist and camper by special service such as route maps, guide books, camp sites and parking spots.

5. Public instruction by lectures, motion pictures, radio news, schools and the newspapers.

6. Individual instruction by personal conference to adjust complaints, explain delays and convert critics.

Each of these activities has been undertaken successfully. Few state highway departments, however, are organized to conduct all of them systematically as a major function of their work. Again it should be stated, organization for educational promotion of highways has to be created and plans of procedure worked out. The character of this organization and its methods of operation will vary in different states because of differences

in fundamental laws and in the legislation establishing the relations of state and county road administration. The main task is alike in all states.

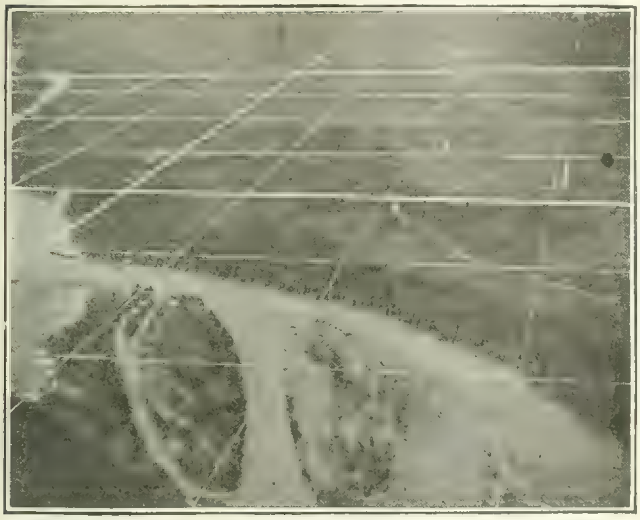
Keep the public "sold" on highways.

This is not the cry of panic; it is a call for preparedness.

Section Lines on Photographs Aid Land Reclamation

Clearing Contracts, Strategic Bridge Locations and Development Work Generally, Planned With Aërial Photographs

AERIAL photography was used effectively in planning the development of a 2,300-acre tract of land which is now under way near the Columbia River in Oregon. The methods used were applicable because the tract was level and they offered a particular advantage in this case because any survey work done on the ground had very dense underbrush and a slough network to contend with, so that the cost was high and rate of progress slow. Aërial photographs on which the section lines could be drawn were found to be of great aid in (1) locating roads and bridges, (2) locating drainage ditches that would use existing sloughs as much as possible and (3) in awarding clearing contracts which would make proper allowance for the relative amount of timber and undergrowth to be cleared. The work under way is part of a project for the diking and reclamation of the entire tract.



AERIAL PHOTOGRAPH WITH SECTION AND QUARTER SECTION LINES
The lines are drawn from reconnoissance and meander surveys that give a few controlling points.

At the outset the plan was to fly in a straight line across the tract at a height of 2,000 ft. and take photographs every half mile with the camera tilted downward at an angle of 55 deg. With the men and equipment available it was not possible to meet these specifications exactly and an approximation was made to serve.

As the section corners had already been established by government survey these were used as a basis for a meander of the main sloughs. With these data section and quarter-section points were located on the photographs made from the air and the connecting lines were drawn in as shown in the illustration.

With a series of photographs of this sort on which the quarter section boundaries appeared, a very close study could be made and details could be filled in on maps made from the meander surveys. With these data it was feasible to subdivide the area in such a way that instead of cutting up small tracts, sloughs would become natural boundaries replacing fences to a considerable extent.

In addition to the pictures taken at the 2,000-ft. elevation, a few closer views were made to show in detail the thickness of brush and timber growth to be cleared. These photographs, like the general views, more than paid for themselves, according to William G. Brown, Portland, Ore., who had charge of the subdivision and who developed the application of airplane photography to this particular use. A series of aërial photographs of this sort give such a detailed view of the situation, Mr. Brown states, that it would probably save time to make the photographs before running the meander surveys, thus having the advantage of the pictures when planning the first ground survey work.

A Close-Up of Some Wood Borers

What the *limnoria,* one of the most destructive of the marine wood-borers, look like may be inferred from the accompanying magnified photograph of a few of them at work, prepared by the U. S. Forest Service. These borers are about the size of a rice grain and destroy the wood with their crab-like claws. The *limnoria* are found on both the Atlantic and Pacific coasts, subsisting on any untreated wood on which they may find lodgment, piling in harbors affording one of their principal opportunities for existence. Coming in contact with the piling through chance of tide or drift and lodging on the surface or in crevices, they start a system of interlaced burrows on the surface, eating away the softer springwood and leaving the harder wood in rib-like ridges. As the outer shell of the wood attacked is in this manner reduced to a spongy consistency, and is broken or washed away, the *limnoria* penetrate deeper and deeper until in time the pile may be eaten almost through and snap off under its own weight. *Limnoria* are especially hard to combat, owing to the fact that they will penetrate the impregnated portion of treated wood through the least crevice or abrasion and occasionally attack treated wood that may have leached out to a low toxicity.

WHAT LIMNORIA LOOK LIKE WHEN AT WORK
Magnified about 7 times.

Spokane Intercepting Sewer Design Construction and Assessment

Rational Method of Design Used and Together With Imperviousness Made Basis of Assessment for Benefit

By A. D. Butler
City Engineer, Spokane, Wash.

There are few things of more importance to the growth and development of a city than proper sewerage, and yet there is no class of public improvement in which it is so hard to interest people. When a sewer is built, it is put far below the surface of the ground and is not fit to be seen even if it could be gotten at. There is nothing to be pointed to with pride as an object of public expenditure. In fact, after a sewer is built it is rarely talked about and would be forgotten altogether if it were not for the unpleasant reminder of the annual payments on the assessments. It is to be hoped that some original engineering mind will devise a method of paying for sewers that will appeal to the public pride. Until this is done municipal engineers must iterate and reiterate the necessity for sewers where they, better than anyone else, know sewers are needed. Meanwhile engineers should address themselves to devising for each case as rational a method of financing sewers as they employ for their design. This article, besides dealing with the design and construction of a large sewer for Spokane, will outline a method of assessment that was devised by the engineering department of the city and that has given rise to only little complaint.

Pressing Need For Interceptor—The construction of the 63-in. intercepting sewer now being built in Spokane was only justified in the mind of the public by a train of circumstances which proved conclusively that the provision of a large sewer could not longer be delayed. In 1893, when the population of Spokane was about 20,000, the present trunk sewer, a 21-in. pipe, was laid. It was sufficient at the time to take care of the district which it served, but during the next ten years Spokane doubled in population and in 1920 it was a city of 104,434. Many times during the year the sewer flowed under pressure, backing into downtown basements and doing more or less damage. It was only after the old sewer had broken twice, and the possibility of enormous damage was apparent, that definite steps were taken to construct an intercepting sewer to relieve the heavily overcharged sewers in the downtown section.

A contract was let for a sewer about a mile long, ranging from 63 to 33 in. in diameter, in the downtown congested section of the city. The contractor was the Miracle Concrete Corporation and the price was $318,000. Because the streets through which the sewer would pass were honeycombed with underground structures, and also because the old sewer connections must be intercepted and connected to the new sewer, it was decided to put the interceptor in the position occupied by the old one. Since the new sewer is 4 to 6 ft deeper than the old one, it is necessary to take care of the sewage in the old sewer while the new one is being laid. To do this, sumps are constructed some distance in advance of where the new sewer is to be laid, and two 10-in. electrically-driven centrifugal pumps installed. A temporary iron pipe is then laid in the gutter and the sewage pumped around the space where the construction work is in progress. This insures a good dry ditch in which to lay the new pipe.

In case of a heavy downpour there was a possibility that the pumps would not be able to handle all the flow in the sewer. It was also foreseen that if the pumps failed to work properly it would be necessary to care for the sewage in the new sewer for some time. To make doubly sure that such an emergency might be taken care of, there is kept in the ditch, at all times, enough sheet-iron flume to connect the end of the old sewer being removed with the new one. This sheet-iron flume is U-shaped, rounded on the bottom, and of sufficient capacity to handle the full flow of the 21-in. sewer, if necessary. It is built in sections of a length that can be readily handled by the workmen on the job. The ends of the flume telescope, and can be put in place quickly when necessity demands.

Precast Reinforced-Concrete Pipe—Due to the fact

LAYING 63-IN. CONCRETE SEWER AT SPOKANE

Excavated material lifted in buckets by derrick, dumped into motor trucks and hauled back for refilling ditch. At right, pipe in gutter through which sewage from old sewer is pumped around section where work is in progress. Its original thickness was $\frac{3}{16}$ in.

that the new sewer is being constructed in the downtown section, where it is imperative that traffic should be as free from interference as possible, precast reinforced-concrete pipe is used. This permits backfilling over the pipe as soon as the joints are properly set, and thus makes it possible to keep down to a minimum the amount of ditch necessary to be kept open.

The pipes are cast in $4\frac{3}{4}$-ft. lengths, each weighing about 5,000 lb. The reinforcing consists of two rings of American steel wire mesh, the cross-sectional area being 0.53 sq.in. for the 63-in. pipe.

One of the reassuring things about the use of a precast concrete pipe is that after the pipe is made and cured, samples may be submitted to a test, which gives a check on the structural design and a very definite notion as to what the pipe will do when submitted to loading conditions in the ditch. During a test of the 63-in. pipe after twenty days curing, using a one-fourth bedding both top and bottom, the first hair crack appeared with a load of 20,000 lb. while a load of 85,000 lb. was required to produce failure of the pipe.

If there was a doubt in the mind of anyone as to whether the new sewer was really needed, it was relieved when the first section of the old sewer was removed. This was a 21-in. steel pipe and was found to be worn completely through on the bottom. Many holes 4 to 6 in. in diameter were found and an innumerable

number of smaller holes showed the pipe had already lasted far beyond what might reasonably have been expected of it.

Assessment and Rational Method Design—Next in importance to the actual design of a trunk sewer is the working out of the scheme of assessment; and since assessments are based on benefits received, the problem entails much study. The design was based on the so-called rational method, in which the length of time of concentration of runoff is taken into account in calculating the size of the sewer. If a theory will serve for the design of a sewer it should also serve as a basis for assessing benefits. With this in mind, the first step was to determine what amount should be assessed against the lateral district or that territory directly abutting on the new sewer which had not only the benefit of sufficient capacity for an indefinite time in the future, but also had the additional advantage of a greater depth than the old sewer. To establish these benefits an estimate was made on a sewer only large enough to accommodate the lateral district and at a depth equal to that of the new sewer. Under the estimate, this cost was found to be about $600 per lot of average size.

There was then a second territory, termed for convenience the Special Benefit Zone, where the sewers originally put in were sufficient until they were overcharged by reason of the outlying territory connecting to them. The plan of the new sewer contemplates the intercepting of this outside sewage before it reaches this district; so that while the Special Benefit Zone does not have the additional depth that is enjoyed by the lateral district, it has the advantage of a sewer sufficient for its tributary area. It was considered that this benefit should be worth nearly one-half that which is enjoyed in the lateral zone, or approximately $300 per lot.

The full amount which would be raised from the lateral benefit and from the special benefit zones amounted to $88,000, which, deducted from the total contract price, left $240,000 to be raised by trunk assessments.

Imperviousness a Factor in Assessments—In determining the capacity necessary for the sewer, studies were made on the imperviousness of the various districts drained. Zone 1, the downtown section, was found by experiment to be 90 per cent impervious, and due to the fact that it lay closer to the sewer and was controlled by shorter and hence more intensive rainfall, it was considered that it was entitled to pay for the proportional increment of size, and hence of cost, that the drainage from this district was responsible for. This was calculated to be 48 per cent of the trunk cost. The remainder of the district, being all about the same per cent impervious, was zoned back concentrically, using the beginning of the sewer as a center, keeping in each zone that territory from which the drainage would reach the intercepting sewer in equal time and establishing a rate of assessment on each zone which would be equal to the particular increment of size, and hence of cost, that this zone actually was responsible for.

Most people are fair minded. and when they understand that their assessment for a given improvement is based on a reasonable method, as I believe this one is, they are willing to pay their assessments, whatever they may be, without complaint.

OLD 21-IN. STEEL SEWER PIPE LAID IN 1893

In spots, the pipe was completely worn through by the grit carried in the sewage.

There were over three thousand pieces of property affected by this assessment and very little complaint has been made.

Many times great care is used by engineers in working out an elaborate design for a sewer or other local improvement, and then the preparation of the assessment roll is turned over to someone outside the engineering staff altogether—some person who has no knowledge whatever of the scientific principles involved. As a result, the distribution of the cost for the improvement is far from equitable. This leads to dissatisfaction and frequently to the courts.

The work of the engineer is not complete when his design for a public improvement is made or estimate prepared. His technical training and scientific knowledge are needed in developing some equitable method of raising the funds to finance the job; for many times, as has been illustrated, the same principles that are used in the design can be carried out in the determination of not only what district is benefited, but also the proportion of the cost each piece of property in the district should bear.

Cross-Connections Put Under Control at Utica

As the result of a letter sent to the Consolidated Water Co., of Utica, N. Y., in the campaign of the New York State Department of Health to eliminate typhoid dangers due to cross-connection between municipal water supplies and private auxiliary fire protection systems, all cross-connections at Utica have been put under control or eliminated, according to a statement made by the department named. After mentioning a special report on cross-connections made by C. A. Holmquist, director of the Division of Sanitation of the New York State Department of Health, the statement reads: "The engineering and biological departments of the water company investigated a total of 76 industrial plants in Utica and vicinity which are supplied by the company. Of these 40 had auxiliary fire supplies, only eleven of which were protected by double check valves. Accordingly the company addressed a letter to each of the plants where potential danger of contamination of the public water supply existed, calling attention to the recommendations of the State Department of Health. The majority of the plants complied cheerfully with the company's request and installed the necessary check valves, or disconnected completely the intercommunicating systems. Since Aug. 1, 1922, all the requirements have been met by all the plants except one which has not been operated for some time and will probably not be reopened.

A Study of High Winds and Thunderstorm Effects

Some Further Notes and Observations on the Storm That Struck New York June 11—How to Measure Velocities

By Jacques W. Redway
Meteorological Laboratory, Mount Vernon, N. Y.

THE thunderstorm which struck the vicinity of New York City on June 11, tornadic both in character and violence, was marked by sudden gusts of wind which wrought not a little destruction. The swamping of many row-boats at City Island and the demolition of a Ferris wheel at Clason Point (*Engineering News-Record*, June 15, p. 1014) were attended by a considerable loss of life. The destructive effects of the wind were noticeable chiefly in the uprooting of trees, the breaking of trees, and shattering of plate-glass windows.

The violence of the storm was manifest chiefly in Mount Vernon, Pelham, and the wooded area in the vicinity of Pelham Bay Park. At City Island, at Clason Point, and along the shore road the destructive effects of the wind were quite as great as at Mount Vernon. Possibly, judging from the number of uprooted and broken trees, they were a little greater; certainly they were not less. The uprooted trees were mainly oaks, growing in soil above rock formation. The broken and

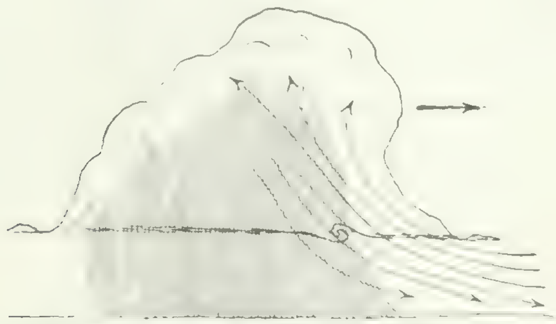


FIG. 1—DIAGRAM OF THUNDERSTORM ACTION

delimbed trees were mainly shade trees, maples prevailing. In Mount Vernon there were many old cherry trees, remnants of a one-time orchard; the gale felled practically all of them. The accompanying barogram (Fig. 2) explains the shattering of plate-glass windows.

Because of the destructive effects of storm winds—that is, winds of 64 miles or more of the Beaufort scale—engineering science is concerned chiefly with winds of this class. When damage to structures occurs from this source, it is necessary as a first step to determine the velocity of the wind and its gusts as closely as possible. Reference, therefore, is made to the records of the nearest Weather Bureau station.

The Robinson anemometer is almost universally employed in the measurement of wind velocities. It is probably the most useful wind meter devised for the purpose, being both practical and foolproof. Its weak point lies in the fact that it does not register sudden gusts. Accompanying a breeze of 20 mi. per hr. are gusts varying from 30 to 45 mi. per hr. They last from a few seconds to about a minute, more or less. The Robinson anemometer does not register nor record them. A Biram anemometer will register them; but to get values, the observer must stand with stop watch in one hand and anemometer in the other.

The anemometer at the New York Station of the Weather Bureau, in Battery Park, is 454 ft. above ground. That at Mount Vernon laboratory is about 35 ft. above ground. Ordinarily the velocities at Mount Vernon average from 40 to 48 per cent of those at Battery Park. During the very high wind storms the registration at the two stations is not very far apart.

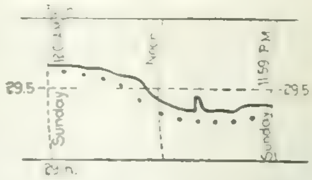


FIG. 2—BAROGRAM OF STORM OF JUNE 11
(Dots are at 2-hr. intervals)

Engineering science takes into consideration wind velocities having a maximum of 65 to 70 mi. per hr.; storm velocities of this value are so common in occurrence that to neglect them would be unpardonable. In New York City this velocity has been exceeded many times; in ten years a velocity of 90 mi. has been exceeded four times. A steady wind of 70 mi. per hr. has a pressure of about 12.2 lb. per square foot. A steady wind of 90 mi. an hr. has a calculated pressure of 19.2 lb. per square foot, which in relation to engineering structures is a matter of much greater importance, inasmuch as for every square of 100 ft. the increase of broadside pressure is about 16 tons. The values are calculated from the formula $P = .004 \frac{B}{30} SV^2$, in which P is the pressure in pounds; S the surface in square feet; V the velocity in miles per hour; and B the height of the barometer in inches. The values differ slightly from Beaufort-scale values. Frankly, I have but little confidence in either—or in the parabolic formula now much used. Perhaps an engineer might not willingly accept the pressure figures of a meteorologist, but the figures noted are not far wrong.

A sudden gust of 90 mi. per hr. is quite a different matter, however. It is comparable to the slapping force of a wave; it likewise involves the problem of inertia. My measurements in the June 11 storm recorded a gale strength of 70 mi. per hr. for a little more than 3 min. and this may be regarded as pretty close to the truth. The maximum velocity of 90 mi. for the same storm was estimated by the Beaufort scale of effects and the destructive effects justify the estimate. When the gust struck, two large maples within 250 ft. of my observation point went down in a crash. About 350 trees in the city were destroyed or badly injured.

Fig. 1 is a cross-section of a thunderstorm, after Humphreys. The experience of observers, covering many years, and of airplane observations in the past six years, attest its correctness in principle. The cross-section is that of a typical cumulo-nimbus cloud. The arrowheads at ground level indicate the advance of the storm and the down-draft of the air. Arrows show also the source of the up-draft. The scud-roll is the locus of gusts. It was this sudden onset that caused the jump in pressure of 0.2 in. almost instantaneously, but I hardly think that this was the tornadic gust that wrought such havoc. Inasmuch as all windows in the house were open there was no accumulated pressure.

Thunderstorms are in the same class of air movements as tornados; and in many instances the difference between them is chiefly one of degree. The jump in pressure, the "thunderstorm nose," as shown in barograms, usually occurs in the case of thunderstorms and tornados, but I have not seen one so sharply defined as this except in the case of tornados, and the storm of June 11 was a tornado.

Effect of 50-Ton Two-Wheel Load On Concrete Test Road

Final Loads on Concrete Pavement in Pittsburg, Calif., Test Road Run Up to 5,000 Lb. Per Inch of Tire

AFTER the completion of traffic tests of the ordinary sort on the Pittsburg test road and before the pavement was removed, some excessive loads were used to determine the ultimate strength of the various types of construction. A 16-ton load was used first and this was increased by stages to 50 tons on two wheels. The latter load moved over the road three times. It caused complete destruction of some sections but was carried over others without being delayed by sinking through the concrete and without breaking up the surface. Whether there was permanent damage to the body of the slab remains to be determined when core borings and other examinations are completed. A preliminary general report of results on the Pittsburg test road appeared in *Engineering News-Record,* June 29, 1922, p. 1066.

On a two-wheel trailer of extremely heavy construction, solid iron bars tied across with chains were used for vertical standards. A facing of 3-in. plank inside these standards completed the superstructure, into which pig iron was piled by hand to secure the desired loading. The wheels were solid metal with steel tires 10 in. wide. For the 50-ton load this gave 5,000 lb. per inch width of tire. This trailer was towed over the test road by tractors and trucks.

With 15 tons on the two wheels the trip over the road was made readily enough, but as these loadings were increased difficulty was experienced in getting over the portions of the pavement where breaks previously made were so large that one or both of the trailer wheels had to cross them. In these spots the great weight of the wheels caused them to sink through the damaged concrete. Steel plates were used at these spots in an endeavor to get the trailer over the road enough times to give an idea of its effect on those sections that had remained intact.

Even with the steel plates to spread the weight, there were frequent delays due to the wheels' breaking through previously damaged pavement and to decrease the delay and difficulty of extricating the trailer from

UNLOADING STALLED TRAILER BY HAND

Where the pavement had already been broken, steel plates were laid in an endeavor, not always successful, to get the trailer across without breaking through

FIFTY-TON LOAD ON TWO-WHEEL TRAILER

such breaks a device was used to limit the settlement of the wheels. This consisted of a heavy steel plate dragged along the pavement under the rear axle by a chain attached to the front end of the truck. Fastened to the under-side of the rear axle above this plate were

RECORD OF TESTS WITH HEAVY TWO-WHEELED TRAILER

Load in Pounds on Two Wheels	Trips Over Test Road	Tons
32,053	105	1,683
61,711	9	278
70,000	3	105
80,000	2	80
100,000	3	150
Totals	122	2,296

NUMBER OF BORINGS REQUIRED TO SECURE SOLID CORES

Section	Thickness Inches	Reinforcement, Tons per Mile	Inner Side	Center	Outer Side
A	5	20	1	2	1
B	5	20	4	2	5
Alternate J	5	46	1	4	1
C	6	55	1	2	1
D	6	55	1	1	2
E	8	Plain	1	1*	1
F	8	Plain	1	4	1
G	6	69	1	6	1
H	5	24	1	7*	3
I	5	24	4	5*	11
Alternate I	8	Plain	1	1	1
J	6	Plain	1	1	1
K	5	69	1	2	1
L	5	55	1	5	2
M	7	Plain	1	1	1

* Core taken at ¼ point on account of longitudinal joint in center.

two 4 x 6-in. timbers. The timbers normally moved along about 2 in. above the plate but when either wheel cut into the pavement as much as 2 in. the weight rested directly on the axle and further settlement was prevented. By expedients of this sort the 50-ton load was taken around the ellipse three times, as shown in the accompanying table.

A significant result of the heavy tonnage test was that reinforced sections 6 in. thick, or unreinforced sections 8 in. thick were nowhere broken down by the highly concentrated 50-ton load, nor did they show anywhere on the surface signs of distress as a result. However, in making core borings to get samples of the concrete from various sections there were many instances where the concrete in the center of the slab was disintegrated so that a solid core could not be secured until after repeated attempts. This condition was encountered so much more often in the center of the pavement than at the edge that the results were tabulated for comparison and are shown here in the table.

Sections that did not withstand the 50-ton load, that is, those in which the trailer wheels sank through the pavement into the subgrade, were *A, B, H, I,* and *L.* Sections that carried the 50-ton trailer without any visible evidence of distress were *C, D, E, F, G, J, K* and *M.* (See accompanying table.)

FROM JOB AND OFFICE

Hints That Cut Costs and Time *For the Contractor and the Engineer*

Use of Perfect Squares in Survey Work

By J. R. Jahn

Williams & Jahn, Consulting Engineers, Berkeley, Calif.

THE "3 – 4 – 5" triangle is well known and the "5 – 12 – 13" one is familiar to many. Some time ago I sought other groups of integers which would have the relation that the sum of the squares of the first two equals the square of the third, the second and third differing by unity. Finding some, I developed the general relation: $n : \frac{n^2 - 1}{2} : \frac{n^2 + 1}{2}$, in which n represented the shorter leg of the triangle. The second and third terms (representing the longer leg and the hypotenuse) are integers when n is an odd number. However, it is possible to reduce even numbers to factors, one of which will be odd and the solution by the formula above will then be possible. Or an even number may be halved and n be taken to represent it in the formula. The second and third terms will be halves of integers. These, doubled, will then be integers.

These ratios have an application in surveying in producing straight lines through obstacles. If the smaller angle of any perfect-square triangle is used as a deflection angle and a distance equal to the hypotenuse be measured and a transit point set, the distance along the true course and the distance out at right angles from the true course will be represented by integers, being the longer and the shorter legs of the triangle. The ratio selected should have an angle which will clear the obstruction. Length may be obtained by taking simple multiples of the selected ratio. Knowing the distance from the true course, it will then be possible to return to the true course by the same triangle, but with the deflection angle double and turned in the opposite direction, or by some other ratio having as a short leg some simple proportion of the length of the departure from the true course.

The following list of perfect squares with their corresponding smaller angles are typical of those ratios having unity as the difference between the second and third term.

Ratio Between Sides	Small Angle	Ratio Between Sides	Small Angle
5: 12: 13	22° 37′	17: 144: 145	6° 44′
7: 24: 25	16° 16′	19: 180: 181	6° 2′
9: 40: 41	12° 41′	21: 220: 221	5° 27′
11: 60: 61	10° 23′	25: 312: 313	4° 35′
13: 84: 85	8° 48′	31: 480: 481	3° 42′
15: 112: 113	7° 38′	45: 1,012: 1,013	2° 33′

The number, 12, when substituted in the above formula would have the following ratio, 12 : 71½ : 72½, which does not yield integers, but its factors 6, 2, and 3 give integer ratios, thus: 12 (2x6) : 35 : 37; 12 (3x2x2) : 9 : 15 and 12 (4x3) : 16 : 20.

Portable Conveyors Handle All Materials on Concrete Road Job

PORTABLE conveyors are combined in an interesting manner for handling materials on a concrete paving operation near Elmhurst, Ill., for which the White Construction Co., Chicago, is the contractor. Sand, cement and stone are all handled by three belt conveyors and one self-feeding bucket conveyor, the stone from stockpiles and the sand and cement directly from the cars.

In Fig. 1 are shown the two steel proportioning bins, one, at the left, for crushed stone and the other for sand. At the stone pile a self-feeding bucket conveyor, the top of which appears in the view, takes the stone from the pile and by means of a chute feeds it onto a belt conveyor which leads to the proportioning bin. At the sand bin, a belt conveyor, like that at the stone

FIG. 1—CLOSE VIEW OF STONE CONVEYOR OUTFIT WITH SAND CONVEYOR IN BACKGROUND

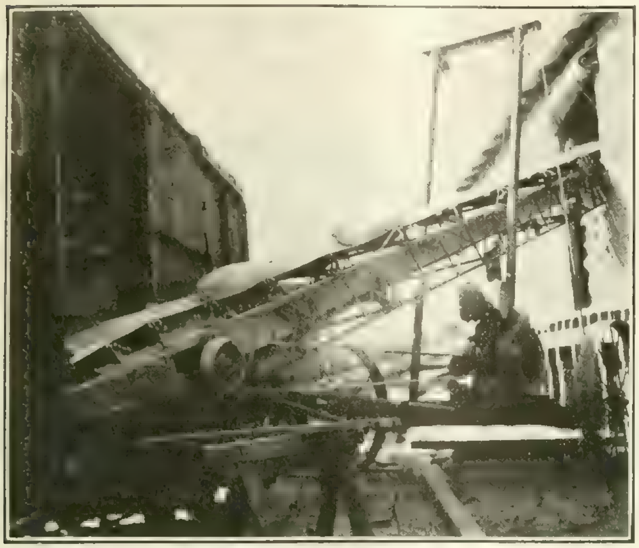


FIG. 2—BELT CONVEYOR UNLOADING FROM CARS INTO CEMENT WAREHOUSE

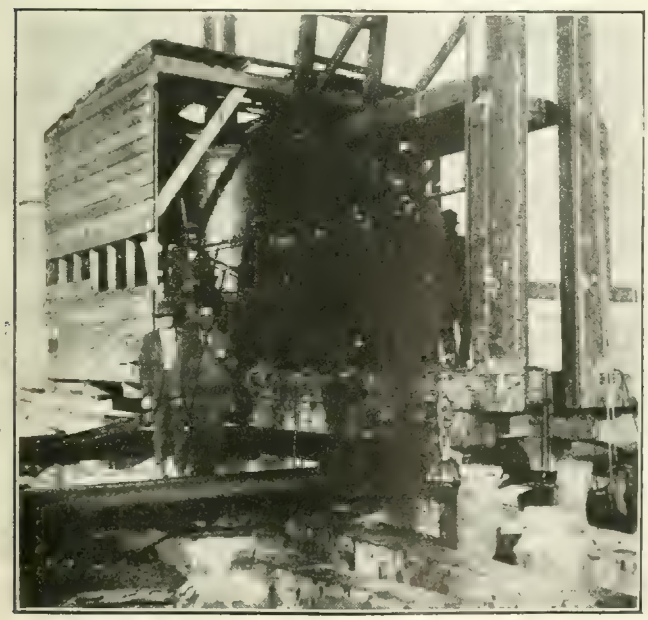
pile, is swung into the cars as they are spotted and delivers directly into the bin. For handling the cement a belt conveyor is operated as is indicated by Fig. 2. In handling cement the belt conveyor has been found a time saver by delivering the sacks high up and thus reducing lifting and stacking.

The views and information for this article were furnished by the Barber-Greene Co., Aurora, Ill.

Piledriver Slides Back and Forth on Two Greased Poles

By W. K. Cresson
4429 Townsend Ave., Detroit, Mich.

In DRIVING the piles for a section of Detroit's new filtration plant, trouble was had with the soft ground until the contractor hit upon the plan illustrated by the accompanying view. Laying some heavy timbers for a base, the piledriver was mounted on two greased poles 14 in. in diameter and 55 ft. long. The outfit is slid from side to side as needed and is rolled back as the job proceeds. A block and tackle attached to the winch furnishes the pull. Double rigging is used for the side shift and straight away for a back pull.



GREASED POLES GIVE TWO-WAY SHIFT FOR PILEDRIVER

Improved Valley Gutter Design Eliminates Features Objectionable to Motorists

By S. M. Cotten
Civil Engineer, Vallejo, Calif.

IN CONNECTION with the paving of streets in Phoenix, Ariz., the valley gutter across street intersections has been frequently employed. In this construction the crown line is carried through on the center line of one street, and the gutter lines parallel therewith on each side are likewise produced across the intersecting street. The valley gutter proper is of concrete, and is 3 ft. 2 in. wide. The standard pavement section is a parabolic curve, the crown height being 0.1242 ft. per 10-ft. width of pavement between curbs.

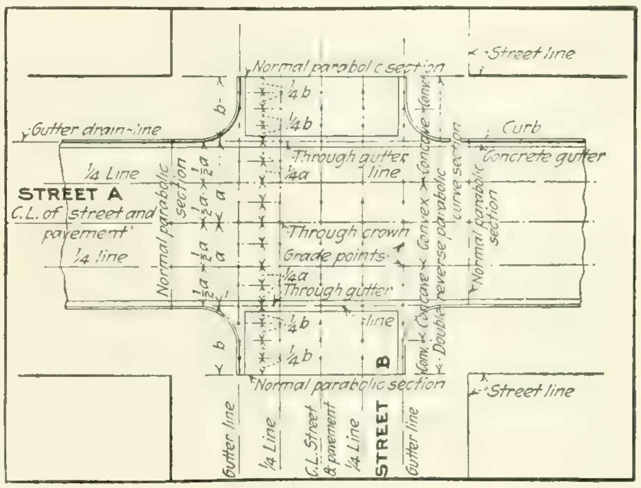


FIG. 1—METHOD OF STAKING OUT VALLEY GUTTER

Until recently these valley gutters were given a dip of 1 in. from edge to center, a distance of 19 in. The normal parabolic section was continued through between the gutters, and a warped transverse surface, varying from a straight line at the gutter to a parabola at the adjacent street or property line, was employed for the intersecting pavement. The consequent change in slopes on a section of the pavement transverse to the gutters did not appear formidable either from appearance or theory, but in passing over such a section in an automobile at a speed in excess of six or eight miles an hour the resulting jolts indicated that the construction was not ideal. Since the elimination of the valley gutter would necessarily mean a considerable increase in the cost of the improvement as a whole, due to the additional drainage structures required, an effort was made to eliminate objectionable features. The new design employed is described below.

Fig. 2 shows a typical half-section of a paved street intersection with valley gutter, the section being transverse to the center line of the continuous-crown paving, as indicated by the typical plan, Fig. 1. The concrete gutter is now made flat, transversely. Referring to Fig. 2 there are three control points on the section, being those on the through crown, h_1, the gutter, h_2, and

the transverse normal section of the intersecting pavement on Street "B," h_9. These points are connected by reverse parabolic curves, as shown. The normal section of intersecting pavements is established at the street lines of Street "A" unless the distances b and e are such as to give a grade from h_5 to h_9 in excess of 3.5 per cent, in which case the distance b is increased as necessary. For convenience, this distance is increased by one-third of the indicated and normal value. This puts the point h_8 on the street line. In our experience, it has never been found necessary to increase b by more than this amount.

Elevations are computed and grade stakes set at points h_1 to h_9, inclusive, on the center line, the quarter lines, and the gutter lines of Street "B," and on these lines produced across Street "A," as shown in Fig. 1. Ordinarily the slope from h_5 to h_9 on the gutter lines is so flat that the gutter is constructed on a straight line between these points, or curved only between h_7 and h_9. It will be observed that the distance d will be practically constant on all of the five lines previously mentioned and on the lines of Street "B," while the distance e changes materially from gutter to center line.

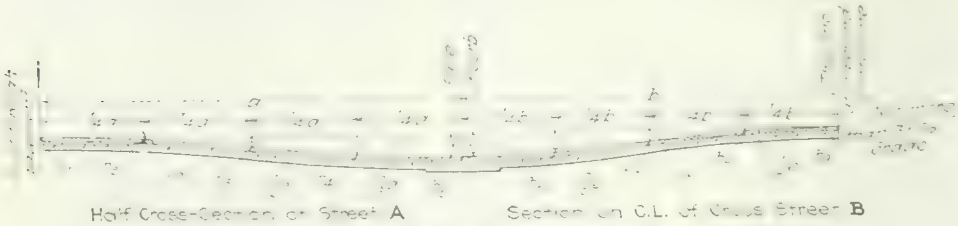


FIG. 2. SECTION ACROSS VALLEY GUTTER ON CENTER LINE OF CROSS STREET

When this method was first devised it was feared that it would involve rather complicated processes as regards office, field, and construction work. In the actual application no difficulties worthy of mention were encountered, and even the contractors have not regarded the innovation as a hardship.

Finding Areas of Irregular Figures With an Analytical Balance

By Woodson Wang

Cornell University, Ithaca, N. Y.

THERE are many approximate methods to find the areas of irregular figures such as Simpson's rule, trapezoidal rule, Durand's rule, Tchebyeff's rule, etc. However, none of them eliminates the tedious addition and scaling. Consequently error may easily result. The writer has devised a method of avoiding these drawbacks and at the same time securing a fair degree of accuracy.

This method is easily conducted when an analytical balance is near at hand. The irregular figures are first traced on a sheet of tracing paper and then each is cut out by a pair of scissors. These figures and a piece of tracing paper of unit area are weighed respectively, accurate to 0.001 of a gram. After dividing the weight of each figure by the unit weight, the areas are obtained.

The writer has found that the unit weight of ordinary tracing paper is uniform and hence this method is generally practicable with reasonable accuracy.

[Weighing irregular figures representing areas is not a new device for area determination, but the above is printed with the belief it will reach many who have not used the method.—EDITOR.]

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Handling and Driving Precast Concrete Piles in Railway Work

IN VIEW of the extensive use of precast concrete piles in railway work, methods employed in handling and driving them formed the subject of a committee report presented at the recent meeting of the American Railway Bridge and Building Association. From this report the following material is summarized. Piles 15 to 40 ft. long are used and are usually octagonal, 16 to 18 in. in diameter, with blunt points and sometimes fitted with cast-iron points. A 14½-in. square pile with rounded corners is used on the Chicago, Burlington & Quincy R. R. The curing period is usually 20 to 30 days, or 45 days in cold weather, and piles must be from 60 to 90 days old before they are driven.

Handling Piles—For stacking and loading piles the Illinois Central R. R. uses a locomotive crane with a bridle carrying two pairs of tongs, so that the pile is supported at two points. Piledriver derrick cars unload the piles in a similar way, and each is handled by the piledriver with a single hitch near the top of the pile. Other roads handle them in much the same way as wood piles, but with greater care. One road unloads them by rolling them from cars, but others prohibit the dropping or rolling of concrete piles, although in some cases they are rolled slowly down skids under the control of a rolling hitch. When loaded on cars the rows of piles are separated by cleats 2x6 in. or 3x6 in., these cleats being wired to the side stakes of the car to prevent shifting. The stakes are also secured by transverse tie wires attached at their upper ends. On the Chicago, Burlington & Quincy R. R. it is the practice to load fourteen piles on a car.

Driving Piles—Both drop and steam hammers are used, the latter being the more frequent practice. Drop hammers weigh usually 3,500 or 4,000 lb., but one road reports the use of hammers weighing 5,000 to 6,500 lb. without damaging the piles. As a rule they are likely to do more injury than a steam hammer. But both the Chicago, Burlington & Quincy R. R. and the Missouri, Kansas & Texas Ry. have found a 4,000-lb. drop hammer most effective for driving piles in shale or hardpan. In such soil it may not be possible to drive the concrete pile until a hole is dug or is churned by means of a wood pile with cast-iron shoe, water being used to soften the ground. With the drop hammer the fall should be sufficient to give only the required penetration, since the damage to the pile increases materially as the fall of the hammer is increased.

A special driving head is needed to protect concrete piles as they will not stand the impact of the blows as well as will wood piles. The Illinois Central R. R. and New York Central (Lines West) have used a boiler-plate extension cap or hood 8 ft. long, with an oak follower block and cushion of old rope. Another design consists of 1½- or 2-in. oak disks and eight or ten disks of old rubber belting fitted into the pocket of

FROM JOB AND OFFICE

For Contractor and Engineer

the driving head; old rubber hose or frayed rope may be used also. In any case about four oak disks are used alternating with layers of the rubber disks, hose or rope. If the top of the pile begins to spall it must be cut off.

Holding Piles in Position—Since concrete piles cannot be bent into line when driving, like wood piles, greater care must be taken to keep them in position while driving. Further, the piles must be plumb and properly spaced in the bent, but with square piles no effort is made to keep them from twisting. To insure proper spacing of piles and direction of bents it may be necessary to dig holes 4 to 5 ft. deep or to start the holes with a timber pile. In work on the Chicago, Burlington & Quincy R. R., piles driven on slopes are kept in line by digging a hole several feet deep before starting to drive the piles. For the same purpose on more level ground a checker-board guide is used. This consists of a frame of 8x16-in. timbers with spaces through which the piles can be driven, the frame being braced against the adjacent bents. The tops of the piles also may be braced to keep them plumb. If a concrete pile gets out of line the ground is dug away on one side and the pile is jacked or pulled into position. If the bent of a slab-deck trestle is more than 3 in. out of position, slabs of special length are ordered.

Jetting Concrete Piles—In sand, gravel and soft ground a water jet is used frequently to assist the driving, but in some cases the hole is jetted first and when the pile is started the jet pipe goes down with it. A method used on the Chicago, Burlington & Quincy R. R. and the Missouri, Kansas & Texas Ry. is to have a 4-in. pipe connected to two 2-in. jet pipes, one on each side of the pile and ending with ¾-in. nozzles. A water pressure of 120 to 140 lb. is used.

Piledriving Progress—On the Missouri, Kansas & Texas Ry. the average piledriving per eight-hour day varies from six to ten piles to as low as five or even three, according to conditions. The Chicago, Burlington & Quincy R. R. gives eight to ten piles as a high average and two as a minimum, but in estimating the cost of pile trestles it is usual to allow five piles per eight-hour day. Since the work is slower than with wood piles and the heads cannot be sawed off quickly to clear the track for a train, in the construction of concrete-pile trestles to replace old timber-pile trestles it is necessary for the construction foreman to arrange his work so as not to obstruct traffic. This will depend on the number of trains and the distance the piledriver must move to reach a track.

Paving Brick Relaid After 30 Years' Service

A brick pavement on Walnut St., in Bucyrus, O., torn up because of foundation failure, is, after 30 years' use, being relaid with the original brick turned bottom up. The brick were paving brick of building brick size made by the Bucyrus Brick & Terra Cotta Co., long ago out of business. The base was rolled limestone and the joints were filled with tar; the street had stone curbs. About 90 per cent of the old brick were capable of being reused. The contractors for the original pavement were Frazer & Kiel, of Bucyrus.

Lugs Welded on Suspension Bridge Cable Clamps With Thermit Steel

When the Rondout Creek suspension bridge, recently constructed near Kingston, N. Y., was being built, it was found that the cast-steel cable clamps by means of which the vertical cables were suspended from the suspension cables provided for only one flange to hold the vertical cable from side-slipping off the clamp shoulder, and that an additional flange was needed on the opposite side of the shoulder. As the builders were in a rush, it was decided to weld an additional lug to each of the 114 clamps at a local foundry by means of thermit welding, instead of waiting for new clamps to be cast.

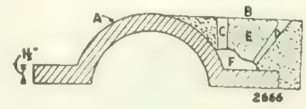


FIG. 1—MOLD FOR BUILDING UP LUG ON CABLE CLAMP

A—Cable clamp casting; B—mold; C—riser; D—pouring gate; E—molding material; F—thermit steel.

Before welding began, a wooden pattern was made of the half clamp to be welded. A wooden lug pattern for the thermit steel flange was doweled to the pattern through two holes drilled into the pattern. A three-sided wooden box, hinged at one corner, was then placed with its open side against the pattern, clamped to the pattern and rammed with molding material. The usual wooden riser and pouring gate patterns were inserted against the lug pattern. No preheating gate pattern was inserted as the preheating was executed in a manner different from the usual. When the ramming was completed the riser and pouring gate patterns were removed, and a plate was placed over the mold. The mold, casting pattern and plate were then inverted and the mold box and pattern removed from the mold, which now rested on the plate.

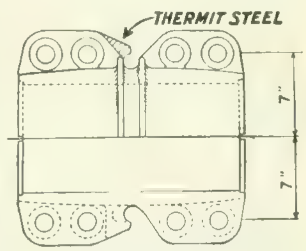


FIG. 2—CABLE CLAMP WITH BUILT UP LUG

The mold was next baked in an oven. In the meanwhile, the part of the casting to be welded was preheated over a blacksmith forge to a temperature suitable for welding. When both the operations of baking the mold and preheating the casting were completed, the baked mold was applied to the casting in the position shown in Fig. 1 and the thermit steel poured into the mold in the usual manner, using 10 lb. for each weld.

Much time was saved by preparing the molds for baking in close succession by applying the same mold box to the same pattern just as soon as the former was removed from one unbaked mold; also by preheating castings successively while baking the molds.

Inner Tube Makes Rod Covering

By Norman H. Gundrum

Junior Highway Engineer, Illinois Division of Highways

I have been having difficulty in keeping the paint on a leveling rod from being marred by scratches and weathering and have found that an old inner tube makes an effective covering. The inner tube should be 30x3½ in., or larger. It is cut to make the tube open at both ends which can then be stripped over the rod.

Patches Welded on 30-Yr.-Old Steel Pipe Without Reducing Water Pressure

By J. A. Foulks
Chief Engineer, Department of Streets and [illegible], Division of Water, Newark, N. J.

IN 1891 the City of Newark laid 26 miles of 36-in. and 48-in. riveted steel pipe and three years later laid a second and third line, making 28 miles in all of 42-in., 48-in., and 60-in. riveted steel pipe. The lines extended for part of their distance through a peat swamp, and there sections have deteriorated, mostly through electrolytic action. The electrolysis has probably occurred either from stray current from trolley lines or local action in the soil. The pipe, as a result, has become pitted badly in places, the pits from time to time becoming holes and causing small leaks. Leaks were temporarily repaired by plugging the holes with pine plugs braced with concrete when the holes were on the side or bottom of the pipe and by capping the plug with a lead cover held in place by braces extending to the sides or bottom of the trench; or by pulling steel bands in place with bolts and running lead between the pipe and the band. While such measures have been more or less successful, they have not been considered permanent and as more permanent methods were necessary unless an entire replacement of pipe was made, electric welding was tried. Results so far obtained have been excellent, the repair is of a permanent nature and secured at comparatively low cost.

STEEL PIPE AFTER THIRTY YEARS SERVICE
Several pits in the pipe are easily discernible. The pine plug has been put in a hole preparatory to its being capped and permanently repaired by electric welding.

WATER ESCAPING FROM $\frac{3}{8}$-IN. HOLE
A piece has been welded at several pits [illegible]

Repairs were made for the most part on a 36-in. line laid from Belleville reservoir to the 60-in. feeder on Bloomfield Ave., running through a swampy section. The thickness of the pipe is $\frac{5}{16}$ in. and carries a pressure of 90 lb. In several places the pipe sprung leaks which showed up on the surface of the ground. In two sections, for a distance of approximately 10 ft. and 15 ft., respectively, the ground was removed and repairs were made without reducing the water pressure.

REPAIR OF THE PIPE COMPLETED
The patch at the extreme right is that over the $\frac{3}{8}$-in. leak seen in the figure opposite.

The method of repair was as follows: Where a $\frac{3}{8}$-in. hole in the pipe was discovered the flow of water was stopped with a pine plug. The plug was then cut off flush with the surface of the pipe and covered with a metal cap held fast by tacking it on the side with an electric arc. The cap used was of metal of approximately a No. 11 gage and was slightly concave. Over this cap metal was welded, extending far enough to get a firm hold on the pipe. All pits were filled and reinforced by welding and a triangular patch of about 9 in. on a side was welded over a number of pits appearing in one spot. The pipe was then recoated. Cost figures kept showed that in the repaired section the cost per lineal foot was about 77c. However, that cost included only labor and materials, and excluded the cost and

FROM JOB AND OFFICE

Hints That Cut Costs and Time

FROM JOB AND OFFICE

For Contractor and Engineer

depreciation on equipment, and excavating and backfilling.

The machine used was a gasoline-driven arc welding set mounted on a Ford chassis, consisting of a four-cylinder, four-cycle vertical type engine direct-connected by flexible coupling to a 200-amp. constant-energy type self-excited arc-welding generator, complete with panel for current-regulated steps from 75 to 200 amp.

Why Center Shots in Blasting Misfire

WHERE large-scale blasting operations are carried on, the custom is to fire a number of shots simultaneously by electric detonators usually connected in series and fired either from a power circuit or from a blasting machine. When firing with a hand-operated blasting machine, trouble with missed shots has been frequent. Under such circumstances the shots that fail to fire are often a group in the center of the series. Various explanations have been given as to the cause of these failures and in a paper recently published by the U. S. Bureau of Mines (*Report of Investigations*, 2,384) data which may be helpful in understanding causes of misfiring of center shots are given.

Whatever the source of the firing current generator may be—magneto or battery—the current delivered through a circuit is determined by the total resistance of the circuit. All current leaving the positive terminal must then return to the negative terminal, and if a metallic circuit is well insulated, practically all of the current keeps within the circuit. However, in a shot-firing circuit where wires are frequently in contact with the earth as in wet holes, and where the insulation of the leg wires is inadequate to prevent leakage, the current may take various courses through the earth. Tests show that if a large number of common electric detonators are connected in series and fired under wet earth conditions, a considerable leakage of firing current occurs. The detonators at each end of the series circuit may fire while the middle ones misfire; the detonators near the positive end will fire because enough current has returned to the circuit.

The reason why the middle detonators misfire is not necessarily because the current through them is insufficient but because it is not great enough to fire them before the end detonators have been fired, opening the circuit. In using hand-operated machines it has been found that misfires are more dependent on the current gradient than upon the minimum value of the current.

In order to assist in the elimination of misfiring of center shots, it is recommended that where wet holes are to be shot, the following practice be used: 1. Use waterproof electric detonators with enamelled leg wires (when making connections with enamelled leg wires care must be taken to scrape the ends of the wires well in order that good electrical contact may be secured).

2. Fire the shots from an underground power circuit that has a capacity of at least 30 kw.

3. Use extra precautions when tamping holes in order not to damage the insulation of the leg wires.

4. Arrange the connections between detonators so that they are supported clear of the earth or any other conducting medium.

Pumping Sand with Hydraulic Elevator on Dam Construction Work

A NOVEL use of a hydraulic elevator was made recently at Decatur, Ill., in connection with the construction of the Sangamon River dam. The work consisted in removing sand from a river bar and filling up a deep hole in the river bed. For this work the arrangement was as shown in the accompanying view, the elevator being placed horizontally on a small barge

HYDRAULIC SAND-ELEVATOR ON BARGE

and the pressure-water pipe coming aboard on pontoons with rubber sleeves both at the shore end and the barge end.

The suction pipe was made up of 8-in. pipe and rubber suction hose and its suction end was supported by block and tackle from a small boom with a hand winch. The 12-in. discharge pipe, 300 to 400 ft. long, was supported on barrel pontoons. The discharge end extended down below the water surface, thus eliminating the static head against the elevator, as all joints were fitted with gaskets and made airtight.

Pressure water was supplied by a large reciprocating pump with Corliss steam valve gear. It required 100,000 gal. per hour at 80-lb. pressure to move 50 to 60 cu.yd. of sand per hour. The pressure pipe consisted of 600 ft. of 12-in. pipe on shore and 10-in. floating pipe. The loss was 10 lb., making the effective pressure at the nozzle 70 lb. The elevator worked well at 40 lb., but was most effective at the higher pressure.

This application of the hydraulic elevator was made by George B. Massey, of the Randolph-Perkins Co., Chicago. The design and construction of the dam has been carried out for the city of Decatur by Pearse, Greeley & Hansen, consulting engineers, Chicago, with J. Albert Holmes as resident engineer. Mr. Massey has been called in from time to time as special consultant in connection with earthwork problems.

More on Estimating Floor Slabs

Another letter on the practice of estimating that portion of a slab which rests in the wall has been received from G. Hamilton, of the Du Pont Engineering Co. Writing from Buffalo Mr. Hamilton says:

For estimating concrete quantities, the portion of the slab over the walls should be included in the slab as it has to be finished the same as the central portion of the slab. It therefore obtains a better price than the concrete in the wall. Exception to this is where the concrete walls carry a brick or tile wall up above the floor level. In this case the slab is only considered as the clear span between walls.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

The Future of the Drainage Congress

Sir—After attending all the sessions of the National Drainage Congress I consider that this was not such a success as some of the previous meetings. The attendance was not large and the proceedings seemed to emphasize the fact that the contractors and material men had put up most of the expense money and were thus entitled to the greater consideration and prominence in the meeting. However, there were excellent papers and addresses and a large number of exhibits.

There seems to be no definite purpose to these meetings. At the earlier meetings the purpose was to get the federal government to finance and construct the works for draining and reclaiming large areas of swamp land. But it developed that the majority of the members did not favor this plan, especially as the swamp lands are mostly in private ownership. As a result there was a large loss of members. A new policy was founded at the St. Louis meeting of 1919, favoring legislation by which the government would provide data and plans and establish a revolving fund for loans to be repaid from crops raised on the reclaimed lands. This plan also failed to get unanimous approval and more members were lost. Those now in the organization are not a unit as to what the Drainage Congress should try to accomplish.

After the four years of government control of the railroads I should not favor government control of drainage projects. We do not want to raid the national treasury for political projects, as has been done too often in the river and harbor bills. I favor joint action of the national and state governments in carrying on the geologic and topographic surveys and such educational work as the investigation of rainfall, runoff, drainage and flood control conditions. That is as far as we should go in regard to government assistance.

Whether the Drainage Congress will live and exert an influence for good depends largely upon the policies which it fosters, and we are now at the point where the best judgment must be exercised if the organization is to continue. Many of the already too-numerous societies are on the wane and will survive only by combining with each other and consolidating with allied interests. It is barely possible that the National Drainage Congress has done all it can hope to accomplish.

JAMES W. DAPPERT, Consulting Engineer.

Taylorville, Ill., Oct. 2, 1922.

Original Investment Plan Not a New Idea

Sir—Referring to the article by Edward Flad, published in *Engineering News-Record* of Nov. 2, 1922, p. 736, and entitled "Original Investment as a Basis of Value in Rate Making," I beg to call the attention of all who may be interested in this subject to the following:

This article sets forth as a new theory "original investment" as a basis on which to found rates. But this theory is not new, it having been presented by me in a paper before the American Society of Civil Engineers as early as 1914 (see "The Valuation of Public Utility Property," by J. H. Gandolfo, *Transactions Am. Soc. C. E.*, vol. lxxix, 1915, p. 842), and touched upon in discussions before the society even earlier. The only variation is that I use the expression "actual cost to date" where Mr. Flad uses "original investment," both evidently meaning the same thing.

My paper is a full discussion of the entire subject, and all the points mentioned by Mr. Flad are discussed, much more in detail than in his article. Concrete examples are there given to illustrate the various arguments, legal decisions quoted, and references made in the text as the discussion unfolds.

However, even in my paper it was not claimed that this theory was then entirely new, but I do claim that previous to my article it had not been set forth to any extent with arguments, illustrations and legal decisions marshalled in their logical sequence to give the proper support and force to this fundamental idea in rate making.

One thing I notice, that in Mr. Flad's article neither depreciation nor obsolescence is discussed. Both are of the utmost importance in any question of rate making, and are fully treated in relation thereto in my article.

The present abnormally and in many cases totally unjustifiably high costs of all materials entering into construction work, with the consequent high values of any appraisal undertaken on a today's replacement cost, or "present fair value" basis, with or without depreciation, etc., serve only to accentuate the fallacy of founding rates on such a basis, and will, I believe, tend to bring more into prominence for this purpose the "actual cost to date" theory as being most equitable and just to the promoter, the investor, the public, and everyone having any interest in this great question.

J. H. GANDOLFO.

Princeton, N. J., Nov. 3.

Steel Powder as a Concrete Content

Sir—In your issue of Oct. 5, 1922, is described the use of steel powder in concrete or mortar to make the same more impermeable based on experiments by the Queensland Railway Department in 1920.

The use of steel powder for hardening and water-proofing concrete is well known in this country and was fully commercialized long before the experiments of the Queensland Railway.

Generally speaking, the materials consist of ground cast iron or steel, are known as metallic floor hardeners, and are divided into two principal classes, the repellent hardener and the absorbent hardener. Some of these materials have certain chemicals added to the steel or cast-iron powder to accelerate the oxidation when mixed with the gaging water.

In 1918 the writer made some fairly extensive experiments with the use of steel and cast-iron powders in mortar for the purpose of oil-proofing concrete and mortar tanks and succeeded in obtaining a surface finish which would hold gasoline under a considerable head. The method was subsequently used rather extensively for oil-proofing concrete oil barges, etc.

General use has been made of metallic powders in this country for the purpose of making concrete impermeable and considerable information on the subject is available.

New York, Oct. 10.

H. FOUGNER, Civil Engineer.

A New Method of Purifying Water

Sir—In the abstract of my paper, "A New Method of Purifying Water," in your issue of Sept. 28, p. 514, your condensation makes me say, at one point, that the efficiency of the process "would depend upon the amounts of turbidity and vegetable matter in the water." As a matter of fact the efficiency of the process is fully as great, as far as removal of color and organic matter is concerned, whatever the amount of turbidity and vegetable matter, but it would be necessary to scrape the loaded filter just as would be required with any slow sand filter when a water containing a large amount of matters in suspension is being filtered. When a turbid and highly colored water is to be treated by this method, the load of hydroxide should be placed in the lower 3 or 4 ft. of sand in the filter so that surface scraping would not remove it. The question upon this point of turbidity, etc., asked by G. W. Fuller, during the discussion of the paper was as follows:

"The economics of this problem, as I take it, would relate a good deal to the amount of turbidity, mineral turbidity or microscopic organisms like algae in the applied water and then your regeneration period would be controlled by other matters than the amount of organic matter held in the filter sand?" My answer was: "The regeneration

period would not be changed, it would be necessary probably in such a case to scrape the filter just the same as it would if you did not have it loaded with aluminum hydroxide, as you would any sand filter receiving such water."

Boston, Mass. H. W. CLARK,
Chief Chemist,
Massachusetts Department of Public Health.

Favors Diagonal Roadway Joints

Sir—The conventional method of placing expansion joints at right angles to the roadway causes a simultaneous impact due to two wheels landing over the joint at once. Trucks and cars alike often reach a certain speed which causes the vehicle to pound excessively and the travel of the vehicle can almost be said to consist of a series of jumps.

By observation in making sensitive contact over expansion joints of adjacent slabs with trucks passing over the same, I have found a considerable vertical movement between the slabs. It is obvious that this movement does not add to the life of the expansion joints and roadway. It was therefore concluded that were the expansion joints placed diagonally at an angle making it impossible to have two wheels strike at once, the objections previously mentioned would be avoided.

After observing a short stretch of concrete roadway with expansion joints placed diagonally as suggested above, it was found that the jolting and jumping of vehicles was eliminated entirely, and the wear of the joints is reduced to such an extent as to become negligible. This seems to prove that diagonal expansion joints would benefit the traveling public, as well as increase the life of expansion joints and roadways.

This is written with the hope that if published, some state highway engineering department officials or commissioners will find it worth while considering and incorporate diagonal expansion joint requirements in future roadway specifications. It is fully appreciated that from the contractor's standpoint the diagonal joints are somewhat more inconvenient to lay, but the life of the road and the comfort of the traveling public should also receive consideration.

Linden, N. J., JULES VERNIER,
Sept. 29. Industrial Construction Engineer.

Wind Velocities Above the Surface

Sir—Some new data on wind velocities above the surface and their comparison with surface velocities have just been made public by the U. S. Weather Bureau through a monograph by Willis Ray Gregg, meteorologist, in "An Aerological Survey of the United States, Part I—Results of Observations by Means of Kites," forming supplement No. 28 of the *Monthly Weather Review*, issued under date of May 31, 1922. A few comments on this valuable monograph may be worth the attention of those of your readers interested in steel structures of unusual height, such as radio towers.

Observations at six stations in different parts of the United States are recorded. They were made by means of self-registering instruments carried by kites. Flights were made only under conditions favorable for kite flying, that is, in surface winds ranging from 4½ to 45 miles per hour, at which time the wind velocities above the surface ranged from 11 to 75 miles per hour.

The principal tables presented are for average velocities. One table, however (table 21, p. 78), gives maximum velocities, and these, of course, are the ones interesting to the structural engineer. These maximum velocities at the surface varied from 30 miles per hour at Leesburg, Ga., to 65 miles per hour at Ellendale, N. D. At an altitude of 1,000 m. above mean sea level the maximum velocities ranged from 50 miles per hour at Leesburg (altitude of station 85 m.) to 90 miles per hour at Ellendale (altitude 444 m.).

This brief indication of the order of magnitude of the figures would tend to indicate that the upper winds are of considerably higher velocity than surface winds. The conclusion is drawn, in fact (p. 27), that the wind velocity increases up to an altitude of 500 m., and that on the average this increase amounts to about 100 per cent. However, the significant showing of the tables is that the increase noted does not hold for the higher surface velocities. Thus, at the time the velocity of 65 miles an hour was measured at Ellendale, the velocity 506 m. above the surface was only 68 miles per hour.

The observations extended over periods of only one to five years at the several stations. This is too short a period to warrant definite conclusions. The structural engineer who desires to exhaust the possibilities of these data, however, should examine the observations in detail as well as the averages presented. The detail data are accessible to those interested.

The Weather Bureau is to be commended for publishing data while they are new. R. FLEMING.

New York, Oct. 3.

Why Paint Galvanized Sheets?

Sir—A letter from F. H. Thomson in *Engineering News-Record*, Nov. 2, p. 759, under the title "Painting Galvanized Sheets," is quite interesting, but raises the question: Why paint, is it for color harmony or for durability? The writer and his associates have spent considerable time and energy investigating what we term "modern galvanizing." We present the following comments in answer to Mr. Thomson's inquiry.

Properly galvanized steel sheets do not require painting unless for color harmony. By a properly galvanized sheet we are in accord with the opinion of the British Crown Agents for the Colonies who in their Specification No. 1, issued in January, 1920, state: "The galvanizing by the hot process must produce a surface uniform, clean and smooth throughout, and is to weigh not less than 1⅛ oz. on each side per square foot of area treated." We recommend such a product which, for ordinary exposures, will not require painting.

The modern galvanized sheet of British or American manufacture does not carry the zinc coating just recommended but, in a recent compilation covering the product of about forty producers in the two countries, has shown from 0.3 to 0.95 oz. with an average of about 0.7 oz. of protective coating per square foot of coated surface. The fact that these coatings are so thin undoubtedly is the principal reason for painting.

In order to obtain satisfactory galvanized sheets one must demand and pay the necessary premium for the quality product, otherwise the galvanizer will furnish a commercial material with insufficient coatings. Sheets with a "two-ounce minimum zinc coating by spot test" (2¼ oz. by weight test or 1⅛ oz. on each side per square foot) are produced by a number of the more reputable manufacturers.

In order to obtain a good adherence of paint to a zinc surface the surface must lose its original luster and greasy appearance (not grease, however). The best way is to permit natural atmospheric corrosion for at least nine months. In cases wherein the builder must paint immediately artificial expedients are employed (chief among which are various copper salts), all of which attack the zinc coating causing an immediate surface corrosion. Such methods reduce the protective influence of the zinc enough to make their use inadvisable unless the engineer in charge cannot wait for the atmosphere to perform the same function in a more efficient manner.

Where such painting is done after exposure Mr. Thomson raises the objection that one cannot paint both sides of the sheet at the overlaps, behind purlins, girts, etc. Our experience has been that this has not proven important, such locations being in a protected or semi-protected position, and not subject to the full effects of atmospheric corrosion.

However, we would be interested in learning whether the real trouble does not lie in the purchase and use of galvanized sheets with an insufficient protective coating? We heartily agree with Mr. Thomson in the statement that great benefits are to be had by a free exchange of data on the subject of galvanized products.

F. G. BREYER.
Chief of Research Division,
Palmerton, Pa., Nov. 13. New Jersey Zinc Co.

NEWS OF THE WEEK

New York, November 23, 1922

Relations of Engineers and Contractors Discussed

Fact That Both Parties Are Interested in Building Satisfactorily, Quickly and Inexpensively Is Stressed

A discussion of the subject of the relations between engineer and contractor before the New York Section of the American Society of Civil Engineers on Nov. 15 laid renewed emphasis on the fact that the two parties are interested in the same problem, that of constructing a satisfactory job at the lowest cost and in the shortest time, and that both must contribute toward reaching from the start an appreciation of their mutual interests.

Specific instances were cited to show that in spite of the improvement in contracts and specifications during the last twenty years or so, they are still very frequently drawn in needlessly severe and unfair terms, and that at the same time the keenly competitive nature of the contracting business very often forces contractors to bid even under unfair specifications, which they otherwise would prefer to avoid. Some points commonly overlooked in the interpretation of contracts were mentioned as follows: That the deciding fact in interpretation is the intent that was in the minds of the parties when the contract was made; that a contract where in doubt should be construed against the drawer of the contract; and that the intent of the contract cannot be construed by the terms of any one single clause which is contained in the contract.

Faults in Engineering Direction

Lack of promptness of decision on the part of the engineer, or his unwillingness to make any changes where conditions developing in the execution of the contract indicate the desirability of changes, were cited as common faults in engineering direction. It was emphasized, however, that it is quite impossible to write a specification or even a single clause so clearly that it is not open to different interpretations, and that in view of this fact and the conditions necessarily developing in execution of work it is necessary that the engineer and the contractor agree, that they recognize their mutual rights, and that either party appreciate its own liability to make mistakes. It was charged against engineers that in order to have at their command a sufficiently strong control over the contractor they draw specifications so severe that strict compliance is well-nigh impossible.

Difference of opinion was expressed as to whether the conduct of municipal work must necessarily be subject to different limitations from those affecting private work.

The difficulties affecting federal contract work were also discussed, though not conclusively.

Treaty Formulated to Allocate Colorado River Benefits

The Colorado River Commission met in Santa Fe, N. M., Nov. 13, with Herbert Hoover, Secretary of Commerce, as chairman, and all seven states traversed by the river represented by delegates with power to act. After a four-day session, according to telegraphic reports, the committee agreed upon the main principles of a treaty between the seven states and the federal government for the apportionment of the benefits to be derived from its waters. Secretary Hoover then invited the governors of the seven states to join the commission at Santa Fe at once to give their final views on the treaty. Meantime the commission devoted itself to completing details.

Although the text of the treaty has not been made public it is understood to divide the seven states into two groups with California, Nevada and Arizona in the lower division and Utah, Wyoming, Colorado and New Mexico in the upper division, equal amounts of water being allotted to each division. Preference in right is given to the use of water on established irrigation developments and no existing rights are to be disturbed. Another commission, to meet after the lapse of several years, is recommended. No announcement was made regarding allocation of water to Mexican territory, or whether water passing from the upper to the lower divisions is to be measured. After approval by the commission the treaty is to be submitted for ratification to the legislatures of the several states and to Congress.

Secretary Hoover stated that "the matter of power has been taken entirely out of the hands of this commission by direction of the President to the Federal Power Commission." The flood-protection needs of the Imperial Valley were recognized as extremely urgent reasons for immediate erection of control works.

Fletcher Asks to Be Replaced on Dam Investigating Body

Since the report on the arch dam investigation of Engineering Foundation was published in *Engineering News-Record*, Nov. 16, p. 857, A. B. Fletcher, director of public works of California, has requested that he be relieved of duty on the committee and that W. F. McClure, state engineer of California, be appointed in his place. The report also stated that H. Robert Porter was a member of the committee. This should be H. Hobart Porter.

Coal Association Suggests Lines of Study for New Commission

Washington Correspondence

Seven fundamental points are suggested by the National Coal Association as subjects to which the President's coal commission should give particular attention. They are:

1. The effect on production and on the price of coal, to the consumer, of the monopolistic and absentee control of mine labor.
2. The opposition of organized labor to the introduction of labor-saving machinery.
3. The non-observance by organized labor of contracts made on its behalf.
4. The existing prices of mining materials and supplies and a comparison between them and the prices existing prior to the war.
5. The existing freight rates and a comparison between them and the rates existing prior to the war.
6. The effect of inadequate transportation facilities on the production and the cost of coal.
7. The character and quality of the different coals, the uses to which they are put and the demand therefor.

The most careful attention was given by the National Association to this document. It was formulated from separate drafts presented by the different groups of operators. John W. Davis, former ambassador to Great Britain and former Solicitor-General of the Department of Justice, who has been retained by the association as its advisory counsel, assisted in the preparation of the document.

Alfred M. Ogle, the president of the National Coal Association, met with the Brydon committee when the report was approved. At the close of the meeting he declared that coal operators generally are convinced that the President's commission is going to do a constructive piece of work. He said that the National Coal Association is more than anxious to co-operate with the commission in the most cordial and effective way possible.

Florida to Hold Anti-Mosquito Conference at Daytona

An anti-mosquito conference under the auspices of the State Board of Health of Florida will be held at Daytona, Dec. 6 and 7. This conference is the culmination of a season's intensive work by Chief Sanitary Engineer George W. Simons, Jr., under whose direction the details of the meeting are being arranged. At this conference the general problem of mosquito eradication will be discussed, and ways and means developed for attacking the problem on a large scale. It will be the first of such conferences in Florida. A special appeal has been made to members of the engineering profession to become identified with this program and take the initiative in its launching.

Dr. E. C. Levy Heads American Public Health Association

Dr. E. C. Levy, the recently elected president of the American Public Health Association, has served the city of Richmond, Va., as special investigator of its water supply, city bacteriologist, chief health officer, and is now director of public welfare. In the last named capacity he has charge of various bureaus, including those of health, hospitals, and charities.

After graduation from the Medical College of Virginia in 1890 and service as interne at Mount Sinai Hospital, New York City, for two years, Dr. Levy practiced medicine in Richmond until 1897. From that date until 1900 he was professor of histology, pathology and bacteriology in the Medical College of Virginia. Since undertaking special bacteriological studies of the water supply of the city of Richmond, in 1899, Dr. Levy has been engaged exclusively in public health work. In 1902-3 and again in 1903-4 he took special courses under the late Prof. William T. Sedgwick at the Massachusetts Institute of Technology. In 1904 he made further studies of the water supply of Richmond in connection with the water purification plant then under construction. He became city bacteriologist of Richmond in December, 1906, and from December, 1905, and for some eleven years beginning July, 1906, he was chief health officer of Richmond. During that year he completely reorganized the Public Health Service of Richmond and made special investigations in connection with typoid fever, infantile diarrhea, fly breeding and control.

From August, 1918, to January, 1919, Dr. Levy served in the Medical Corps of the United States Army as camp epidemologist at Camp Pike, Ark., with the rank of major. In January, 1919, he secured an honorable discharge from the army to accept the position of director of public welfare at Richmond.

New Bridges To Span Willamette at Portland, Oregon

By popular vote at the general election held Nov. 7 Multnomah County, Ore., was authorized to issue $3,000,000 for the construction of the new Burnside bridge over the Willamette River at Portland and another issue of $1,600,000 for the construction of what will be known as the Beacon St. bridge. The bonds are to become immediately available and steps are now being taken to prepare and sell them.

West Virginia Passes Road Bonds

Advocates of good roads in West Virginia succeeded at the recent general election, in having passed several bond issues which provide money for hard-surface road construction. In Upshur and Lewis Counties $3,168,000 were authorized at the recent election. Other issues favorably voted upon were: three districts of Upshur County, $784,000; and Freeman's Creek District, Lewis County, $800,000.

The Engineer in Public Life

JOHN H. WILSON

As mayor of the City and County of Honolulu, Hawaii, John H. Wilson, first president of the Honolulu chapter of the American Association of Engineers, is giving to the executive department of the municipal government the benefit of experience gained in more than 25 years of engineering activities in the Territory. There have been only three mayors since the inauguration of the city and county government, and of the three, Mayor Wilson has been the only engineer to serve as the city's chief executive. He has been in office two years.

Mayor Wilson's supporters point out that it is particularly fitting that an engineer should stand at the head of the Honolulu municipal government. The city and county comprise the entire island of Oahu with an area of approximately 600 sq. miles and a population of 123,527. But the old city of Honolulu, so designated before the creation of the city and county government, occupies only a small concentrated part of the island—40 square miles, and has a population approximating 83,000. The greater part of the area under the jurisdiction of the mayor, therefore, is made up of broad country districts wherein road building and maintenance is a strong factor in administration of affairs. The topography of the country is such that proper highway construction requires the most modern and ingenious methods. It was Mr. Wilson, back in the 90's, who constructed the first wagon road over the Nuuanu Pali in the Koolau range of mountains, otherwise impassable to vehicles for the entire length of the island, which they divide in the middle.

Mayor Wilson, prior to his election, undertook private construction work in connection with the Oahu Ry. until 1897 when he joined the staff of the department of public works in the short-lived Republic of Hawaii. He later engaged in private engineering on the islands of Oahu, Hawaii, Kauai and Maui. Between 1908 and 1911 he was superintendent of highways in Maui and of streets in Honolulu. He was city engineer in Honolulu in 1920.

He has taken an active interest in politics as a democratic leader in the Territory and since 1912 has been a member of the Democratic National Committee, attending as delegate the national conventions at Baltimore in 1912, St. Louis in 1916, and San Francisco in 1920. He received his education in the Hawaii public schools and at Leland Stanford Jr. University. He was born in Honolulu, Dec. 15, 1871.

Builders to Meet in January

The twenty-seventh annual convention of the New York State Association of Builders will be held in Elmira, N. Y., Jan. 30-31. Builders of the state and country are invited to attend.

Lincoln New Dean of Electrical Engineering School at Cornell

Paul M. Lincoln, the recently-appointed director of the electrical engineering college at Cornell University, assumed his new duties on Nov. 1. For the past three years he has been associated in an executive capacity with the Lincoln Electric Co., organized by his older brother, which organization he has left to replace Prof. Alexander Gray, who died some months ago. Mr. Lincoln received his collegiate training at Ohio State University, being graduated with the degree of M.E. in E.E. in 1892. His first work after graduation was with the Short Electric Co. at Cleveland, Ohio. Later he went to Pittsburgh, Pa., to work for the Westinghouse Electric & Manufacturing Co. and after about two and a half years with that concern became electrical superintendent to the Niagara Falls Power Co., Niagara Falls, N. Y. He was with that company for seven years, returning in 1902 to the Westinghouse company in an engineering capacity. For the next six or seven years he had charge of the power division of the engineering department, in which division was designed electrical equipment for power plants, generators, switchboards, etc. In 1910 he was appointed a general engineer for the Westinghouse company, remaining there until the date of his resignation in 1919, when he became associated with the Lincoln Electric Co. From 1911-15 he acted as head of the electrical school of the University of Pittsburgh while still carrying on his work with the Westinghouse company.

He is a member of various technical organizations and during 1914-15 was president of the American Institute of Electrical Engineers. He is an inventor of some note, having been awarded the John Scot medal by Philadelphia for his invention of the synchroscope.

Rule of Road Changed in Province of New Brunswick

On Dec. 1 the rule of the road will be changed in the Province of New Brunswick, Can., from left- to right-hand drive. Ten thousand notices, some in French and some in English, have been distributed throughout the province. Motion picture houses are exhibiting special advertising signs and the press of the province is being used in the advertising campaign.

Building Permits and Plans

Under a new ruling of the city engineer's office, the city of Ogden, Utah, will hereafter require plans and specifications to be presented before building permits will be issued. The order is to apply to all buildings costing more than $1,500. Practice up to the present has been to grant permits without presentation of plans. For some time an ordinance has been in force requiring plans and specifications to be presented, but it has not been enforced.

Clearing Snow From Highways Again an Imminent Problem

With the approach of winter those highway departments having snow removal as a special maintenance problem are beginning to think seriously how that problem is to be attacked. Indicative of the difficulties met in some quarters in combatting snow are the notes given below on the opening in the spring season of the Sunset Highway in Washington.

The Sunset Highway crosses the Cascade Mountains in Washington via Snoqualmie Pass at an elevation of 3,010 ft. It is the main route connecting the eastern and western portions of the state. For five or six months every year snow blocks the road and ranges up to 12 or 15 ft. in depth, extending from three to four miles on either side of the pass. Considerable importance is attached by automobile clubs and the motoring public generally to the exact date of opening this road. The highway department is also interested in the time and method of opening the road each year because this has an important bearing on the cost of maintaining the road during the open season. High maintenance costs had to be met in years when automobiles were allowed to go over the road before the snow was properly cleared because the road surface was rutted and cut up under the slush and snow water, which remains on the road for some time in early spring.

In the past two years the snow was cleared from the road in the spring with a steam shovel and before opening it to the public the surface was graded up in the center and adequate side ditches were provided for carrying off the large volumes of water that came from the melting snow piled alongside. This plan has proved so successful and economical that it is now proposed to keep a steam shovel continually on this stretch of highway, using it for maintaining and widening the road in the summer and when the construction season is over each fall, storing the shovel with a supply of fuel near the summit of the pass where it will be conveniently located for starting to clear the road in the spring.

This past season the road was cleared about six weeks earlier than would have been possible without the use of power equipment. The work was done with a standard steam shovel, using a special dipper with a volumetric capacity of 3½ cu.yd., but which actually moved about 5 cu.yd. per load much of the time. This dipper was built with a slight taper enlarging toward the outlet so as to avoid the tendency of the snow to pack and stick in the dipper.

The shovel was used only where the snow exceeded 3 ft. in depth; graders and scrapers being used to clear snow of lesser depth. This year depths ranged up to 11 or 12 ft. and the shovel is estimated to have moved about 125,000 cu.yd. of snow in the eight miles of highway over which it was used.

The total cost of the steam shovel work was about $7,000, or 5.6 cents per cubic yard. The major portion of the cost of this work is borne by King County. Thomas R. Beeman is county engineer.

CLEARING THE HIGHWAY THROUGH SNOQUALMIE PASS, WASHINGTON
The steam shovel operating over an 8-mile section, handled 125,000 cu.yd. of snow at a total cost of 5.6 cents per cubic yard. The shovel operated in depths ranging from 3 to 12 ft.

Pittsburgh Bridge Raising Order Again Confirmed

According to news from Washington, Secretary of War Weeks has approved the recommendation of the Engineer Corps that all the Allegheny River bridges at Pittsburgh be raised to a uniform height of 45 ft. above mean low water, confirming and sustaining the decisions of former administrations and rejecting recent renewed appeals on the part of Pittsburgh interests for reduction or elimination of the bridge-raising requirements.

British Concrete Institute Changes Its Name

At a meeting on Sept. 28 the Concrete Institute, of London, by vote of its members decided to change its name to "The Institution of Structural Engineers," in which there will be a section devoted to concrete constructional work. This change is partly the result of a development of the activities of the society and partly in answer to a demand of the British law. Some time ago the Concrete Institute began to consider structural problems other than those found in concrete and its papers and discussions more and more covered a wider field. In consequence, the Board of Trade, which has control over such matters, called attention to the Council of the Institute that it was undertaking work considerably beyond the scope of its original articles of association, and that it either must alter the title of the Institute or revert to the more limited scope of activity originally contemplated. There was some opposition on the part of members, first because of the fear that the concrete phase of the society would be submerged, and, second, that the new name would require investigations and studies stepping into the field of a number of the other technical societies, notably the Institution of Civil Engineers and the Institution of Municipal and County Engineers, but this opposition was not strong and the vote was greatly in favor of the change. Of interest to members of similar societies in this country is the fact that the annual dues have been increased from £2 2s. to £3 3s.

To Sell Hog Island

Bids have been called by the U. S. Shipping Board on the Hog Island shipbuilding plant, just below Philadelphia, where fabricated ships were built during the war period under charge of the American International Corp. The date of opening bids is Jan. 30, 1923. The Shipping Board considers that the plant will not again be called upon for shipbuilding purposes and that its value lies in its possible development as a terminal and manufacturing site. All surplus materials which had been stored at the plant have already been sold, and the present offer covers the land and buildings.

Contractors and Engineers to Tour South America

A 69-day tour of South America for a large party of engineers and contractors has been arranged under the direction of "The Earth Mover," Aurora, Ill., and the American Express Co.'s travel department. Sailing from New York on Dec. 2 by the Pacific Steam Navigation Co.'s steamer "Ebro," the party will go through the Panama Canal and visit a number of ports on the west coast. From Valparaiso, Chile, the transcontinental railway will carry the party to Buenos Aires and then another steamer will be taken up the east coast, stopping at different ports and making a longer stay at Rio de Janeiro on account of the Brazilian centennial exhibition in that city. Leaving Jan. 22 on the Lamport & Holt line steamer "Vasari" and stopping at West Indian points it is expected to end the 12,750-mile trip by arrival at New York on Feb. 9, 1923.

Utilities Commissioners Meet in Detroit

Urge Railroad Valuation by States—Suggest Abolition of Express Companies—Other Matters

Faced by augmented problems of railroad and utility regulation, the members of the National Association of Railroad and Utilities Commissioners held one of its best attended annual conventions at Detroit last week. There were about 95 representatives from 37 states at the convention. An appeal for valuation of railroads according to states as well as systems; an urgent recommendation that the Interstate Commerce Commission be given enough money to keep valuations up to date; a suggestion that express companies be done away with and their business handled by railroads; unqualified support of private ownership of railroads and public utilities; and strong recommendation for modification of the Esch-Cummins Bill restoring certain powers of regulation and jurisdiction over distribution of cars of railroads, were outstanding features of the convention.

Mayor Couzens, of Detroit, in his welcoming address urged the commissioners to work toward municipal ownership. So far as the Detroit experience was concerned, he said that they had not yet entirely eliminated graft, interlocking relationships, unreasonable salaries, and other excessive expenses from privately operated public utilities.

President Jackson of the association warned against centralization of too much authority in federal hands, asserting that "if it were not for the activities of this organization, the states would shortly find themselves stripped of local control" in fields wherein the state commissions had superior knowledge of conditions to be governed.

Resolutions Passed

Following the discussion of the report of the committee on valuation the association adopted several resolutions, chief among which was that urging the I. C. C. to find the value of all interstate roads by states, and one urging amendment of the Esch-Cummins law defining the power of the I. C. C. and restoring to the states control over interstate traffic and rates relating thereto. The association also went on record as favoring the giving of assistance to the Interstate Commerce Commission to get a sufficient appropriation for its valuation work that the valuations could be kept up to date when made.

There was a marked tendency to support the requirement of having to get certificates of public convenience and necessity before motor vehicle lines could be operated and the executive committee was requested to draw up a proposed law for submission to the various commissions, to be discussed at the next convention, for suggestion to legislatures in the various states.

The report on express rates went into the question of the lack of necessity for express companies and suggested that it would not be long before it would probably be found desirable to do away with express companies and turn their business over to railroad companies. It was thought by the commissioners that two agencies were unnecessary in the same transaction.

Officers for the ensuing year were elected as follows: President, Dwight N. Lewis, member, Iowa Board of Railroad Commissioners; first vice-president, Alexander Forward, member, Virginia State Corporation Commission; second vice-president, H. G. Taylor, chairman, Nebraska State Railway Commission; secretary, J. B. Walker, secretary, New York Transit Commission, and assistant secretary, J. H. Corbitt, secretary, Tennessee Railroad and Public Utilities Commission. The next convention of the association will be held at Miami, Florida, Dec. 4, 1923.

For Society Secretaries

Three years ago *Engineering News-Record* issued a pamphlet listing the names and addresses of national, district and local engineering societies and clubs, together with the name of the president, the name and address of the secretary, the date of annual meeting and approximate membership of each society.

The list was widely distributed and its usefulness demonstrated to such an extent that we are planning to issue a revised list bringing the information up to date. Blank forms to be filled in and returned have been sent to all organizations of which we have record. If any have been omitted it is requested that their secretaries forward the information noted in the first paragraph of this announcement.—EDITOR.

British Passenger Train Attains Speed of 100 M.P.H.

A record run on the Great Western Ry. has just been disclosed. An ocean special traveling between Paddington (London) and Plymouth attained an average speed, exclusive of stops, of 66 m.p.h. At times the speed exceeded 100 m.p.h. while 80 and over was general. An observer on the train says that at the extreme speed the travelling was so smooth that, except for the sound, it was difficult to believe that the train was moving at all.

The run from Paddington to Plymouth is a daily service on the Great Western, the distance of 225 miles being covered in exactly four hours without a stop, this working out at an average speed of 56 m.p.h. Passengers for intermediate towns are dropped by the slip-coach system of which the Great Western has always made a great feature. This run is the longest and fastest non-stop in the world.

Philadelphia Garbage Tankage Sells for $4.27 a Ton

Philadelphia garbage tankage has been sold for the half year October-March to John Meehan & Son, Philadelphia, at $4.27 a ton. The contract is on the "as is" basis with 15 per cent of moisture. John H. Neeson, deputy chief, Bureau of Highways, and head of the Division of Street Cleaning, states that Philadelphia tankage averages about as follows in per cents: Ammonia, 3.17; bone phosphate, 0.07; potash, 0.61.

Narrow Bridges in Pennsylvania To Be Widened

Systematic work in widening the narrow old highway bridges in Pennsylvania is to be undertaken with the beginning of next season, according to plans just announced by the highway department of the state. A recent survey by the department shows that there are 1,834 bridges less than 16 ft. wide, on roads which have been made part of the state highway system. As the law of the state permits the operation of trucks 90 in. wide, most of these narrow bridges will not carry two trucks side by side. Plans for widening the most important of the narrow bridges are now being worked out, so that active work in widening them can be started at the beginning of the 1923 season.

Some of the bridges, 50 to 100 years old, are so weak that it would not be advisable to repair them; these will be renewed. In other cases the cost of widening is too great for the present, and work will have to be held in abeyance until more money is appropriated. In such cases safety signs are being placed reading "Danger: One-Way Traffic Bridge."

It is the present policy of the department to build all new bridges at least 24 ft. wide. The narrow bridges which are not entirely rebuilt but merely widened will be carried to the same width wherever possible. The department will endeavor to retain the contour and general architectural character of the old structures.

Financing American Falls Dam Progressing Favorably

Financing of the American Falls dam, Idaho, creating the largest reservoir in the world, is progressing favorably. In October one irrigation company wanting future storage water paid $150,000 into the U. S. Reclamation Service fund and a second company has sold its bonds and in December will pay in $125,000. The Twin Falls, Idaho, commissioners have set Jan. 16, 1923, as the date upon which an election will be held on the organization of the American Falls Reservoir District which will include 500,000 acres. Barry Dibble is project manager. The American Falls development was described in *Engineering News-Record* Sept. 21, p. 473.

Automobile Unseats Bridge

A 100-ft. iron bridge spanning the Juniata River on the state highway between Tyrone and Bellwood, Pa., was knocked from its seats on Nov. 5 by a speeding automobile which ran into the end of the truss. The span dropped several feet and then wedged against the abutment. The structure was 34 years old. It was damaged so seriously that a temporary bridge will be built at once, to be replaced by a permanent concrete bridge next year.

Moffat Tunnel Decision Favorable

The State Supreme Court of Colorado has decided unanimously in favor of the legality of the proceedings for building the Moffat tunnel, on the Denver & Salt Lake R.R., by means of an assessment district. It had been expected that the decision would be handed down during the first week in January, 1923.

Collapsible Dam Across Maumee River Planned at Fort Wayne

A collapsible dam 300 ft. long and 12 ft. high across the Maumee River is proposed by the city of Fort Wayne, Ind., as part of a project for park work and general improvement along the three rivers within the city. The location is about a mile below the confluence of St. Mary's and St. Joseph Rivers. Floods will be passed by lowering the dam. Funds for the work are now available and the Board of Public Works has issued a request for the submission of plans.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. [illegible]

AMERICAN ROADBUILDERS ASSOCIATION, New York City, Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City, Annual meeting, New York City, Jan. 17-18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting, [illegible], Jan. [illegible]-Feb. [illegible]

The Kansas County Engineers' Association held its annual meeting in Topeka Nov. 15-17. The following engineers were elected for the ensuing year: President, R. C. Ham, Dodge City; 1st vice-president, W. S. Ruggles, Jr., Winfield; 2nd vice-president, James Irons, Garnett; secretary-treasurer, A. C. Lagerwall, Topeka; and corresponding secretary, J. O. Gunnels, Belleville.

The South Carolina Chapter of the American Association of Engineers held its annual meeting recently at Columbia, S. C. The following officers were elected: L. M. Fisher, Columbia, president; L. S. LeTellier, Charleston, first vice-president; Harwood Beebe, second vice-president; L. A. Emerson, Columbia, secretary, and Charles H. Moorefield, Columbia, and B. R. Cowherd, Greenwood, executive committee. The principal speakers included State Highway Engineer Charles H. Moorefield, Prof. Rowe, the new head of the engineering division of the University of South Carolina, and Prof. L. S. LeTellier, vice-chairman of the State Board of Engineering Examiners of South Carolina.

The Virginia Section of the American Society of Civil Engineers will hold its first quarterly meeting in conjunction with the Virginia sections of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Association of Engineers at the Virginia Military Institute, Lexington, Va., Nov. 24-25. The principal speakers in the [illegible]

H. K. Bishop, chief, Division of Construction, U. S. Bureau of Public Roads; C. M. Upham, state highway engineer, North Carolina; T. R. Agg, professor of highway engineering, Iowa State College; Dugald C. Jackson, professor of electrical engineering, M. I. T.; A. J. Brosseau, Chamber of Commerce of the United States, and Dean A. N. Johnson, University of Maryland.

Personal Notes

RANSOME BROWN, of Wichita, Kan., was at the recent general election re-elected to the office of county engineer of Sedgewick County, without opposition. Mr. Brown has held this office for the past twenty years.

EARLE RUSSELL, formerly structural engineer for MacDonald and Kahn, engineers and contractors of San Francisco, has opened an office for private practice in the Santa Fe Building, San Francisco.

JEAN M. ALLEN has established consulting offices in the Monadnock Bldg., Chicago, where he will give special attention to examinations and reports on dredging and earth-moving projects, and other details concerned with engineering for dredging contractors.

GEORGE T. FREITAS, city engineer of Modesto, Calif., has tendered his resignation. It will become effective Jan. 1.

C. E. GRAFTON, county road engineer of Hancock County, W. Va., has resigned and will leave Nov. 26 for San Diego, Calif., to spend the winter.

J. P. TUPLIN, structural engineer, who has been connected with the Foundation Co., 120 Liberty St., New York City, for the past six years, has joined the forces of George B. Post & Sons, 101 Park Avenue, New York City.

W. B. MCMILLAN has become associated with the consulting engineering firm of Thebo, Starr & Anderton, San Francisco, Calif., having severed his connection with the San Joaquin Light & Power Co., with which organization he was associated as resident engineer. In his new position he is office and field engineer.

E. B. WILSON, formerly civil engineer with the Wales Lines Co. of Meriden, Conn., has severed his connection with that organization to become general foreman for the Immick Co. of Meriden, general contractors. At present he is employed in superintending the construction of the New Britain High School.

M. N. BAKER, associate editor of *Engineering News-Record*, delivered a Delemar lecture in hygiene at the Johns Hopkins University School of Hygiene and Public Health on Nov. 20. The subject was "Engineering and Public Health."

[illegible] has been appointed project engineer with the Missouri State Highway Commission. He is in charge of work in Audrain County and is stationed at Mexico, Mo. Prior to Oct. 1 Mr. Hall was with the Kansas State Highway Commission.

CARL J. LOFSTEDT, until recently a designer with Palmer Bee Co. of Detroit, Mich., has accepted a position on the engineering staff of the Tidewater Portland Cement Co., Union Bridge, Md.

B. E. CLARK, for the past two years state highway commissioner of Oklahoma, has resigned, his resignation to become immediately effective. It is understood he will become associated with the Portland Cement Association in Oklahoma territory.

W. N. WILLIAMS, until recently mechanical engineer with the City of Akron, Ohio, in the Bureau of Water Works Improvement, has become connected with Sargent & Lundy, Inc., mechanical and electrical engineers of Chicago.

ROSCOE L. SMITH, until recently with the Louisiana Fire Prevention Bureau and before that consulting engineer of St. Paul, Minn., has become chief engineer of Houston Dunn, Inc., fire prevention and fire protection engineers of Philadelphia. Prior to his entering consulting practice in St. Paul, Mr. Smith was the engineer of the city water-works department of St. Paul. During the war he was captain in the Quartermaster Corps of the Construction Division of the Army, and assistant to the advisory engineer of water supply.

WILLIAM WADE ELLISON has become superintendent of construction for the S. S. Kresge Co. He was formerly superintendent of construction for the Ford Motor Co.

CARL H. GILMAN has joined the engineering staff of the J. G. White Engineering Corp., general contractors, New York City. He was formerly a resident engineer in the Maine Highway Commission. Mr. Gilman is at present on a job in Pine Grove, Pa.

HAROLD A. THACKREY has severed his connection with the Nebraska State Department of Public Works where he was employed in an engineering capacity, and has accepted a position with the Portland Cement Association as a promotion engineer. He is at present located in Champaign, Ill.

A. E. DREW, until recently a resident engineer employed on highway construction work by Collin County, Texas, has become identified with the Midwest Engineering Co., Silverton, Texas. His position is that of resident engineer.

P. H. BUDD is now attached to the office of the Constructing Quartermaster of the United States Army, New York City, as an assistant superintendent of construction employed in constructing buildings, roads, etc., for different branches of the army. Until recently he was engineer for the Universal Steel Export Co., Inc.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Improved Equipment Will Cut Construction Wastes

Benefits from Closer Contact Between Contractor and Manufacturer Stressed By Marshall

REAL economy and the lowering of construction costs go far beyond the question of field efficiency, according to the views expressed by Brig.-Gen. R. C. Marshall, Jr., general manager, Associated General Contractors of America, in an address delivered Nov. 22 at Buffalo, N. Y., before the New York State Industrial Conference. There is unquestionably need for improvement, and this improvement, he emphasized, should be carried out in co-operation between the men who have developed and are now developing equipment and the men who are using it in the field.

"It is surprising," General Marshall said, "how great the progress in equipment development has been when we recall the lack of contact that has existed between the manufacturer and those who use his machines. In producing new devices for one or another of the manufacturing industries development has been fostered by co-operative studies of plant facilities which profited from creative minds of both the machinery manufacturer and his customer; but in the construction industry there has been little such co-operation. Construction companies have either accepted or rejected the devices placed before them, while the manufacturer's principal guidance from the field has been his record of complaints. As these complaints have not always been of a constructive character they have failed to furnish the necessary information and both groups have suffered through lack of contact."

Contact Between Maker and User

The manufacturers, General Marshall pointed out, have been handicapped by this want of constructive study and criticism from the field where the true value of every new device is determined, and construction companies have been handicapped by the lack of adequate means for reaching the manufacturer and obtaining the incorporation of ideas into machines suitable for the work. The time has come, however, when both parties appreciate the value of eliminating this breach and the initial steps have been taken to establish proper co-operation between them. To this end a joint committee of representative equipment manufacturers and members of the Associated General Contractors of America, which was recently appointed at Detroit, will investigate the development of equipment, construction practices, and other matters that will expedite the adoption of efficient methods as explained in *Engineering News-Record*, Nov. 2, p. 765.

Not one construction project in five, according to General Marshall, is carried out under the most effective methods that could be devised for that particular piece of work. On almost every construction project the problem arises of whether it is more economical to buy additional equipment and install a superior method than to use existing plants and a method less effective. This means, he said, that the real economy in methods arises from operating plants that are not necessarily the most effective for each particular job, or even for any particular job, but which are the most all-around adaptable for all of the jobs that the construction company expects to perform. Therefore, in investigating and improving construction methods, it is necessary, General Marshall believes, to consider not only the most effective means of performing a particular type of work, or a particular type of project, but also the variety of work for which a particular plant and method can be employed.

To Confer on Numbering of Steel as Quality Index

To consider the desirability of designating qualities or kinds of steel by code numbers, a conference will be held on Dec. 6 at the Department of Commerce Building in Washington under the auspices of the American Engineering Standards Committee. The movement originated with the Bureau of Standards. It is said that a system of number designation already has wide currency in the field of automobile steels and that there is a desire in some quarters to apply such a system more widely. Uniform numbering systems for various classes of steels will be considered separately, and a joint system for all steels will also be discussed. The substitution of numbers for existing brand names will be considered.

Slate Industry to Meet

Manufacturers, producers, distributors, dealers, roofing and other contractors using slate are planning to gather in New York at the Commodore Hotel, Jan. 25 and 26, for the slate industry meetings to be held under the auspices of the National Slate Association. Roofing contractors and other users of slate will discuss the program for a co-operative promotion of the use of slate and the betterment of the conditions and relations within the industry, which Secretary Hoover urged the progressive concerns of the industry to undertake at the first meetings last year.

Crushed Stone Association to Meet in Chicago in January

Broad questions such as transportation, financing developments, the importance of geological studies in proposed sites, etc., will be on the program of the convention of the National Crushed Stone Association to be held in Chicago, Jan. 15-17, 1923. Group sessions at which trade details will be discussed will also be held. Nathan C. Rockwood is chairman of the entertainment committee.

To Place American Export Trade on Sounder Basis

A house-cleaning to eliminate the unscrupulous and insincere element generally from the American export field was advocated recently by Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce of the Department of Commerce, speaking before the Export Managers Club, New York City. With improving conditions, he declared, these undesirables are beginning to reappear in export centers. It is the duty of every believer in the economic future of this country, he said, to help stop their operations.

American exports are now moving out at the impressive rate of nearly $4,000,000,000 a year—a formidable figure which is vital to the stability of our whole industrial and commercial edifice. It must not be jeopardized by the dealings of irresponsible opportunists. Our sales abroad are no longer confined to a few big self-selling staples like cotton, wheat or copper. Nearly 49 per cent of American exports are now made up of manufactured or partly manufactured articles, great quantities of them being the products of factories which were expanded during the war and are now realizing the value of permanent overseas outlets.

Bureau's Function Explained

The function of the Bureau of Foreign and Domestic Commerce, Director Klein explained, is to promote American commerce abroad. Whether the manufacturer or merchant requesting aid is large or small makes no difference. The biggest corporations and banks in the country make constant use of the bureau. It is also being called upon every day by thousands of small factories and dealers whose individual export interests amount to less than $10,000 a year. In the week ending Sept. 23, the bureau's New York office handled foreign-trade problems for no less than 10,200 inquirers whose transactions were of all sizes and descriptions.

Director Klein predicted a gradual but sound rebuilding of our export trade and said that the Department of Commerce is making every effort to bring the profits from it into every small manufacturing village in the country. In connection with our future welfare in the overseas markets he asserted that price cutting and long terms are not the trumps in America's hand. In his opinion well-directed sales effort, honest desire to do business at a moderate but adequate profit over a long term of years, co-operation with the foreign distributor and well-conceived advertising, are the weapons of America. They can be used just as well by the small manufacturer who knows the wants of his foreign customers and how to satisfy them as by the gigantic corporation.

Paving Brick Makers to Meet

The annual meeting of the National Paving Brick Manufacturers' Association is to be held in Cleveland, at the Cleveland Hotel, Dec. 12-13. The meeting is to take the nature of a business review. Announcement of a program will be soon forthcoming.

Winter Buying of Pipe

Discussion continued from last week's issue.

George W. Batchelder
Water Commissioner, Worcester, Mass.

I have read with much interest the article you sent me concerning seasonal buying of pipe. It appears to me that the arguments advanced are sound and logical and I believe it would be better all around if the purchase of pipe could be more evenly distributed, but unfortunately most water departments use up their appropriations pretty closely at the end of their fiscal years. We do not get any other appropriations until three or four months later. Consequently it is difficult to make large obligations during the winter months.

The City of Worcester was fortunate some years ago, just previous to the war, in having a considerable balance available for the purchase of water pipe at the end of the fiscal year Nov. 30. Pipe was purchased at that time at what we consider a very reasonable figure, the foundry I believe wanting the business, but an opportunity of that sort is exceptional.

Dow R. Gwinn
President, Terre Haute (Ind.) Water Works Co.

The spreading of cast-iron pipe purchases over the entire year is a good idea and is worth consideration. Our friends, the manufacturers, suggest that pipe can be made at a lower cost in the winter; if they are willing to give the buyers a fair share of the saving, winter purchases may be stimulated.

Objections to several of the points made by the manufacturers are as follows: (1) Bad policy to have pipe delivered to streets several weeks or months before it is laid; danger of injury to pedestrians, when it becomes an obstruction due to being rolled by boys. (2) Accumulation of dirt in pipe. (3) Pipe broken in dropping from truck when ground is frozen. (4) Added cost for storage and rehandling when it must be held until needed. (5) Winter weather is variable in Terre Haute; some years there is practically no frost, but one year there was 4 ft. penetration.

There are some advantages in laying pipe in cold weather: (1) Even the lazy man must work to keep warm. (2) Ordinarily labor is more plentiful in winter. (3) It is a good thing to be able to furnish employment to the unfortunate and improvident when outdoor work is scarce.

Where it is necessary to lay pipe for the good of the service, such as reinforcement of the system, it would be well to plan to take advantage of a favorable price in the winter if it can be secured. However, where orders for extensions ordinarily follow building operations and these do not start until spring, one cannot always anticipate quantity needed or the sizes that will be required. Limited winter purchases might be advantageous where the water utility is a large one and has a storage yard with switch track and modern facilities for unloading.

Perhaps it might not be out of order to mention one reason why water utility operators have been buying only enough pipe to take care of current requirements—the belief, whether well founded or not, that the price is too high, out of proportion with other commodities (including water rates), and that it must surely be reduced; that if liberal purchases are made, the manufacturers will be encouraged to maintain prices.

Business Notes

Osgood Co., Marion, Ohio, manufacturer of steam shovels, has established a district sales office at 50 Church St., New York City, with M. E. Pullen in charge. All business of the company, previously handled by M. E. Davis, former New York representative, will now be handled through the district office.

Ed. C. Wilson, formerly connected with the U. S. Light & Heat Corp. and the Vapor Car Heating Co., with offices at Chicago, has been appointed Western sales manager for the Ohio Locomotive Crane Co. of Bucyrus, Ohio, with offices in the Railway Exchange Building, Chicago.

Harry Benjamin Equipment Co., St. Louis, Mo., has just purchased 100 miles of 75-lb. relaying rails from the St. Louis Southwestern R.R., which will replace them on the main line with heavier rail. The Benjamin company plans to dispose of the used rail to the smaller steam and electric lines and will export part of the supply. The transaction, it is pointed out, is on a considerably larger scale than is customary for this class of material.

Frederick Franz, who, for the past four years, was chief engineer of the Terminal Engineering Co., manufacturers of the TEC truck which is designed for combined indoor and outdoor service in connection with railroads, shipping and industrial plants, has established an engineering office at 27 Warren St., New York City, for the purpose of solving special problems of engineering relating to labor saving machinery for industrial plants.

Link-Belt Co., Chicago, announces the promotion of W. W. Sayers to the position of chief engineer of the company's Philadelphia works and Eastern operations. For many years Mr. Sayers was a representative of the company in its Chicago territory in lines related to power-house machinery, coal storage, Peck carriers, crushers, etc., and later in charge of the locomotive crane department. His headquarters will be at Philadelphia.

W. & L. E. Gurley, Troy, N. Y., makers of surveying and hydraulic instruments, announce the appointment to their engineering staff of C. C. Covert, who, for the past twenty years, has been closely identified with the stream gaging work of the Water Resources Branch of the U. S. Geological Survey in Alaska, Michigan and New England and, for the last thirteen years, as district engineer at Albany, N. Y. Mr. Covert's services will be available in connection with the installation or operation of the Gurley line of hydraulic instruments, water stage registers and current meters.

Austin Machinery Corp. has moved its accounting, publicity, and sales promotion departments to Toledo to join the administrative offices located there, as noted in this journal Nov. 9. At Toledo has been centralized the manufacture of the company's various lines of earth moving and concrete machinery. The Chicago office remains at 603 Railway Exchange Bldg., in charge of Henry Lamont. Arthur Cameron is with the company in Toledo.

Street Bros. Machine Works, Chattanooga, Tenn., and the Patten Manufacturing Co., of the same city, have consolidated under the name of Street Bros. Machine Works, Inc., for the manufacture of hoists, derricks, derrick cars, cableways, and windlasses. The consolidation became effective Nov. 1.

Howard Rhode, formerly advertising manager, Lehigh Portland Cement Co., Allentown, Pa., has been promoted to the position of manager of the company's service department. H. M. Eichelberger succeeds Mr. Rhode as advertising manager.

Equipment and Materials

Fibre Flooring Made From Shoe Factory Wastes

A new type of industrial flooring in which waste materials from its tanneries and shoe factories are employed has been developed, after three years of experimentation, by A. C. Denning, manager of the fibre-board department of the Endicott-Johnson Corp., leather-shoe manufacturers, of Johnson City, N. Y. At the present time the company has 300,000 sq.ft. of this flooring in use at its own plant and experience with it in actual service is said to indicate many desirable qualities, among which are durability, non-slipperiness, non-conductivity of heat or cold, non-inflammability, noiselessness, and resiliency to a degree which largely eliminates foot troubles on the part of industrial employees.

The material is made in two thicknesses, ⅝ and ⅞ in., in slabs 16 in. wide and 28 in. long; the latter dimension, however, may be varied. The fibre flooring is preferably laid over wood and fastened with staples between the laminations of the fibre through which steel rods pass; the staples are countersunk down to the rods. The sections are usually laid to break joints. Mr. Denning reports that the laying of this fibre flooring over concrete also has been successful; in that case, the material is bonded to the concrete by the use of hot pitch.

"We have selected the most difficult places for testing this material," Mr. Denning informs *Engineering News-Record.* "For instance, on our freight elevators where enormous trucking is had wear has been negligible over a period of two and a half years. In our

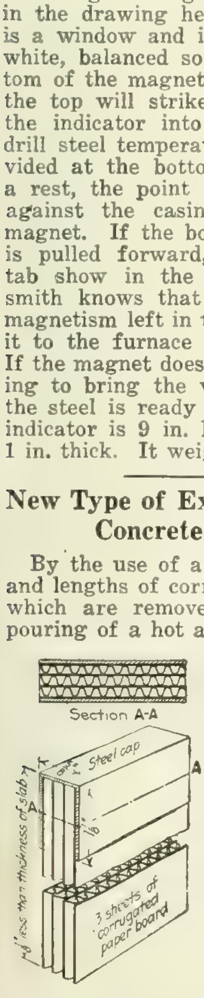
horse stables the fibre flooring shows absolutely no signs of wear after horses, sharp shod, have been tramping on it for two winters."

Magnetic Device Aids Blacksmith in Quenching Drill Steel

A magnetic indicator to assist blacksmiths in quenching drill steels at the proper temperature has been developed by the Sullivan Machinery Co., Chicago, as an accessory to its drill-steel furnace using oil or gas fuel. Drill steel, the company points out, in order to be tempered for the greatest possible toughness and resistance to wear should be quenched at the lowest possible temperature above the critical point, at which the structure of the steel changes. The fact that steel loses its magnetism at this point is the basis of the design of the magnetic indicator. The device consists of a brass or bronze casing with a common horseshoe magnet hung on a pivot as shown in the drawing herewith. At the top is a window and indicator tab painted white, balanced so that when the bottom of the magnet is impelled forward the top will strike a lever and throw the indicator into view. For testing drill steel temperatures a shelf is provided at the bottom of the casing as a rest, the point of the steel butting against the casing in front of the magnet. If the bottom of the magnet is pulled forward, making the white tab show in the window, the blacksmith knows that there is still some magnetism left in the steel and returns it to the furnace for further heating. If the magnet does not move, thus failing to bring the white tab into view, the steel is ready for quenching. The indicator is 9 in. long, 3 in. wide and 1 in. thick. It weighs 4 pounds.

New Type of Expansion Joint for Concrete Pavement

By the use of a removable steel cap and lengths of corrugated board paper, which are removed to allow for the pouring of a hot asphaltic filler, W. F. McGovern, superintendent of construction for the New Jersey State Highway Commission, Trenton, N. J., has devised a concrete pavement expansion joint for which patent applications have been made. The details of the joint are indicated in the accompanying sketch. Three lengths of corrugated paper board, held in place by a steel cap in the form of a channel at the top, are set across the line of the pavement where it is desired to form the expansion joint, the top of the cap being about ½ in. lower than the finished grade to permit of the passage over the joint of a finishing machine or screed.



After the concrete has attained its set, the steel cap is removed and a heavy butcher's knife is passed along between the pieces of corrugated boards, crushing them and making possible their removal. There is formed, in this way, a groove extending through the thickness of the paving slab, into which hot asphalt is poured. It is claimed that the joint thus formed is simple to construct, is waterproof and insures smooth riding qualities in the finished pavement due to the fact that the finishing machine passes over slabs on either side of each joint, thus bringing the joint edges to the same level.

Largest Railroad Wreck Crane Has 200-Ton Capacity

What is claimed to be the largest railroad wreck crane ever built has recently been shipped by the Industrial Works, Bay City, Mich., to the Virginian Ry. Co. With all outriggers set it has a capacity of 200 tons at 17 ft. 6-in. radius, as against 160 tons which was the previous record capacity for equipment of this type. With end outriggers only the new crane for the Virginian has a capacity of 100 tons and

without outriggers a capacity of 42½ tons at the 17 ft. 6-in. radius. The capacities on the auxiliary hoist are 45 tons at 24- to 30-ft. radius with end outriggers only and 30 tons at 24 ft. radius without outriggers.

The crane is mounted on special six-wheel trucks and has a maximum axle load in running order of 32 tons. The car has a total wheel base of 26 ft. 2 in. and is 34 ft. long. The crane is 15 ft. 9 in. high at its highest point and 10 ft. 6 in. wide at its widest.

The engines are 12 x 12 in. and steam is provided by a 65-in., 160-lb. A.S.M.E. boiler. A Westinghouse air pump is provided with clasp brakes on each of the twelve wheels. The brakes may be operated by the engineer on the crane or by the engineer of the locomotive which may be hauling it in a train. All clutches are operated by air. The crane in running order weighs 356,500 lb.

The main design problem met with in building this crane was to keep within railroad clearances and the maximum allowable axle load—on account of bridges—of 65,000 lb. and still to obtain the 200-ton capacity required by the excessively heavy rolling stock and motive power in use on The Virginian. The crane was designed and built complete in the plant of the Industrial Works, and was tested before a distinguished party of railroad men from all over the country.

Publications from the Construction Industry

Motor Trucks—GENERAL MOTORS TRUCK Co., Pontiac, Mich., features its 1-, 2-, 3½- and 5-ton trucks in a 23-p. illustrated booklet. Among the special features of these trucks are removable cylinder sleeves in the engine, a positive pressure oil system operated by a gear pump and, in all models above 1-ton capacity, a two-range transmission, the first range for rapid movement on good roads and the second range for increased pulling power, at lower speeds, on poor roads. For all models above 1-ton capacity a worm drive is employed.

Alloy Iron for Castings—BETHLEHEM STEEL Co., Bethlehem, Pa., is distributing a 28-p. illustrated booklet describing the distinctive features of Mayari pig-iron, a natural nickel-chromium alloy iron for making high-grade castings. The ore comes from the northeast coast of Cuba. The use of this iron, it is claimed, produces castings with increased strength and solidity, better surface, reduction of spongy spots and segregations, fine machining qualities, and long life when subjected to heat and wear. Unlike other alloys, this iron is a natural product, nickel, chromium and other elements being intimately mixed in the native ore without any additions in the smelting process. A table is given showing the proper percentage of Mayari iron in mixtures for castings to serve different purposes, such as brake shoes, car wheels, engine cylinders, grate bars, sand pumps, valves, crusher heads, and superheated steam fittings.

Portable Loaders—LINK-BELT Co., Chicago, has published a comprehensive 32-p. illustrated catalog covering its entire line of portable loader equipment. Complete specifications are given for all of the standard machines, which include the large one-man power swiveling loader, the portable belt conveyor, the standard type A machine for anthracite, and the CS loader for sand and gravel. A well selected group of photographs and drawings illustrates the various types of machines and their uses. The equipment featured in this catalog represents a development based on fifteen years' experience in the manufacture of material-handling machinery.

Rust-Resisting Iron—CUTLER STEEL Co., Pittsburgh, after research work covering a period of twelve years, has developed a chromium iron alloy which is described under the trade name "Duraloy" in a 4-p. folder. Developed primarily as a low-cost alloy to resist oxidation, it was found to possess, its manufacturer states, not only this property but also a resistance under certain conditions to corrosion, a high tensile strength at extreme temperatures, and resistance to wear and abrasion. The metal is now furnished commercially in forms including castings, rolled or forged bars, sheets, wire and tubing.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Week's Loadings Over Million —Still 179,000 Cars Short

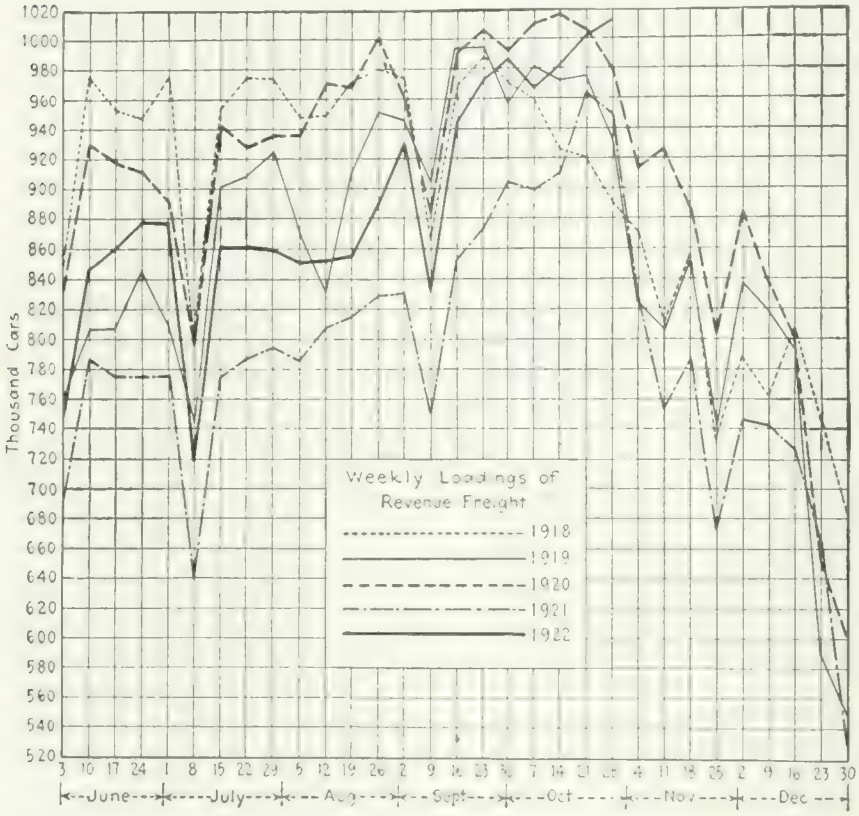
Present Records, Index To Business Conditions — Indicate Recovery From Post-War Deflation

"If there existed any adjusted period in the country's history which might with certainty be termed 'normal' the present record car loadings indicate a full and complete recovery from the periods of post-war deflation," states the American Railway Association in its bulletin of Nov. 9.

"The fluctuation in the progress of railroads was rapid and with the resumption of coal mining in the union fields carloadings have increased to a point where for the week ending Oct. 28 they were but a fraction of one per cent under the highest week in the history of the railroads.

"While the general trend of the curves indicates a falling off of business during the months of November and December, this period has been forced ahead during 1922 to a point where we can reasonably expect a continuance of exceptionally heavy loading this year beyond the period of prior years.

"It is reasonably certain, therefore, that the entire year of 1922, when completed, will be indicative of the fact that business conditions throughout the year and the performance of transportation will lend special emphasis to improved economic conditions and a return to so-called 'normal' conditions."



agriculture and industry during and since the war," continues the report, "is depicted in the depressions and peaks of the curves for the various years, and an analysis of economic conditions existing during periods of low carloadings gives a fairly accurate picture of the causes of price decline and periods of inflation.

"In analyzing the trend of the loading for 1922 in relation to former years, it will be noted that in spite of the fact that the year was commenced with extremely low loadings, a gradual and healthy improvement is indicated up to the period of the coal strike. The disarrangement in this industry, coupled with the effect of the shop strike on the railroads which commenced on July 1, retarded the accomplishment of an immediate return to a period of exceptionally heavy carloadings and an upward trend of prices. Commencing in August, however, the recovery of the

Peak loadings of revenue freight, throughout the five-year period, occurred during the following weeks:

Date	No. of Cars
1918—Sept. 28	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
1922—Oct. 28	1,014,480

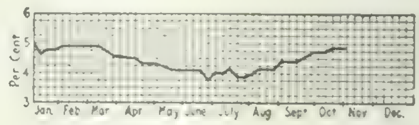
Of the 2,272,680 freight cars on all Class One roads as of Nov. 1, 249,960, or 11 per cent, were in need of repairs as compared with 11.9 per cent in bad order, Oct. 15, 1922. About 110,040, or 10.5 per cent, of the total number on line were box cars; 109,967, or 11.5 per cent, coal and 10,433, or 10.9 per cent, flat cars.

Business Briefs

Employment increased in fifty-six of sixty-four representative cities of the United States during October, according to the United States Department of Labor.

Bank debits for the week ending Nov. 15 totaled $9,244,000,000 compared with $8,204,000,000 for the preceding week, which included Election Day, and $7,693,635,000 for the corresponding period one year ago. This year's figures are larger than last year's for all the leading cities.

Money was firm on time loans but cheapest since Nov. 18 on call. Call rate 3½ to 5 per cent last week, 4½ to



5 early this week. No change expected in the immediate future. The year's range of time loan rate is given in the chart.

Bond market still slow. Par value of bonds sold last week on the New York Sock Exchange totaled $78,663,000, against $96,480,950 and $80,580,850 in the corresponding periods of 1921 and 1920, respectively, according to *Annalist* figures. Commonwealth Edison Co. $7,143,000 first mortgage 5s, due 1943, offered at 99 and interest to yield 5.07 per cent, were successfully floated. Liberty bonds unsettled, due to rumors of revival of soldiers' bonus, net result being a decline of 32@72c. per $100. Municipal bond market dull.

A "saving wage" was recently substituted by a public man for a "living wage." An article in the New York *Times*, Nov. 19, states that "the declaration of Senator Cummins (chairman of the Committee on Interstate Commerce) for incorporation of a living-wage provision in the Transportation Act has lifted the discussion (of what is a living wage) from the theoretical to the practical." Opinions differ as to what a living wage should be, but all agree that it cannot be more than is earned. In February, 1922, the National Conference Board conducted a survey of prices in the anthracite zone and submitted the following budget for a single man:

Room and board	$416.00
Clothing	136.12
Carfare	[illegible]
Recreation	[illegible]
Tobacco, candy, etc.	[illegible]
Reading material	[illegible]
Church and charity	[illegible]
Insurance	9.36
Medical care	[illegible]
Toilet articles, etc.	10.40
Laundry	[illegible]
Organization	[illegible]
Personal taxes	6.24
Total	[illegible]

General Wholesale Price Level Up Fraction of Per Cent in Month

Wholesale prices of commodities averaged higher in October than in the month before, according to information gathered in representative markets by the U. S. Department of Labor through the Bureau of Labor Statistics. Measured by the Bureau's weighted index number, which includes 404 commodities or price series, the increase in the general price level was approximately ¾ of one per cent.

Farm products again showed large increases. In this group prices in October averaged 3¾ per cent higher than in September. In the group of miscellaneous commodities, the increase was 3½ per cent. Food articles advanced 1½ per cent and cloths and clothing, 2¾ per cent in average price from September to October. Building materials and housefurnishing goods showed an increase approximating 1¾ per cent, while metals and metal products increased less than one per cent.

Continued decreases took place in the group of fuel and lighting materials, bituminous coal and coke declining rapidly in the face of increased production. No change in the general price level was reported for the group of chemicals and drugs.

Of the 404 commodities or series of quotations for which comparable data for September and October were obtained, increases were shown in 216 and decreases in 79 instances. In 109 instances no change in prices was reported.

INDEX NUMBERS OF WHOLESALE PRICES, BY GROUPS OF COMMODITIES

(1913=100)

	1921 October	1922 September	1922 October
Farm products..	124	133	138
Foods	140	138	140
Cloths and clothing	180	183	188
Fuel and lighting.	189	244	226
Metals and metal products	116	134	135
Building materials.....	159	180	183
Chemicals and drugs...	131	124	124
Housefurnishing goods	180	173	176
Miscellaneous.........	118	116	120
All commodities	142	153	154

Comparing prices in October with those of a year ago, it is seen that the general level has increased 8½ per cent. Fuel and lighting materials show the largest increase, 19½ per cent, with building materials and metals coming next with increases of more than 15 per cent.

Alabama Passes Improvement Bonds

In the general election held Nov. 7 two constitutional amendments were passed by the State of Alabama by large majorities, which make available considerable funds for public works construction. The first amendment authorized the state to lend its credit to the State Dock and Harbor Board to the amount of $10,000,000 for the construction of docks in Mobile Bay. The work will proceed along the lines followed by Louisiana in work at New Orleans. A meeting of the Dock and Harbor Board has already been held for the purpose of outlining a construction program.

Another amendment to the constitution allows twelve small cities of the state to issue water-works bonds in excess of the present debt limit.

How Much Does Structural Steel Cost?

A correspondent writes that structural steel can often be bought at $10 to $11 per ton less than the warehouse prices quoted weekly in *Engineering News-Record*, and that the published prices must therefore apply to small lots. This is essentially true, inasmuch as large orders are usually placed at the mills. Orders out of stock vary up to 500 tons. and stock prices quoted in the *News-Record* apply up to that quantity. With present low demand orders from stock are said to average one ton. One of the largest dealers in New York maintains a warehouse stock of 25,000 tons, and 500 tons was the heaviest order received in recent years.

Readers interested in the price of steel in large quantities should note both the mill quotations quoted each week in this section and the unit prices on actual contracts published in Construction News. When demand is active quotations on large orders are sometimes as high as on carload lots. Conversely, when orders are at a premium a large order may be placed at a figure under the formal quotations. This is the case in nearly all trades.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 267 to 278, are the following:

Stadium, with complete system of roads around same, Berkeley, Calif., for University of California, $1,100,000.

Hotel, ten story, Duluth, Minn., for Duluth Residential Hotel Co., $1,000,000.

High school, for City of Boston, Mass., $1,000,000.

Hospital, Houston, Tex., for G. Herman Estate, first unit, $400,000; total cost to reach $1,000,000.

Railway, 29½ mi., Ontario, Canada, for Canadian National Railways, $1,500,000.

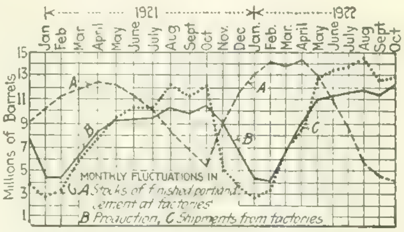
St. Louis Plans Extensive Paving Program for 1923

Expenditures in St. Louis for municipal paving for next year will amount to approximately $6,000,000. As in most American cities, in St. Louis paving fell during the war far below demand. The street paving itself dropped to an average of 12 miles a year for four years. While this to some extent has been made up in the work of the last two years, the condition is still far from satisfactory. The program for the present year entailed the expenditure of $2,500,000, but on account of the strike situation approximately one-third remains uncompleted. The program for next year will be an increase of about 500 per cent over the average work for several years preceding.

All of this work is paid for in special tax bills which require that the contractor finance the work until completion and then take payment in tax bills bearing six per cent interest. This tax bill provision has apparently prevented small outside contractors from coming in on St. Louis work during the period of expanding business, and may make it difficult to place satisfactorily the business proposed for the coming year.

October Cement Shipments Heavier Than Year Ago

Cement production figures for the entire country, as compiled by the Geological Survey, totaled 12,287,000 bbl. during October. This is an increase of nearly 17 per cent over the 10,506,000-bbl. total for October, 1921. Shipments, however, reached 12,854,000 bbl. as against 12,114,000 bbl. for the corresponding period last year, which is of particular interest when considered in connection with the current car shortage. Mill stocks amounted to 4,157,000 bbl., on hand Nov. 1 as compared with 5,348,000 bbl., available at the same time last year.



Department of Commerce statistics show that cement imports, from Sept. 1 to 21 inclusive, amounted to 42,641,000 bbl., valued at $88,724. Shipments were received mainly from Canada, Denmark, Belgium, Japan, Mexico and Norway. Cement exports totaled 78,615 bbl., valued at $219,898.

Los Angeles Votes $5,000,000 for Extending Water System

At the Nov. 7 election, voters of Los Angeles, Calif., approved by a majority of more than two to one, the proposition to incur a bonded debt of $5,000,000 for constructing and completing extensions and improvements in the water-supply system. The proposed work includes the following:

Improvements	Estimated Cost
Tujunga Reservoir	$650,000
Tujunga trunk line to reservoir..	486,000
Trunk line, Tujunga Reservoir to Main City	510,000
Stone Canyon Reservoir, one-half cost	338,000
Harbor district, improvement of water supply system.........	125,000
Twenty-four inch cast iron line, along Hooper Ave., between 16th St. and Vernon Ave.....	150,000
Haiwee Reservoir enlargement..	125,000
Corporation yard and shops.....	550,000
Rowena pumping plant and trunk line, Rowena Reservoir to Highland Reservoir	230,000
Miscellaneous supply trunk lines, reservoir construction and reservoir sites	2,050,000
Total	$5,214,000

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 267 to 278, are the following large projects:

Bank and office building, Fresno, Calif., to R. F. Felchin Co., $750,000-$1,000,000.

Apartment, nine story, San Francisco, Calif., to Clinton Construction Co., $1,000,000.

Hotel, eighteen story, New York, N. Y., to Thompson-Starrett Co., $6,000,000.

Dock, 7,000,000 ft., Vancouver, B. C., to S. E. Junkins & Co., $2,000,000.

Apartment, fourteen story, Chicago, Ill., to Paschen Bros., $1,500,000.

Montana Highway Department to Let 1923 Contracts Early

The Montana Highway Department will receive bids on fourteen road projects during the winter months according to present plans. A somewhat novel method is being employed to acquaint contractors with the character of the work in the various proposed projects in order that they may be able to bid intelligently when bids are called for. It is the plan of the department to complete the field surveys on a goodly portion of the 1923 projects before the ground is covered with snow preparing the plans as soon as possible thereafter. Contractors have already been advised of the work contemplated by the department and definite dates have been set for district engineers to accompany contractors over the proposed locations where they will have an opportunity to study the character of the material to be handled, and other local conditions. Upon the completion of plans the various projects will be immediately advertised regardless of the winter weather. In this manner it is hoped to bring the 1923 work to the construction stage as early as weather will permit in the spring.

The fourteen projects now proposed for 1923 construction have a total length of over 250 miles and are estimated to cost approximately $2,250,000. Surveys on a number of these are now in progress and plans are under way or complete on a few. Dates for inspection of the proposed locations of these have been set between October 23 and Nov. 13. The work is under the general supervision of John N. Edy, chief engineer.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 2; the next, on December 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.14	$3.95	$4.40	$3.02½	$3.15	$3.85	$3.30	$3.80	$3.75
Structural rivets, 100 lb.	3.85	4.60	6.00	3.75	4.00	4.80	4.50	—4.25	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.04	3.85	4.00	2.92½	3.05	3.85	3.30	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	+53.95%	45%	59½%	57–5%	41%	39.2@51.8%	40%	30.00
Cast-iron pipe, 6 in. and over, ton	55.30	45.82	55.00	51.17	54.16	63.61	53.00	+55.00	55.00
Concreting Material:									
Cement without bags, bbl.	2.60	2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd.	2.00	—1.75	—2.25	2.25	1.75	1.90	2.25	1.00	1.50
Sand, cu.yd.	1.00	—1.32	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.10	1.65	2.25	2.25	3.50	2.25	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59.00	—38.00	40.00	51.00	—39.75	39.75	35.00	22.00	50.00
Lime, finishing, hydrated, ton	16.80@17.17	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	17.45@18.55	—11.50	9.90	11.00	18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	.0796	.065	....	.11	+.09
Hollow partition tile 4x12x12, per block	.1230	.0776	.115	.0808	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	.93	.97	1.07	.95	1.00	1.08	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	......	......	......	.50@.55	.56¼	.50@.60	......
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — sign. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5¾ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par.) Bag charge is 80c. per bbl. Discount of 10c. per bbl for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Pig iron, coke, steel and iron scrap prices, all tending downward. Steel plate inquiries better, however, giving rise to quotations of $2@$2.10 per 100 lb., f.o.b. Pittsburgh. Demand for steel structurals quiet, with prices firm at $2 per 100 lb., base.

Atlanta quotes ¾-in. gravel at $1.75 as against $2 and sand at $1.32 as compared with $1.35 per ton, last week. Easier market reported as due to increase in car supply. Dallas also quotes reduction of 27c. per cu.yd. on ¾-in. gravel.

The yellow-pine market, while it remained unusually firm during the last month, is beginning to show some signs of weakening. Atlanta quotes $38 as against $42 per M. ft. b.m. on long-leaf yellow pine, base sizes; while Douglas fir is $39.75 in Minneapolis as compared with $41, one week ago. A total of 394 mills, reporting to the National Lumber Manufacturers' Association for the week ending Nov. 11, show a falling off of over 7 per cent in production; but a gain of one per cent in orders and 8 per cent in shipments. The industry now stands at a trifle over 5 per cent below normal as to production; with orders at 15 per cent and shipments, 20 per cent below normal.

About 150 bricklayers, members of the Bricklayers' Masons' and Plasterers' International Union, went on strike Nov. 17, in New York City. The trouble arose from the refusal on the part of the International Union, which is affiliated with the A. F. of L., to use materials handled by members of the Independent Laborers' Union, not affiliated with the Federation. The employers, represented by the Mason Builders' Association, intend to stand by the contract existing between themselves and the Independent Laborers' Union and continue to employ members of the latter organization.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*

Volume 89 — NEW YORK, NOVEMBER 30, 1922 — Number 22

Highway Research Council

CONFIDENCE in the purpose and opportunities of the Advisory Board on Highway Research is strengthened by the proceedings of the annual meeting held last week under the auspices of the National Research Council in Washington. With limited funds for the director's office and practically no money for committee expenses a substantial volume of work has been accomplished in a year. Standing committees on economics, structural design, materials, traffic, maintenance and finance have been created and are functioning. There has been compiled and published a census of highway research activities in the United States. Few engineers will have realized that there are now under way in field and laboratory 479 separate research studies in highway engineering. The census locates and outlines the nature of each of these investigations. With these concrete accomplishments there is clear evidence that the board is finding its work. The fact is quite as evident in less tangible ways. Its committees in a year have proceeded far in analyzing their fields of effort and in formulating programs of action. Their ideas have crystallized and taken positive shape. They know what they have to do. They are ready in every respect except that of working funds. These have to be created. A sum of $20,000 is estimated to be sufficient and the industries concerned in highway development should find means to provide it.

A Naïve Competition

IF THE mayor of Boston is interested in activating the minds of the students of the Massachusetts Institute of Technology, or even desirous of testing out the type of instruction that admirable school gives, his prize offer noted on another page is a worthy enterprise. If, on the other hand, he is honestly seeking a solution of what the Boston official *City Record* calls "civic problems which have baffled succeeding generations at City Hall" he is going about it in a curious way. Traffic, the increasing bugbear of city life; street cleaning, effective and cheap; odor and nuisance reduction from city industries and finally, fire-proofing of structural steel—these four problems are indeed troublesome ones. Toward their solution is going continuously the best effort of engineering talent the country over. If the young men at "Tech" succeed in contributing to their solution anything so novel and worthwhile as to warrant the city in purchasing the scheme or proposal and putting it into use not only will it be a great testimonial to the student and to his "Alma Mater" but the city will be getting a good deal for its $500.

Fighting the Marine Borer

WHEN man sets out to conquer some natural enemy he generally succeeds. It takes time but in the end he wins. Witness the successive subjection of the wild animals and the gradual, but no less impressive, subjection of the dangerous animalculæ. Lion and typhoid germ both retreat before civilization. There is every hope, then, that sooner or later we shall defeat that persistent and expensive enemy, the marine borer, especially since now there has begun an organized study of its nature and habits. The investigation under the auspices of the National Research Council is now taking on tangible form, as the statement of its progress on p. 941 of this issue shows. While as yet there is no remedy put forth, there is evidence of a groundwork of study which promises a wealth of hitherto unknown facts. On the basis of these facts as to species, occurrence, and habits there will undoubtedly develop some suggestions or principles which will save many thousands of dollars now destroyed by the omnivorous marine worms and bugs.

Railroads and Motor Trucks

CO-OPERATION of railway and highway transport is discussed in an inspiring manner in the address by W. H. Lyford, which is published on p. 933. As a railway executive, Mr. Lyford sees no rivalry between the railway and the vehicle which travels the public roads. Complete transportation, that is carriage from the premises of the producer to the premises of the consumer, he points out can be accomplished only by the agency of the railway and the highway working in conjunction. Each agency has an economic field in which it excels the other. Short hauls of less than carload freight and collection and delivery of freight are particularly the task of highway transport. On the contrary long hauls of carload freight are obviously the task of the railways. Operated in co-ordination the two systems of transport give complete transportation service to the public. It is this conception of railway and highway transport as companion agencies for performing a complete industrial service which is inspiring and gives the address by Mr. Lyford a real constructive value. Incidentally some of the specific applications of highway transport to railway service which are recorded deserve the most serious attention. They suggest, if not a complete solution, at least a way for ameliorating the ever-pressing difficulty of railway terminal management.

"Criminal" Engineering

THOUGH unconsciously given, no more apt commentary on a widely held attitude toward engineering could be conceived than that contained in a recent widely circulated news story stating that fifteen prisoners in a Pennsylvania county jail are to "take up" engineering. The course was offered by the extension division of the state college and the textbooks were donated by one of that species of uplift worker who makes penal institutions his stamping ground. To a certain type of mind engineering is acquirable through six months of correspondence school study

which may or may not be continuous, such a course to be punctuated by summer surveying junkets. Inasmuch as the culprits (in the case at point) desiring "engineering" are inmates of a county jail, they are doubtless first offenders more or less ashamed of their situation and eager for a desire to learn honest means of self-support. Again, their terms of incarceration must be short, else they would be in the state's prison. So one is led to conclude the course is not one in engineering, but the most rudimentary surveying. It is inconceivable that a group of 15-year old minds should be fed upon anything but elementals. Why, then, contemn a profession by intimating that the acquisition of its principles is no weightier a task, mentally, than learning to pick a lock or blow a safe! How silly that same news item would have sounded had the law or medicine been substituted for engineering! And yet, a "stake-artist" is no more an engineer than is a hospital orderly a physician.

Seasonal Road Contracting

SEASONAL letting of contracts is rapidly disappearing in highway practice. A number of states continue to bunch their road lettings into three months in the spring and to limit the work contracted for to the mileage that can be completed in a season, but more commonly bids are being asked and contracts are being let the year around. This changed practice perhaps explains in a measure why this fall a campaign for fall letting of road contracts has not been in evidence. There is a more significant reason, however, in the fact that while letting highway contracts has in large measure ceased to be confined to a few spring months, highway construction is yet an intensely seasonal operation. It is this practice which caused the substantial failure a year ago of the drive to let fall contracts. The contracts were let but construction did not begin until about the usual time in the following spring despite the fact that it was urged by the federal government as a necessary measure for reducing unemployment during the winter. Late season contracts, while they distribute the planning work of the highway department over the year and give contractors more time for ordering equipment and getting ready for spring operations, will not change the time of beginning work nor extend the season of actual construction over more months unless means are developed for doing work in cold weather. This is true even for the task of accumulating construction material.

Waste or Speed?

THE long heralded attack on the contractors who operated under the Construction Division of the Army during the war has apparently begun. The government has sued four of the cantonment contractors to recover millions of dollars which the Attorney General says were wilfully wasted and vague hints are made that this is only the beginning of an effort to recover millions more and possibly to prosecute criminally those responsible.

No one over 21 years old needs to be reminded that in the war preparation of the summer of 1917 waste and extravagance ran riot. We were but newly entered upon a war for which only the slightest preparation had been made. Shelter and equipment had to be supplied for millions of men, supplied in the greatest of haste and in quantities beyond any scale then known or even comprehended. There was no time for the orderly development of production, the step by step forward which guarantees excellence and economy in normal business. Production, quantity production, immediate production, was the need and everything else went by the board to get it.

Cantonment construction was no exception. In fact, coming almost the first of the war expenditures it was probably the best example of feverish haste without regard to considerations of cost. Possibly in this haste more money was wasted than even the imperative demands of war warranted; possibly some individuals profited overmuch. If they did they should be punished, but the prosecutor who tries them and the judge or jury who judges them must be careful to reconstruct the scene. It is not fair to apply the calm standards of peace to the rush and hysteria of a beginning war. Wilful diversion of funds or intentional extravagance will be mighty hard to distinguish through the haze of five years from the honest drive for faster and faster construction regardless of what such speed would cost.

And then, too, will the government attempt to particularize in its search for profiteering? Will it look into the political machinations in that torrid Washington June of 1917, when senators and governors pulled unseen wires leading to the selection of cantonment towns? Will it search out the petty extravagances of army officers who called up New Orleans and Pensacola as though they were on inside phones? Will they denounce that vast body of floating labor which wandered from job to job seeking still higher wages and less work and which cost the people of this country many millions more than could possibly have been stolen by unscrupulous contractors? These are all part of the high cost of war and an equal part with waste and extravagance in construction work.

After all it will be a good thing to get one of these suits brought to court. There have been enough ugly rumors since the war about contractor profiteering to make it desirable to have the matter settled once for all, to have brought before the cold impartiality of a court the facts surrounding one of the big war construction jobs, to have balanced against the wastes, big and little, the magnitude of the impossible things accomplished, to restore if possible the atmosphere of a cantonment under way, with it successes set against its failures. If after such a calm and balanced statement of conditions and facts the evidence is against the contractors and they are made to return the huge sums demanded we will accept the government's contention of fraud and deception. From the facts as we know them, however, we believe the Department of Justice is conducting an unfair campaign.

Twenty Years of Service

THE American public takes it as axiomatic that there must be co-operation in industry, that the best service to the consumer cannot be secured until manufacturers and distributors, out of their long experience, have agreed upon the broad policies essential to the stability of the industry. Consequently, associations for co-operative effort are found in almost every line. To be an outstanding leader among such associations, to be regarded as a model for industrial co-operative effort is indeed a proud distinction. And yet that distinction, accorded ungrudgingly by

business men generally, has been achieved by the Portland Cement Association, which at its meeting in Chicago last week celebrated its twentieth anniversary.

Such an achievement, of course, does not come by accident. There are well-defined reasons, and these, if they be understood by other industrial leaders, will make possible a duplication of the Portland Cement Association's unusual success.

The reasons, or factors, can be rather briefly stated:

1. The portland cement industry, through the association, has brought practically all its manufacturers to co-operate in educating the public to the value and uses of its product.

2. Every manufacturer has thus been able to profit by the vision of the leaders of the industry, while contact of leader with leader has broadened even their vision.

3. There has been extraordinary faith in the product —a faith strengthened immeasurably by the technical and experience studies made possible through the co-operative effort.

4. There has been insistence upon adherence to fact —of founding promotion work upon study, experiment, demonstration. At the core the association is an engineering or, it may be better said, a technical organization.

5. The association's personnel has been decidedly superior, a personnel, we say deliberately, unmatched by any other branch—whether single manufacturer or association—of the construction industry. We doubt whether it is matched in any industry.

And, last but by no means least—and this ought to be written in black-faced type of triple size—the individual companies have backed up by most vigorous individual selling effort the educational work of the association. Many manufacturers, given such an educational service, might have restricted their own efforts, counting on the association's work to make the sales. Not so the cement manufacturers. The association's efforts were educating the public, were creating the demand, but it was for them to move the cement from the bins to the jobs. They did their part with extraordinary vigor. They cultivated the seed which the association had sown—and have reaped a bounteous harvest.

To single out for special attention any one of these factors in the association's growth will throw the others into undeserved shadow. All of them were necessary for the big result. But we want to place emphasis on what we regard as the fundamental characteristic of the organization—its engineering or technical nature.

We can conceive of a vigorous propaganda organization astonishing the public for a time by an extraordinarily vigorous promotion campaign. Much smoke can be made by a little fire. But we cannot conceive an educational effort, sustained and broadening and intensifying each year, unless it were built on a solid basis. In this case the basis, because of the character of the product, was engineering fact.

That view has been taken by the leaders of the cement industry. Of the 342 employees of the association more than 200 are trained engineers, and of these no less than 169 are constantly engaged in the field making studies, inspecting work, telling the story of possible uses of the product. The laboratory is a research organization of outstanding ability, with many important contributions to the understanding of concrete to its credit, while the association's co-operation with technical societies has been an indispensable element in the formulation of standards and recommended practices.

With the base secure, a superstructure of vigorous, far-reaching promotion effort would be safely reared.

Of course, its work has not been free from criticism. Even if it were without fault, no organization would be so successful without inviting the attack of competitors. Moreover, it is to be expected that with an enthusiastic personnel there would be at times overstatement, the making of claims which cold reason would not justify in the light of facts. There has been a disposition to defend concrete in season and out, to refuse to admit the plain evidence that in this structure or that there had been concrete failure. Furthermore, there has been, in our judgment, quite a marked indifference toward the improvement of cement itself—an indifference now happily vanishing, as is evidenced by the initiation of a research into the constitution of portland cement. Except for the latter indifference, though, the faults have grown out of faith and enthusiasm, pardonable faults almost inevitable to an organization that does and dares.

As to the success of the association's work little need be said. The figures are eloquent—17,000,000 bbl. shipped in 1902, the first year of the association's life, 110,000,000 bbl. this year; and this year, be it noted, was marked by a practically negligible railroad construction program, restricted building of industrial plants and curtailed farm purchasing power. In the field of its greatest individual success, concrete roads and pavements, the figures are equally eloquent—5,000,000 bbl. in 1914, 22,000,000 in 1921. For this progress the leaders of the industry unanimously give great credit to the association's efforts.

What service the association has rendered the public by its work we leave to the imagination of the reader to estimate. Figures can hardly tell the tale. They must be fantastically large to give any idea of the truth, for the benefits reach to every walk of life—from the million dollar structures of business, of industry, of transportation, down through the conveniences of public services, from which even the humblest profits, and into the small private home and the simple but money-saving concrete devices of the farm. But there are benefits that cannot be estimated in dollars, that minister, for example, to greater safety, as in fire-resistive construction, and to healthful recreation, as in better highways. In ways such as these cement has contributed mightily—increasing immeasurably the debt which the public owes the cement industry. It has been—as every business should be—an institution of public service.

But the end is not yet. The leaders see a future much greater than the past. In fact, they speak rather lightly—but not disparagingly—of the past. To them it is water over the dam. Their eyes are directed ahead —planning ways for more fully educating the public to present uses of cement, developing new uses, arranging through their individual strong sales and distributing organizations and through the building of new mills to supply the coming demand.

Of the association's and the industry's future success there can be no doubt—so long as vision, the solid technical base, and the boundless enthusiasm persist.

Congratulation and long life!

Building the Baldwin Reservoir, Cleveland Water-Works

Mixing Plant Has Duplicate Equipment—Cableway Electrically Operated and Synchronized —Seven-Yard Concrete Bucket and Sixteen-Ton Skips

A COVERED reservoir of reinforced concrete having the remarkable lateral dimensions of 1,035 x 551 ft. and a height of 39 ft. is nearing completion for the water-works of Cleveland, Ohio. The area and height and the volume of concrete, 104,100 cu.yd., make this perhaps the largest covered reservoir in America. Because of these large dimensions, the thick and high columns and the unusual spans of the groined arches of the roof, the construction task has been correspondingly unusual and the contractor has developed a highly improved plant for his operations. In particular he has demonstrated that the mobility of the cableway reaches considerably beyond the limits that are ordinarily assigned to it as a construction tool.

FIG. 1 ROOF VIEW OF BALDWIN RESERVOIR
Each half of the reservoir requires a roof approximately 500 ft. square consisting of 1,104 groined arch panels 20 ft. square on columns nearly 35 ft. high

The new reservoir for Cleveland is known as the Baldwin Reservoir and is a part of the new filtration works located just east of the old Fairmount reservoir. In fact the Fairmount reservoir, with its two basins of 80,448,400 gal. combined capacity, will be the receiving basin for the new filtration works. These comprise a chemical house, mixing flumes, coagulation basins and a clear water reservoir, which is the Baldwin reservoir that is being described. The diagram plan, Fig. 2, shows the relative locations of the several units. With mention that the Baldwin reservoir was planned, and indeed partly excavated, as a storage reservoir and its dimensions were not changed when it was made a unit of the new filter plant, further reference to its functions as a part of this development may be omitted.

Structurally, and also as a construction problem, the governing factor of the new reservoir is its size. The large lateral dimensions give an enormous roof area and the depth of the basin gives a great height of column. The views, Fig. 1 showing the roof area of half the reservoir, the smallest unit embraced by walls, and, Fig. 3 showing the forest of columns, nearly 35 ft. in clear height, vision the situation fairly well. Actual lateral dimensions are given by the plan, Fig. 4. Substantially there are between walls two 500-ft. squares of roof each consisting of 1,104 groined-arch panels supported by 1,196 columns, 30 in. in diameter and 34¾ ft. high from footing level to the springing line of the arches.

General Structural Design—A brief explanation of the main operating functions of the reservoir helps in understanding the structural elements. Water from the filters enters a flume hung to the north wall of the reservoir 21 ft. above the floor. Wier notches in the front wall of the flume deliver the water into the two basins across which it flows and enters two conduits, one from each basin, leading to the gate house where an elaborate set of valves turns it into the distribution system. One of the outflow conduits is a box-structure in the angle of the south wall and the floor, and the other is within the wall, with its bottom at floor level. Admission to both conduits is through a row of orifices so proportioned that the rate of admission is uniform the whole length of the conduits. In the same manner the flow into the reservoir from the flume is kept at a uniform rate throughout its length. Briefly, careful thought has been given in designing both inlets and outlets to ensure an even, steady current in the reservoir water and thus eliminate surging and stagnant corners.

Wall design was modified to some extent by the requirements for interior conduits and by the fact that the excavation made originally, required the wall to be thickened at places, but generally the outside walls are of the ordinary abutment-wall type. A section of the division wall between basins is shown by Fig. 5. It is a sturdy section heavily reinforced for full head on one side only, although normally this condition of loading will not exist. The design calls for the construction

of the walls in two lifts, with keyed construction joints, and for vertical expansion joints about 60 ft. apart. The vertical joints are keyed and have the copper-strip water-stop arrangement shown in Fig. 6.

As the reservoir is founded on shale rock the floor design called for a sub-floor, to level up the rock bottom, and a 9-in. plain concrete slab with joints dividing it into squares corresponding to the panel between four columns and also with joints between it and the column base. Nominally the sub-floor was 3 in. thick, but due to the rough breaking of the shale ledge it averaged perhaps more nearly a foot thick. The floor has a very slight fall, 1½ ft., from each wall toward the middle as indicated in Fig. 4. The outstanding feature of the floor design is that it is not only divided by expansion joints into sections about 20 ft. square but expansion joints separate it from all vertical elements of the structure, such as walls and columns. These joints reach to the bottom of the 9-in. slab, are ½ in. wide for the lower 4 in. and then flare out to 1 in. wide at the top, and are filled with bitumen poured hot.

Column and roof-arch design embody no special features aside from those naturally introduced by the size and height of the column and the dimensions of the groined-arch panels, as indicated by Fig. 7. The notable structural feature, considering the roof and its supports as a whole, is the insertion of stiffening walls between the columns of two rows each way across each basin of the reservoir at the middle. This stiffening cross of columns is indicated by Fig. 4 and the construction in detail is shown by Fig. 7. It subdivides the 500-ft. squares between basin walls into quarters making the roof areas carried by unbraced supports only 250 ft. square.

The preceding discussion of the reservoir structure indicates clearly the main features having influence on the construction plant and methods. There were 104,100 cu.yd. of concrete, with 1,750 tons of reinforcing steel, distributed over an area in round figures, 1,135 x 551 ft., as follows:

Walls, footings and floor	69,200 cu.yd.
Roof arches	16,000 " "
Columns	8,500 " "
Valve house, flumes, etc.	10,400 " "

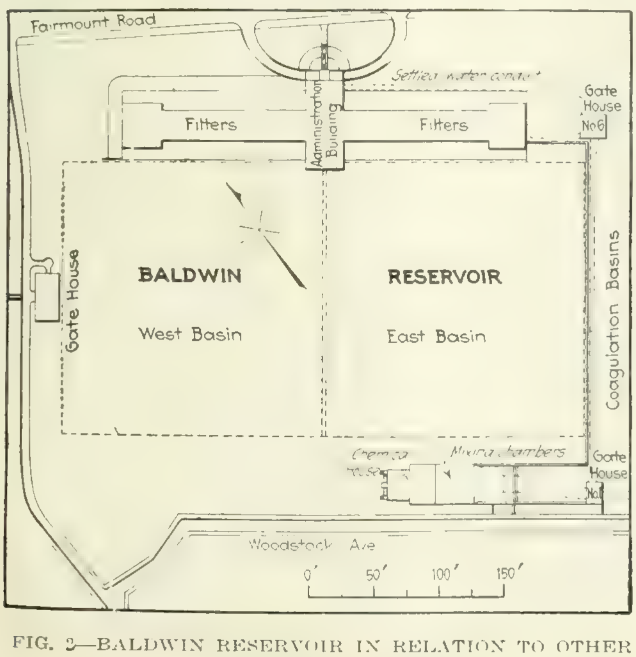


FIG. 2—BALDWIN RESERVOIR IN RELATION TO OTHER FILTER PLANT UNITS

FIG. 3—VISTA OF CONCRETE COLUMNS IN BALDWIN RESERVOIR

Some 2,000 tons of other metal work; 57,000 cu.yd. of excavation, and 215,000 cu.yd. of fill of different sorts completed the materials to be handled. Besides the walls, there had to be built 2,208 groined-arch panels and as many separate sections of floor slab and a total of 1,196 columns. This enumeration indicates the extent of the handling of forms. In brief the large tonnage to be fabricated into many units created a handling problem of exceptional magnitude.

Plant Layout—A very satisfactory track arrangement, as shown by Fig. 8, was possible for bringing in materials and handling the spoil. With this important service arranged the disposition of the remaining units was tributary to the cableway which was selected as the main plant item, with the duty of handling all materials into the structure. As shown, the mixing plant was placed near one end with tracks leading from it along one side of the reservoir so that cars with buckets of concrete could run under the cableway span.

The mixing plant arrangement and dimensions are given by Fig. 8. Aggregates are brought in by cars onto a trestle which parallels the plant on one side and are dumped through the trestle. Three bucket elevators feeding from hoppers under the trestle deliver the sand and crushed stone into the bins. These elevators have a capacity of 75 tons per hour each. On

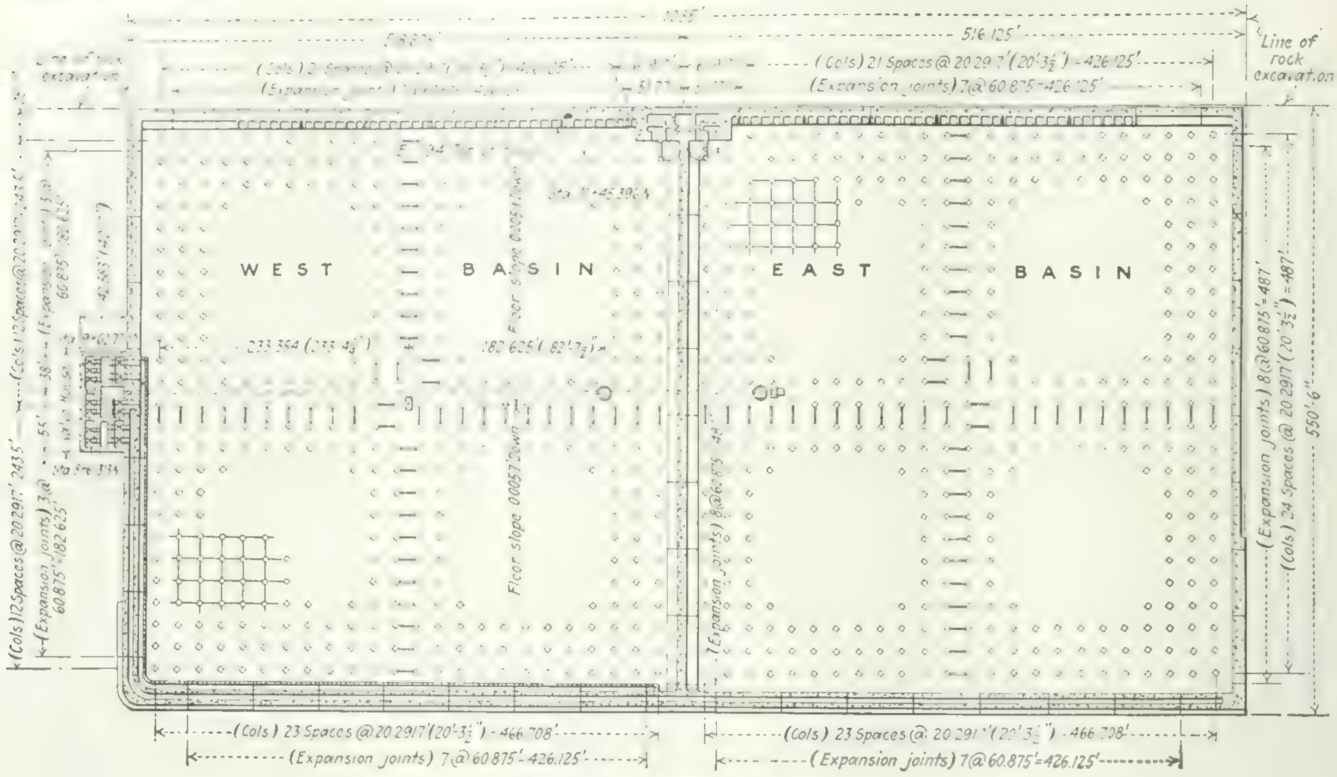


FIG. 4—SECTIONAL PLAN OF BOTTOM OF BALDWIN RESERVOIR

the opposite side of the plant is a track for cement cars. These are unloaded into a cement house which is connected by a belt conveyor with the mixer charging floor. The cement elevator has a capacity of 400 bags per hour.

There are two 28-cu.ft. mixers each served from its own bin compartments and with its individual sand and stone measuring hoppers. Both mixers dump into a central hopper which feeds into the bottom-dump concrete buckets carried on cars. The bin hoppers, measuring hoppers and receiving hopper, as shown by Fig. 8, are steel. In fact all the appliances of the plant are of excellent quality and the plant as a whole is remarkably well outfitted in a mechanical way, practically all operations being mechanical from the stockpiles to the concrete in the buckets on cars. Indeed, from the mixing plant the handling is all mechanical, by cars and then by cableway into the forms.

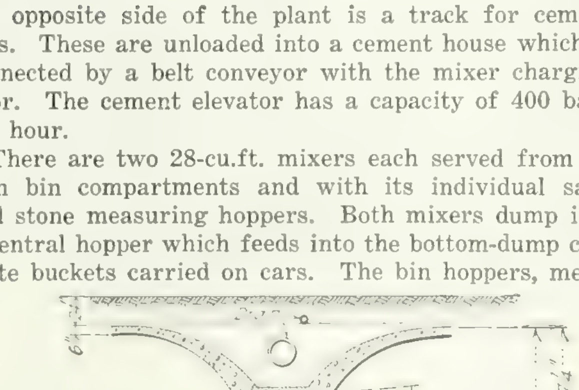


FIG. 5—DIVISION WALL BETWEEN BASINS OF BALDWIN RESERVOIR

Cableway Outfit—An 800-ft. span cableway on 85-ft. timber towers handles excavated material, concrete, reinforcing steel, forms, timber and workmen to or from any point within the rectangle of the reservoir structure. The main cable is 2½ in. in diameter. For rock and earth large skips weighing about 16 tons loaded are employed. The concrete is handled in a 7-cu.yd. shear-gate bottom-dump bucket which weighs with its load about 15 to 16 tons. The cableway was designed for 15 tons load but it has on occasion carried 30 tons. A 300-hp. electric motor operates 52-in. hoisting and conveying drums through direct gears.

As indicated in the view herewith towers are mounted on trucks and travel on tracks on either side of the reservoir. On each tower there is a 75-hp. motor geared directly to an elliptically-grooved drum which carries the steel haulage rope for moving the tower along the track. Both of these moving winches as well as the main hoist are controlled through magnetic controller-panel by one operator located on the head tower.

In operation the loads are hoisted and conveyed at high speeds and at the same time both towers are moved along the trackways as desired. The speeds of travel of the towers are nominally 100 to 150 ft. per minute, but the speed attained in actual practice has seldom exceeded 100 ft. The nominal speeds of the cableway in conveying loads are up to 1,200 ft. per minute.

Electric current for operating the cableway is taken off wires carried on a pole line parallel to the head-tower trackway. It is received at 2,200 volts and is

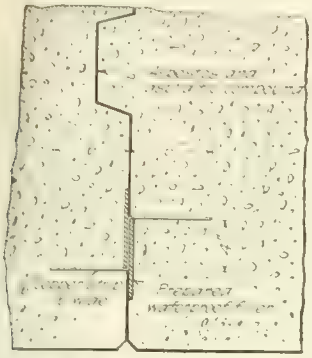


FIG. 6—WATER STOP IN WALL EXPANSION JOINTS

stepped down by a transformer on the head-tower to 440 volts. Near the top of each tower is a cross-arm which carries the conductor and control cables and the light and signal wires. These wires cross the work from tower to tower. From the light-wire high-power incandescent lights, with reflectors, are hung at frequent intervals. Drop wires for signals are also spaced at frequent intervals along the span so that it is easy to signal the operator from almost any part of the operation.

As previously stated this cableway has handled practically all materials—spoil from the excavation, mixed concrete, reinforcing steel and forms—into, from and about the reservoir area. There is not a derrick or gin pole within the reservoir to supplement the cableway in distributing and placing materials.

Concrete Construction—Three classes of concrete are used: (1) A 1:3:5 mixture, with 2½-in. stone, for the wall foundations, 16,500 cu.yd., (2) A 1:3:5 concrete, with 1½-in. stone, for walls, sub-floor and roof, 55,200 cu.yd., and (3) a 1:2:4 concrete, with 1-in. stone, for columns, floor and valve house and flume walls, 32,400 cu.yd.

In placing the concrete, aside from the usual requirements of good practice, attention was given to the location of construction joints and continuity of placing. All walls were built above the footings in two lifts. In the outside walls the first lift went to elevation 211 which made the lower section 19 ft. 9 in. and the second section 18 ft. 3 in. high. In the dividing wall the first lift went to the top of the spread base as indicated by Fig. 5. Along the walls there was an expansion joint every 60 ft. The walls therefore were concreted in sections 60 ft. long and one lift high, each unit as a single operation. The columns, however, were poured in one operation from footing to spring line. In the groined-arch roof construction joints were limited to the junction plane with the barrel arches and to vertical planes at mid-span.

In the barrel arches construction joints were permitted only over expansion joints in the supporting

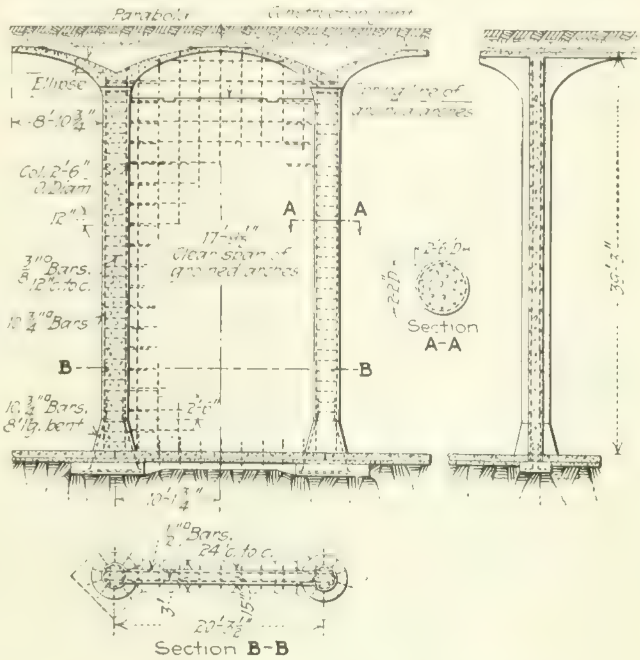


FIG. 7—COLUMN AND ROOF ARCH DESIGN BALDWIN RESERVOIR

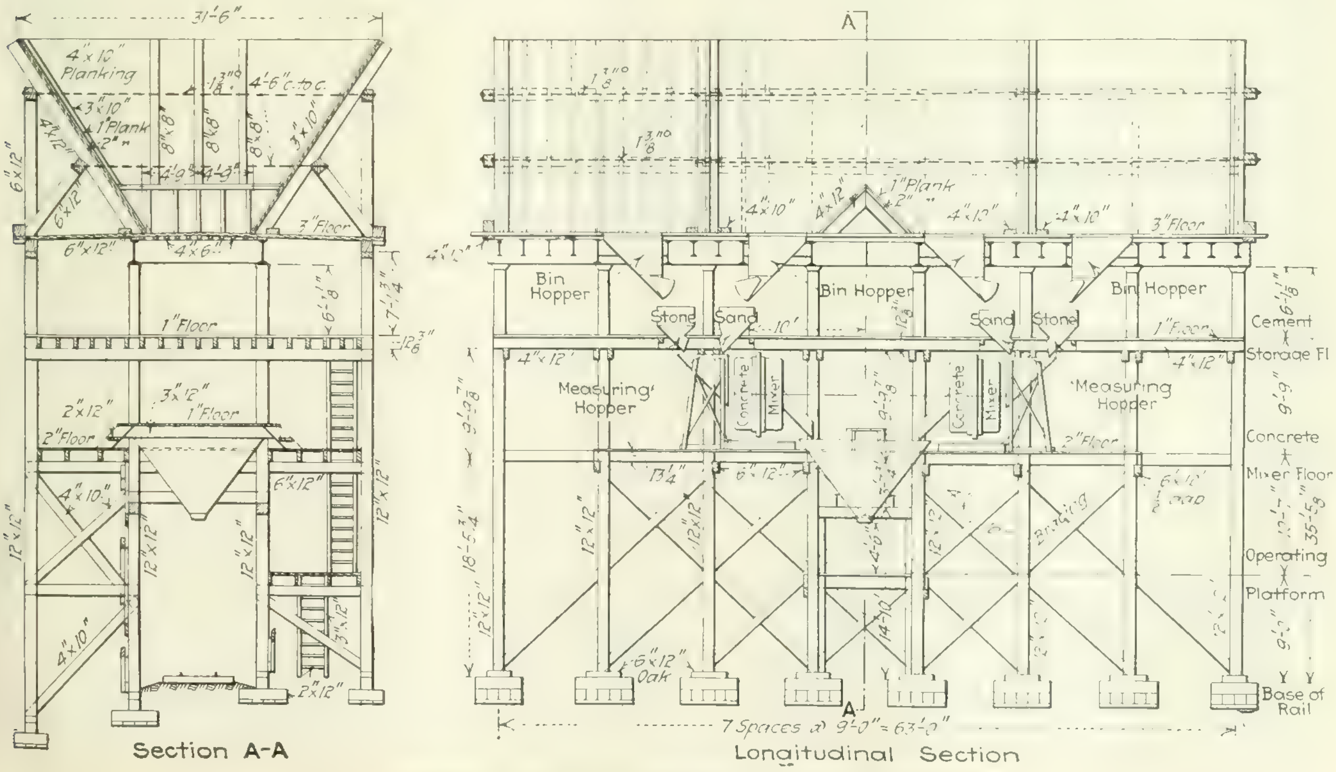


FIG. 8—MIXING PLANT ARRANGEMENT BALDWIN RESERVOIR

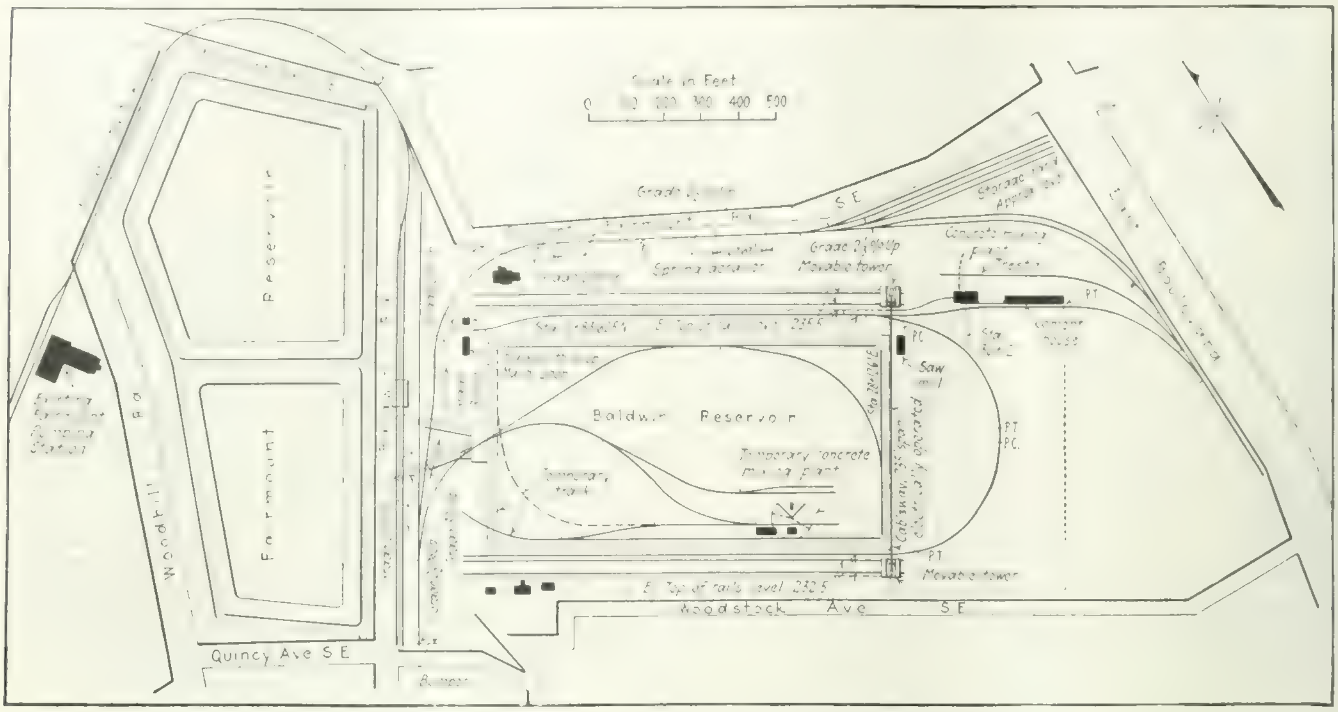


FIG. 9—TRACK AND PLANT LAYOUT FOR BALDWIN RESERVOIR

wall. The floor was poured in alternate sections of one-panel area as previously described. Each unit within the joint limits indicated was invariably concreted as a monolith.

All forms, except the steel forms for the circular columns, are made of wood in large units. The roof unit was a full groined-arch panel form about 20 ft. square. The cableway lifted the wood panel and shifted its position by means of a four-hook sling. For the walls the panels were made 45 ft. long and one-lift high. This required two panels for each 80-ft. section of wall but longer forms coming within any reasonable weight could not be made without being too limber. No unusual methods of bracing or fastening the wall forms were employed. The column forms had to be very firmly anchored to the footings to resist the lift due to the flare of the base section, but otherwise were connected and braced by usual methods.

Progress in concreting has been rapid, from 12,000 to 18,000 cu.yd. a month having been placed during the season of 1922.

Outstanding Construction Features—As a solution of a construction problem the operation at the Baldwin Reservoir in Cleveland is chiefly of interest in demonstrating the mobility of the long-span cableway. In this operation a rather ideal situation existed for cableway installation and operation—a rectangular construction area, with ample room for traveling towers on each of the long sides. With electrical control from the head tower, complete synchronism of travel of the two towers made the cableway a reasonably rapid means of transportation even when movement of the whole outfit was necessary. Its equal adaptability to loads of various kinds and forms combined with its mobility made it the sole transporting and hoisting device, besides the service railway, required on the work.

Men in Charge—The reservoir was designed by and is being constructed under the supervision of the Frazier-Sheal Company, engineers, Cleveland, Ohio. Their resident engineer is H. T. Hammer. This work is being carried on by the Division of Water of the Department of Public Utilities of which A. B. Roberts is director, A. V. Ruggles, commissioner of water, and J. W. Ellms, consulting engineer on water purification. The contractor constructing the reservoir is the Stange-Walsh Construction Co., Cleveland, Ohio.

Damages Due to Party Wall Not Recoverable Is Supreme Court Decision

There can be no recovery for loss incident to removal of a building wall which comes to the property line and is not suitable for a party wall, according to a decision by the U. S. Supreme Court Oct. 23 in a case from Pennsylvania. The opinion was delivered by associate justice Holmes. Edward F. Jacksman, who owned a theater building in Pittsburgh, had sued The Rosenbaum Co., which erected a building on adjoining property.

The wall of the theater had to come down to permit of constructing a party wall, and Jacksman claimed that because of delay he lost a season's rent on the theater. He lost in the courts below. In affirming the decision of the lower court in favor of the defendant, Justice Holmes' opinion agrees with the pronouncement of the Pennsylvania Supreme Court that "when either lot owner builds upon his own property up to the division line, he does so with the knowledge that, in case of the erection of a party wall, that part of his building which encroaches upon the portion of the land subject to the easement will have to come down, if not suitable for incorporation into the new wall."

Much of the case hinged upon ancient custom in Pennsylvania, as well as the laws of that state, and the opinion of the Supreme Court does not indicate whether the same tests would apply to cases in all other states.

Majority and Minority Reports on Columbia Basin Project

Supervisor of Hydraulics for State of Washington Dissents from Opinion of Other Members of Special Board

THE report on the use of the waters of the upper Columbia River by a Board of Engineers appointed at the instance of the Federal Power Commission, is to be printed and will be available for distribution before the end of the year. The printed report will include the minority report submitted by Marvin Chase, the supervisor of hydraulics for the state of Washington. In the minority report vigorous exception is taken to what is alleged to be an effort on the part of the Federal Power Commission to exceed its authority. The majority members of the Board of Engineers point out, however, that it is essential to the Commission's duties in passing upon permits and licenses to follow a well-defined policy for the most efficient use of the resources of a river. The conclusions of the majority members follow:

(1.) Freedom should be given to fullest irrigation expansion in Montana, Idaho and Washington, and no rights should be allowed to accrue to lower interests which would legalize limitation of or interference with irrigation above.

(2.) It is the most important single item to be considered in the uses to be made of Columbia River water above the mouth of Snake River.

(3.) It can be irrigated by gravity from the Clark Fork at Albany Falls or by pumping from the Columbia River at Grand Coulee.

(4.) The Columbia Basin gravity project can be adequately supplied by the aid of storage in Pend Oreille and Priest Lakes in Idaho, conditioned upon maintenance of natural flow from Flathead Lake when needed.

(5.) It can be supplied with practically no shortage, without the aid of storage, with a dam at Grand Coulee about 156 ft. high above low water.

(6.) Information upon which to base a final decision between a gravity and a pumped supply for a Columbia Basin irrigation project is not complete and should be completed. Any decision should take into account the effect upon potential power.

(7.) Pending such decision no permanent rights of storage should be granted in Pend Oreille and Priest Lakes.

(8.) If ultimately the decision is in favor of a Columbia Basin gravity project, storage rights in Pend Oreille and Priest Lakes should be granted to such project, but should be limited to storage of inflow in excess of 7,000 sec.-ft.

(9.) If ultimately the decision is in favor of a Columbia Basin pumping project, storage rights in Pend Oreille and Priest Lakes should be granted to the joint interests of power on the Lower Clark Fork and the Columbia River, subject to limitations contained in Section 1.

(10.) Storage rights in Flathead Lake should be granted to Flathead power interests, subject to fullest development found practicable after complete investigation. Prior to such development rights may be advantageously granted to power interests on Clark Fork subject to conditions protecting ultimate control for Flathead power and natural flow release when needed for the protection of the Columbia Basin project if built on the gravity plan.

(11.) Storage control at Flathead, Pend Oreille and Priest Lakes should be under impartial supervision.

(12.) A permit to develop power at the Grand Coulee site or at any point on the Columbia River as far downstream as the Foster Creek site should not be granted to power interests until it is known that such site will not be needed by the Columbia Basin project. In case the Columbia Basin project shall require a power site for irrigation and power on this stretch of the river, a permit should be granted to it after the best location and height of dam shall have been determined from the project and the public interest.

In his report Mr. Chase concludes that:

(1.) The use of the water of the Columbia River for irrigation is of greater benefit to the people of the United States in general and of the Northwest in particular, than its use for power.

(2.) The published reports of the United States Reclamation Service, and other investigations show that the irrigated lands in the arid portion of Washington yield greater returns per acre and per dollar of capital cost than those elsewhere. This is due to the wonderful fertility of the soil, the exceptional climatic conditions, and the progressiveness of the population in adopting the best methods.

(3.) For these reasons, construction of the officially adopted Columbia Basin Gravity Project, for the irrigation of 1,753,000 acres of arid land in the State of Washington, is a matter of supreme importance to the people of that State. It is in fact a most important national problem.

(4.) The Federal Power Commission, while having no jurisdiction over irrigation, should recognize the superiority of right for irrigation of this vast project, and should grant no power rights to conflict with irrigation development.

(5.) The Columbia River Board has evaded its duty by not considering and recommending an arrangement of power development on the Flathead, Clark Fork, Spokane, and upper Columbia River which would yield the maximum commercial power, near existing and probable markets, subject to the superior use of the waters for irrigation of the greatest possible area.

(6.) The State of Washington having officially adopted the gravity project for the reclamation of the Columbia Basin lands, the Federal Power Commission should not become involved in any controversy as to other possible means of reclamation, but should co-operate with the State to forward the early development of this area, allowing maximum utilization of the water resources of the Columbia River.

Data Concerning Cloudburst Flood at Colorado Springs

Hydraulic Factors Determined From Flood-Line Measurements—Relation Between Cloudburst and Flood

By Paul V. Hodges

Assistant Engineer, United States Geological Survey, Denver, Colo.

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IN THE paper entitled "Floods on Small Streams Caused by Rainfall of the Cloudburst Type," in *Proceedings* of the American Society of Civil Engineers. for May, 1922, the author states that he "believes that if the toll taken annually by these floods were better known, it would attract greater attention to the problem of providing against them, and he takes this opportunity to emphasize the importance of collecting reliable statistics on this subject."

A typical example of a flood of the cloudburst type, which caused much damage to property in and adjacent to Colorado Springs, Colo., occurred on the night of May 27, 1922, as the result of torrential rains above Templeton Gap, five miles northeast of Colorado Springs.

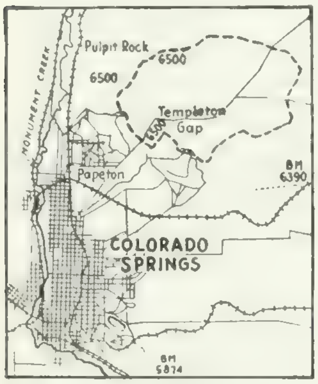
The topography northeast of Colorado Springs is composed of a semicircular range of hills, which rises abruptly and reaches an altitude of more than 6,800 ft. —about 800 ft. higher than Colorado Springs. These hills, whose rocky slopes support little vegetation, except a few coniferous trees and small brush, encircle an oval-shaped basin which has a narrow outlet called Templeton Gap. Dry waterways or gullies of nearly equal length descend from the hills and join a short distance above the gap. For three-fourths of a mile below Templeton Gap there is a deep, well-defined channel which can carry extreme floods, but farther downstream it widens until there is practically no channel.

HYDRAULIC FACTORS DETERMINED FROM FLOOD AT TEMPLETON GAP

Stream	Drainage Area in Sq. Mi.	Topography of Basin	[illegible]	Per Cent of [illegible]	Slope S Ratio	Maximum Discharge Sec. Ft. Total	Maximum Discharge Sec. Ft. per Square Mile	Equivalent Runoff In. per Hr.	Remarks
Templeton Gap	7.1	Steep [illegible] small [illegible] [illegible]	[illegible]	20	0.0108	6,120	862	1.34	536-foot stretch good condition.

Cloudburst and Flood—About 6 p.m. on May 27 heavy, rain-bearing clouds from the southwest passed over Colorado Springs and upon reaching the range of hills were deflected upward until their moisture was condensed and precipitated. The resulting storm lasted from 6 to 9 p.m. over an extensive area north and northeast of Colorado Springs although it was much severer directly above Templeton Gap. Here, a semicircular basin, concave toward the southwest, converged the air currents; and when the moisture was carried up and condensed it fell in a cloudburst which practically covered the drainage area of Templeton Gap and the adjoining area on the north and northeast. At Papeton and Colorado Springs the precipitation was only ½ in., but just above Templeton Gap 7 in. of water was caught in a pail standing in an open space, and farther up towards the hills about 10 in. of hail was reported.

The cloudburst above Templeton Gap caused a flood which reached Papeton about 8:30 p.m. About three-fourths mile above Papeton a railroad trestle is built over the channel. This trestle is 15 ft. high and has earth-fill embankments at each end. These embankments restricted the channel and caused an appreciable pondage above, until they were partially washed out. The pondage was computed to be about 6 acre-ft., and the effect of backwater amounted to about 5 ft. just above the trestle. This stored water, when released, probably increased the flood discharge downstream; but the amount of increase is not known as it would depend on the length of time consumed in washing out the embankments. Below the trestle, where the channel widens and flattens out, the flood was forced to spread out over the fields for about half a mile. Then part of it passed through a railroad culvert and finally escaped down a gulch through Colorado Springs to Fountain Creek, while the other and larger part flowed down over Papeton and flooded some of the streets to a depth of 4 or 5 ft. with swiftly flowing water which washed out fences, barns, streets, and sidewalks. From here it passed on and washed out the Atchison, Topeka & Santa Fe tracks at a point half a mile below Papeton before it escaped into Monument Creek just north of Colorado Springs. Although the area above Templeton Gap is subject to frequent cloudbursts this flood is reported the highest ever experienced—at least since 1880.



SKETCH MAP OF TEMPLETON GAP AND COLORADO SPRINGS

A notable feature of this flood was the mud balls, left in the channel, closely resembling black boulders and of a nearly black clay or gumbo, with stones and pebbles embedded, and ranging from 6 to 30 in. in diameter.

Estimated Maximum Flood Flow—In order to estimate the maximum discharge of this flood five cross-sections about 200 ft. apart were measured, using the high-water marks, in a stretch of channel a short distance above the railroad trestle. When these cross-sections were plotted, however, the two lower sections were found to be influenced by backwater from the trestle and were not used in determining the slope and other hydraulic factors. The channel was fairly smooth and even in this stretch, and a value of 0.030 was given to Kutter's coefficient of roughness and used in computing the quantities in the table of hydraulic factors. The area above Templeton Gap was accurately determined from the Colorado Springs topographic sheet.

Data regarding the duration of the flood are not available, but if it is assumed that an average of one-half of the maximum flow lasted for three hours it would give a volume of 757 acre-ft., or about 2 in. in depth over the drainage area.

Cloudbursts Explained—The following explanation of cloudbursts is taken from United States Geological Survey Water-Supply Paper 487:

> The phenomena called "cloudbursts" are very intense rainfalls of short duration over small areas that are sharply defined. Cloudbursts are common along the eastern slope of the Rocky Mountains wherever canyons have cut deeply into the mountain masses. Each of these canyons acts like a chimney flue in creating a strong, upward draft for the warm and relatively moist air from the plains, which passes up the canyon and reaches an altitude where the temperature becomes low enough to condense the moisture. The upward draft is sufficiently strong to support the moisture for some time after condensation begins, but finally the weight of moisture in the air becomes too great to be longer sustained, and it is precipitated in torrents. Cloudbursts of less violence also occur on the plains.
>
> Coincident with a cloudburst is the other phenomenon of a "wall of water" rushing down the stream.

The above explanation of cloudbursts tends to show a relation between topography and intensity or violence of cloudbursts, whereas the relation between topography and rate of concentration of runoff tends to connect rate of concentration with intensity of cloudburst. In other words, a rush or wall of water flowing down a channel would give the impression that this volume of water was actually dumped on a small area, when in fact the area contributing the runoff may be small or large with the intensity or violence of the so-called cloudburst varying in inverse proportion for similar drainage areas. A precipitation of a certain intensity over one area may be called a cloudburst though the same amount of precipitation over another area would not attract attention.

As the area above Templeton Gap has physiographic features that produce large floods it is said to be subject to frequent cloudbursts. The drainage area is so small that heavy storms practically cover the entire area; and the steep, rocky slopes, covered with little vegetation, are largely impervious and the rains that fall on them run off quickly. The shape of the basin, also, is such that floods from different parts of the area arrive at their junction at the same time and concentrate the flow.

Until more data on intense precipitation and its corresponding runoff are available it is impossible to distinguish the true relationship of cloudbursts and floods.

Standardized Appliances for Irrigation Structures

Designs for Gates, Lifts, Hoists, Radial Gates, Stems, Couplings and Guides as Standardized by the U. S. Reclamation Service

BY J. L. SAVAGE
Designing Engineer, U. S. Reclamation Service

THE designing department in the office of the chief engineer of the U. S. Reclamation Service at Denver, Colo., has recently completed a large number of standard designs of mechanical appliances for use in connection with irrigation structures. These designs embrace the first step in a comprehensive program of standardization work which will ultimately include the preparation of standard designs for all kinds of irrigation structures.

The designs for mechanical appliances were undertaken for the reason that the types, detail dimensions and anchor-bolt layouts for these appliances had to be

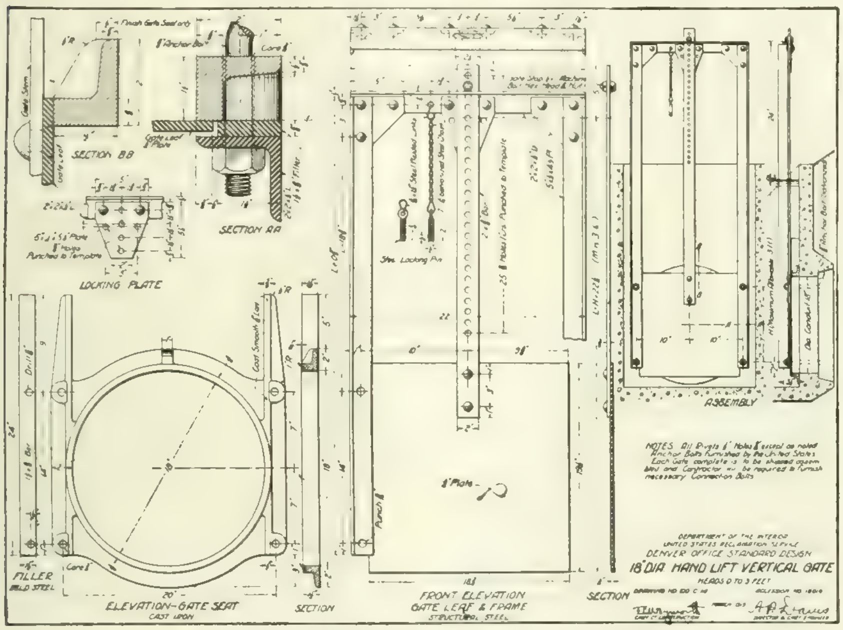


FIG. 1. HAND-LIFT VERTICAL GATE, 18 IN. IN DIAMETER

determined before the structure designs could be made. The standardization of structures is under way at the present time and it is expected that a large number of standard designs will be completed within the next few months.

The mechanical appliances which have been standardized include the following:

- Farm and lateral turnout gates.
- Handwheel gate lifts for turnout gates.
- Cast-iron gates for canal and reservoir outlets.
- Gate hoists for cast-iron gates.
- Radial gates for canal headworks, checks and wasteways.
- Radial gate hoists.
- Gate stem couplings and guides.

Farm and Lateral Turnout Gates—The designs for farm and lateral turnout gates include five different types: (1) Vertical gates for circular conduits, Fig. 1; (2) slope gates for circular conduits; (3) vertical gates for rectangular conduits; (4) slope gates for rectangular conduits; (5) vertical gates for rectangular open channels.

Designs have been completed for 93 different sizes of gates of these general types, based on heads grouped as follows: 0 to 3 ft.; 3 to 6 ft. and 6 to 9 ft. The types for conduits consist of structural steel gates and frames combined with cast-iron gate seats. These types are assembled in place on anchor bolts embedded in the concrete turnout structures. The type illustrated in Fig. 2 is made entirely of structural steel. It is fully assembled and riveted up in the shop ready for bolting to the turnout structure.

The simple hand-lift type of gate as illustrated in Fig. 1 is used only in small sizes, 12 to 24 in. in diameter, and under low heads, 0 to 3 ft. Screw lifts are used in all cases where the size of gate or the head on the gate is sufficient to require a mechanical device. The threaded stems for turnout gates are made of mild steel bars which have proved satisfactory and more economical than cold-rolled or turned-steel shafting. The threads on these stems are usually cut in a threading machine and an acme thread of loose fit in the nut is provided. The loose fit is effected by threading the nut $\frac{1}{16}$ in. oversize and by this means the stems are made to work freely in the nuts, irrespective of their condition as regards rust or other coating on the threads.

Handwheel Gate Lifts for Turnout Gates—The designs for handwheel gate lifts include four different types: (1) Handwheel gate lift with cast-in lifting nut; (2) with line-bearing lifting nut; (3) with ball-bearing lifting nut, and (4) geared gate lift with ball-bearing lifting nut.

The principal difference in the various types of gate lift lies in the design of lifting nut. In the type with the cast-in lifting nut a bronze bushing is cast into the hub of the handwheel. This is usually accomplished by pouring the cast iron around the bronze bushing. In the line-bearing type the bronze lifting nut is a separate part. The thrust collar on this nut is designed to provide a line contact with the bearing surfaces, resulting in comparatively low friction. In the ball-bearing type the friction is still further reduced by ball bearings, which are provided on both sides of the thrust collar. Ball bearings are also used in the geared-lift type and in addition this lift is provided with a set of spur gears to increase the capacity. The capacities of the various types of gate lifts vary in fairly uniform increments from 425 lb. for the simplest 12-in. handwheel lift to 2,420 lb. for the single-threaded geared gate lift. By reference to the table the reader will find the stem specifications and capacities of different gate lifts for which designs have been prepared.

Cast-Iron Gates for Canal and Reservoir Outlets—The designs for cast-iron gates include three different

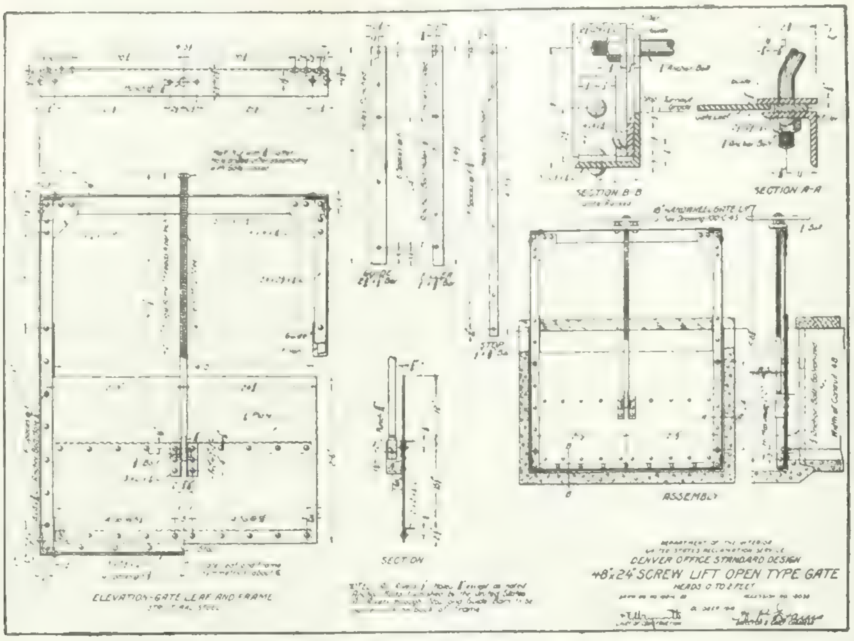


FIG. 2. SCREW LIFT OPEN TYPE GATE, 48 X 24 IN.

types: (1) For heads 0 to 15 ft.; (2) for heads 15 to 30 ft., and (3) for heads 30 to 50 ft.

Designs have been completed for 33 different size gates of these general types. The gates for heads 0 to 15 ft. are very similar to those for heads 15 to 30 ft., Fig. 3, the principal difference being the heavier castings in the latter. In both cases the sliding surfaces are cast iron on cast iron, the comparatively low heads not requiring bronze surfaces. The gates for heads 30 to 50 ft. are of quite different type as these higher heads require the introduction of air in considerable quantities and the use of bronze strips on at least one of the sliding surfaces. The bronze surfaces can for important installations be put on both the gate and frame. The introduction of air is necessary to prevent vacuum conditions below the gate when discharging in a partially open position. Any considerable vacuum results in the disintegration of metal and concrete surfaces by cavitation and serious damage will result if air is not admitted below gates which are subjected to high water velocities. The hollow frame of the gate was designed to admit air not only at the top of the gate opening but also along the sides, permitting a thorough distribution of air to all points where a vacuum tends to form. The bottom of the gate frame is flush with the conduit both above and below the gate and no air is required at this point.

Hoists for Cast-Iron Gates—The hoists for cast-iron gates are illustrated by three representative designs: (1) Handwheel gate hoist; (2) single-geared gate hoist, and (3) double-geared gate hoist. Designs have been completed for twelve different hoists of these general types, ranging in capacities from 690 lb. for the 24-in. handwheel gate hoist to a maximum of 15,225 lb. for the 24:1 geared gate hoist. Designs are under way for power-operated gate hoists of greater capacity and it is probable that these will be standardized for capacities up to about 40,000 lb. The capacities as discussed herein are based on a crank pull of 20 lb. and a sliding coefficient of 0.35 between gate and frame. All gate hoists and gate lifts are, however, designed safe for a crank pull of 40 lb. and a sliding factor of 0.70 (for starting gate) so that the actual safe capacity of all gate hoists and gate lifts is double the rated capacity.

The stems for all gate hoists are cold-rolled shafting cut with acme threads and all nuts are threaded $\frac{1}{16}$ in. over size to provide a loose fit between the stem and nut. This has been found essential to eliminate binding due to rusting or other coating on the stem. The designs, stem specifications and capacities of 61 different gate hoists have been prepared.

Radial Gates for Canal Headworks, Checks and Wasteways—The designs for radial gates include 49 different sizes, ranging from a width of 6 ft. and height of 3 ft. up to a width of 20 ft. and a height of 11 ft. The gates are all of the general type shown in Fig. 4 and consist of structural steel frames with corrugated galvanized steel face plates. Each gate is provided with an extension of variable height (up to about 1 ft.) so that the total gate heights can be varied to fit closely the water depth. The gate sills are made of wood which permits easy fitting to the concrete floor of the structure, resulting in a water-tight joint at the bottom of the gate. The side seals consist of sections of rubber hose fastened to the edge of gate in such manner as to seal completely the clearance spaces between the ends of the gate and the structure walls. The radial gate rotates on pins held in pin bearings embedded in the walls. For large gates the pin bearings are of cast iron with anchor bolts for distributing the gate load to the concrete structure walls.

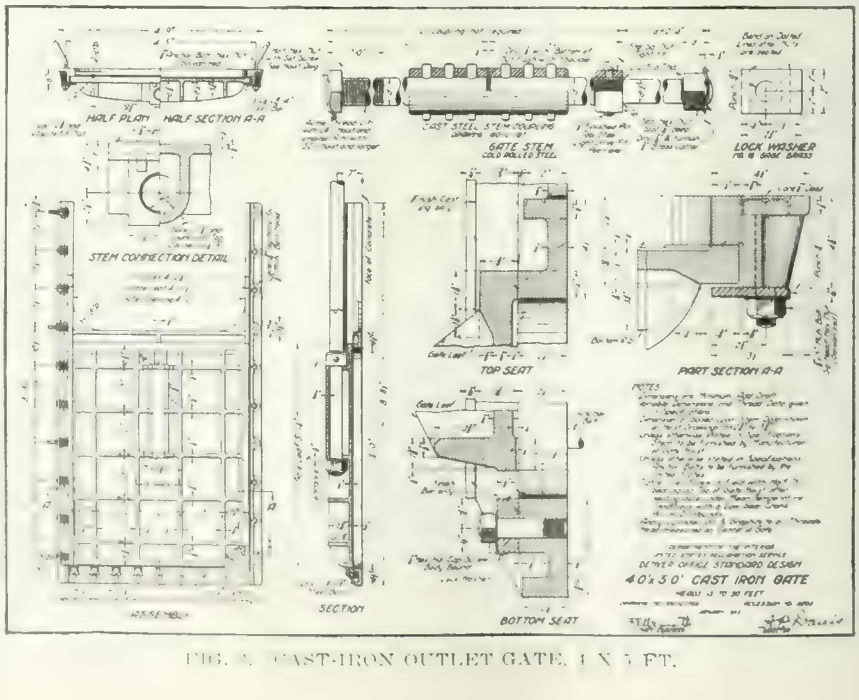


FIG. 3. CAST-IRON OUTLET GATE, 4 X 5 FT.

STEM SPECIFICATIONS AND CAPACITIES OF DIFFERENT GATE LIFTS

Handwheel Lifts Size, In	Type	Stem Dia In	Acme Threads		Max Unsupported Length At Threads Ft	In	In Body Ft	In	Capacity, Lb
12	C*	1	Single	4 per inch	3	11	7	6	425
15	C	1[illegible]	Single	4 per inch	5	0	9	3	495
18	C	1[illegible]	Single	4 per inch	6	3	10	5	550
21	L	1[illegible]	Single	4 per inch	5	9	9	7	640
24	L	1[illegible]	Single	4 per inch	7	6	11	10	695
27	L	1[illegible]	Single	4 per inch	6	8	10	6	780
30	L	1[illegible]	Single	4 per inch	6	2	9	11	865
18	B	1[illegible]	Single	4 per inch	6	7	10	3	965
18	B	1[illegible]	Double	4 per inch	7	5	11	6	785
24	B	1[illegible]	Single	4 per inch	5	7	8	8	1,285
24	B	1[illegible]	Double	4 per inch	6	5	9	9	1,045
30	B	1[illegible]	Single	4 per inch	4	10	7	9	1,600
30	B	1[illegible]	Double	4 per inch	5	7	8	9	1,305
15	4:1 Geared	1¾	Single	3½ per inch	6	3	9	9	2,420
15	4:1 Geared	1¾	Double	L. 0.5714 in. P. 0.2857 in.	7	2	11	0	1,980
15	4:1 Geared	2	Single	3 per inch	5	2	14	0	2,120
15	4:1 Geared	2	Double	L. 0.6666 in. P. 0.3333 in.	10	4	15	9	1,730

*"C" refers to cast-in lifting nut, "L" to line bearing nut and "B" to ball bearing nut.

Radial Gate Hoists—The designs for radial gate hoists include five different capacities, ranging from 1,200 to 7,500 lb. All of the hoists are of the same general types, consisting of two drums on a line shaft which is operated by a worm gear. The smallest capacity hoist has the worm gear only, while single- and double-spur gearing is used to increase the power in the larger capacity hoists. All gears are of cast iron, pinions of cast steel and worms of soft steel. The base, bearings and drums are of cast iron. Shafts are of cold rolled steel.

Gate Stem Couplings and Guides—Standard designs have been prepared for gate stem couplings and for stem guides. The stem couplings consist of cast steel, cold rolled steel or forged steel sleeves having a light drive fit with the ends of stem. The sleeve is fastened to the stem by means of finished taper pins of medium steel. The taper pins are held in place by brass cotter pins. Couplings are provided for stems varying in size from 2 to 5 in. in diameter. A similar design has been prepared for reduction couplings by which two stems of different diameters can be coupled together. The reduction coupling is not often required but is sometimes used where the threaded portion of the stem is made larger than the rest of the stem.

The stem guides consist of two iron castings, one bolted to the concrete face wall of the structure and supporting the other casting which forms the guide for the stem. Both castings are made adjustable by slotted holes in order to facilitate the alignment of stem. The design for stem guides covers stems from 1 to 3½ in. in diameter. A similar design covers larger stems up to 6 in. in diameter.

Advantages of Standardization—The standardization of mechanical appliances has resulted in many advantages, among which are the following:

(1) The cost for engineering is very materially reduced as the standard designs when once prepared are made available for all projects in the service. Duplication of designing work is eliminated and the engineering work on the projects is reduced due to the similarity of devices and the repetition of work in their installation.

(2) The purchase of the mechanical appliances is expedited as this does not have to await the preparation of special designs.

(3) The construction of concrete structures is expedited as this does not have to await the preparation of designs or delivery of mechanical appliances. The anchor bolt layout and other details are known and the appliances can be bolted to the structures after the completion of the concrete work. They do not need to be on hand at the time the structure is built.

(4) The standard designs have been prepared in sufficient detail to serve as shop drawings, a complete detail drawing having been made for each size of appliance. As a result most manufacturers do not incur the expense of making shop drawings in filing orders for standard appliances. This saving in engineering expense on the part of the manufacturer is of course reflected in the bid prices on the standard appliances.

(5) Manufacturers who make a specialty of irrigation appliances are gradually accumulating patterns for castings used in the standard designs and even where the patterns are not in stock manufacturers are known to omit pattern costs when bidding on the standard appliances in the expectation of using the patterns for future orders. In this way the standard designs have greatly reduced the costs for standardized appliances.

While the value of the standardization work has been fully demonstrated by the completed designs of mechanical appliances, it is expected that very much greater value will result from the standardization of structures. The structure designs will include such structures as turnouts, drops, checks, chutes, weirs and many combinations of these structures. Extensive use will be made of precast concrete construction and a large number of designs are already completed (not yet lithographed) for structures of precast concrete.

The large demand for the standard designs of the Reclamation Service indicates that extensive use of the designs is being made by different foreign interests, and also by various private irrigation districts in the United States. Many of the manufacturing companies who specialize in irrigation appliances have adopted as

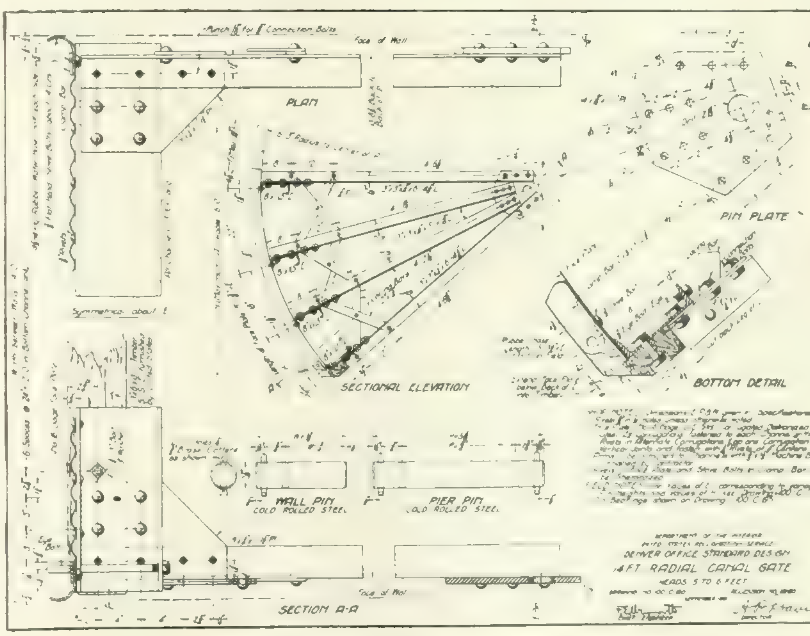


FIG. 4. RADIAL CANAL GATE, 14 FT.

standard, the designs of the Reclamation Service, and in this way the advantages of this standardization work are designed to reach many of the smaller private projects which might otherwise fail to discover the availability of the designs. Lists of the available designs which have been lithographed can be secured upon application to the chief engineer of the Reclamation Service, Denver, Colo.

The standardization work is being done by the designing department in the Denver office of the Reclamation Service, under the general direction of A. P. Davis, director, and F. E. Weymouth, chief engineer.

Concrete Continuous-Truss Bridge Without Diagonals

French Structure 135½ Ft. Long Has Steel X-Frames in Posts and Gussets Instead of Usual Diagonal Members

A TWO-SPAN continuous-truss reinforced-concrete deck bridge in which no diagonal members are employed, but having the vertical reinforcement so arranged as to take care of the diagonal stresses, is a curious structure built recently by the Paris, Lyons

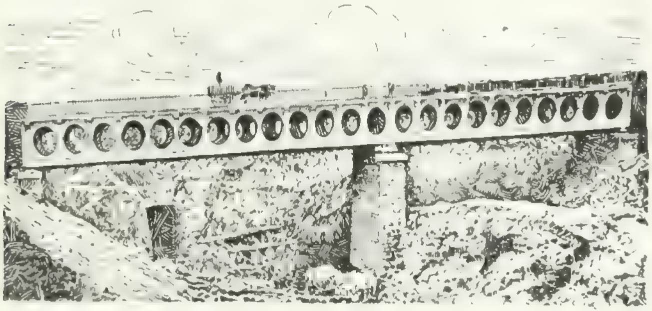


FIG. 1—FRENCH CONTINUOUS-TRUSS CONCRETE BRIDGE

& Mediterranean Ry. at Randan, France, to carry a highway across a deep cut on the new line from Riom to Vichy. This bridge, shown in Fig. 1, is described in the September number of the *Revue Generale des Chemins de Fer* by E. Chartiee and G Blot, two engineers of the railway. The contractors were Lossier, Mallet & Co.

An arch bridge was impracticable because in addition to the two main tracks there was a third track at a higher elevation on one side of the cut. It was decided therefore to build a center pier for two spans of 75.6 and 58.3 ft. Since the available depth for the structure, 9.7 ft., was too much for a plate girder and too little for a lattice truss, a truss design composed only of horizontal chords and vertical posts was proposed. To provide against deformation at the angles between the posts and chords, steel X-frames were introduced in the post reinforcement, these frames having their extremities embedded in the chords and their intersections in the neutral axis of the truss. This arrangement is shown in Fig. 2. If the concrete had been shaped to the lines of the reinforcing steel it would have formed octagonal web openings with unequal sides, but as this would be unsightly the openings were made elliptical.

Each truss is 135.6 ft. long, with chords 22 in. deep and varying from 22.4 to 26 in. in width. Posts are

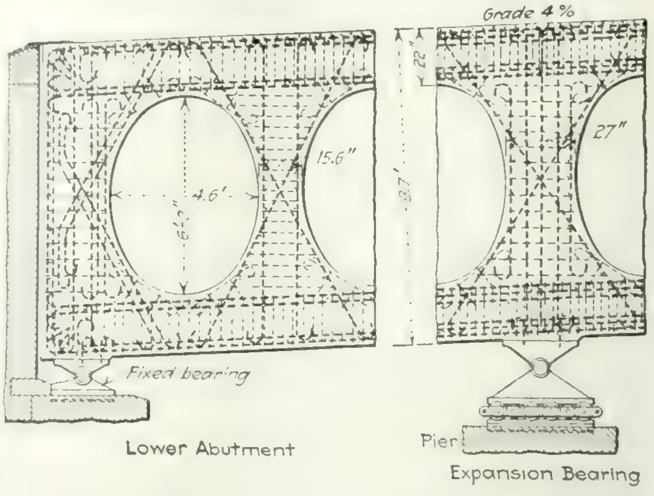


FIG. 2—CONCRETE TRUSS HAS CHORDS AND POSTS ONLY

spaced 5.77 ft. c. to c., except that over the pier and abutments the spacing is 6 ft. The bridge is on a grade of 4 per cent and has expansion bearings on the pier and upper abutment, with fixed bearings on the lower abutment. No sway bracing is used, but the floorbeams between the top chords are shaped with knee braces against the posts. The beams over the bearings are of exceptional depth. The ordinary floor beams are 9 in. thick and 29½ in. deep including the 6½-in. deck slab. On the bottom of the slab is a central longitudinal rib. The trusses, floorbeams and slab constitute a monolithic structure. On the slab is a waterproofing course protected by a paving of lean concrete.

A pleasing appearance was desirable, as the bridge is near a station, and means were taken to offset the unsightly effects of form marks and discoloration so often seen in concrete structures. For this purpose shadow and relief effects are produced by corbels for the hand-rail posts, moldings on the outer faces of the top chords and ribs on the lower edges of the bottom

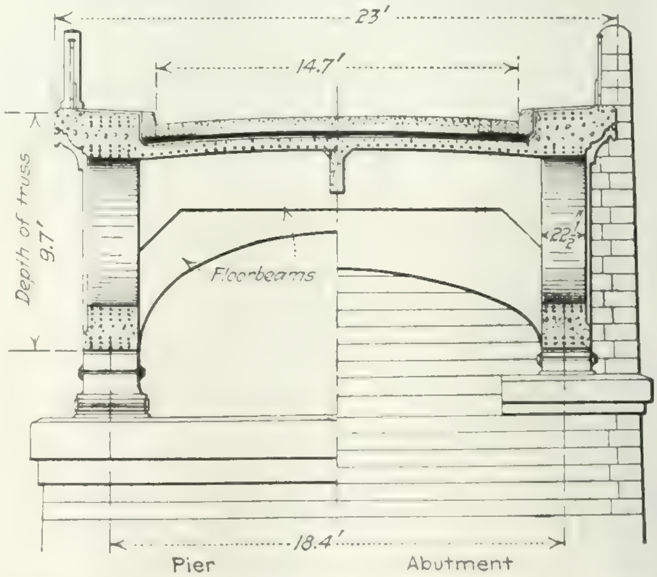


FIG. 3—CROSS-SECTION OF CONCRETE TRUSS BRIDGE

chords. This will be seen by Fig. 3. The exposed sides of the trusses are faced with 2 to 3 in. of cement mortar and finished with two coats of stone-colored paint.

Theory of Bond Issues for Road Construction

A Rational Method of Fixing the Ultimate Amount and Life Based on Possible Annual Expenditure for Maintenance

By Jeremiah C. Finch
Secretary, New York State Commission of Highways, Albany, N. Y.

THERE has been a great deal of discussion as to the proper method of financing such extensive highway improvements as are being undertaken by the various municipalities or subdivisions of the country. The original theory generally advocated was one of issuing long-term bonds on the assumption that the life of an improved highway was at least fifty years. In recent years there has been a tendency to decrease the term of the bonds or to substitute serial bonds, and, still more recently, many advocates have appeared for the "pay-as-you-go" policy. It has become a generally accepted theory that a highway shall not be built which will not last longer than the life of the bond, but the discussion has revolved around the question, what portion of a highway improvement is permanent, and the length of life of the portion not permanent.

In view of the fact that a very large proportion of the political subdivisions of the country are going into the question of highway improvement on as extensive a scale as they are able to finance, the proper theory on which to base their highway program is determined by the answer to the question: What amount of money can any municipality afford to raise for the permanent maintenance of a highway system? The funds available from direct taxes or other sources will limit the annual expenditure of any municipality for highway maintenance and reconstruction and the voters must be willing not only to obligate themselves to raise that sum annually but also to obligate posterity to continue to raise that sum annually for all time. Only under these conditions is a municipality justified in instituting a highway construction program of a magnitude which the annual highway fund will permanently maintain and reconstruct, but of no greater magnitude. It is therefore clear that no municipality has a right to issue bonds for the construction of a greater mileage of highways than posterity will be able to maintain without an undue burden, as it certainly would be most unjust to place a greater burden on posterity than the present generation is willing to assume.

Illustration of Theory—In order to illustrate this theory clearly a hypothetical case has been taken of a municipality which can afford a permanent highway maintenance and reconstruction budget of $2,000,000 and, for this purpose, it is assumed that a highway system costing $30,000,000 will eventually require at the expiration of 35 years a sum of $2,000,000 per annum to reconstruct and maintain the system in a condition to carry satisfactorily the traffic of the municipality. The amounts indicated each year in the accompanying table as necessary for maintenance are wholly empirical and no assertion is made that these are the exact amounts required in any given year for maintenance of any given highway system, as the amounts necessary from year to year will depend largely on the character and type of pavement laid, together with the nature of the traffic and soil conditions, and there are many other features which may enter.

It may be assumed, however, that maintenance and repair charges at the fourteenth year, when the average age of the pavements is eleven years, will be $400 per mile per year. Beginning with the fifteenth year, $50,000 will be available for reconstruction, and increasing amounts each year thereafter, so that sufficient moneys will have been available to reconstruct two-thirds of the system at two-thirds of its original cost in the thirty-four year period, the average age of the pavements in the thirty-four years being thirty-one years. Sufficient funds will be available so that all of the remaining one-third will have been constructed in the following four years. After that time, it is hardly

PLAN OF DISPOSAL OF BOND ISSUE FOR HIGHWAY IMPROVEMENT

Years	A Total Bonds Issued	B Accrued Retirement Fund	C Annual Amount Retired	D Term of Bonds	E Balance Bonds Outstanding	F Interest at 4 Per Cent	G Maintenance and Reconstruction	H Annual Highway Taxation
1	$6,000,000		$1,760,000	Years	$6,000,000	$240,000		$2,000,000
2	6,000,000	$1,760,000	1,590,600	1	10,240,000	409,600		2,000,000
3	6,000,000	3,350,600	1,383,024	2	14,649,400	585,976	$25,000	2,000,000
4	6,000,000	4,733,624	1,179,345	3	19,266,376	770,655	50,000	2,000,000
5	6,000,000	5,912,969	961,519	4	24,087,031	963,481	75,000	2,000,000
6		6,874,488	974,980	4	23,125,512	925,020	100,000	2,000,000
7		7,849,468	988,979	5	22,150,532	886,021	125,000	2,000,000
8		8,838,447	1,003,538	6	21,161,553	846,462	150,000	2,000,000
9		9,841,985	1,018,680	7	20,158,015	806,320	175,000	2,000,000
10		10,860,665	1,034,427	8	19,139,335	765,573	200,000	2,000,000
11		11,895,092	1,025,804	9	18,104,908	724,196	250,000	2,000,000
12		12,920,896	1,016,836	9	17,079,104	683,164	300,000	2,000,000
13		13,937,732	1,007,510	10	16,062,268	642,490	350,000	2,000,000
14		14,945,242	997,810	11	15,054,752	602,190	400,000	2,000,000
15		15,943,052	987,723	12	14,056,948	562,277	450,000	2,000,000
16		16,930,775	977,231	13	13,069,225	522,769	500,000	2,000,000
17		17,908,006	966,321	14	12,091,994	483,679	550,000	2,000,000
18		18,874,327	954,972	14	11,125,693	445,027	600,000	2,000,000
19		19,829,299	943,172	15	10,170,701	406,828	650,000	2,000,000
20		20,772,471	930,899	16	9,227,529	369,101	700,000	2,000,000
21		21,703,370	918,195	17	8,296,630	331,865	750,000	2,000,000
22		22,621,565	904,863	18	7,378,435	295,137	800,000	2,000,000
23		23,526,428	891,058	19	6,473,572	258,942	850,000	2,000,000
24		24,417,486	876,700	19	5,582,514	223,300	900,000	2,000,000
25		25,294,186	811,768	20	4,705,814	188,232	1,000,000	2,000,000
26		26,105,954	744,239	21	3,894,046	155,761	1,100,000	2,000,000
27		26,850,193	674,008	22	3,149,807	125,992	1,200,000	2,000,000
28		27,524,201	600,969	23	2,475,799	99,031	1,300,000	2,000,000
29		28,125,170	525,007	24	1,874,830	74,993	1,400,000	2,000,000
30		28,650,177	446,008	25	1,349,823	53,992	1,500,000	2,000,000
31		29,096,185	363,848	26	903,815	36,152	1,600,000	2,000,000
32		29,460,033	278,402	27	539,967	21,598	1,700,000	2,000,000
33		29,738,435	189,538	28	261,565	10,462	1,800,000	2,000,000
34		29,927,973	72,027	29	72,027	2,881	1,925,092	2,000,000
35		30,000,000	None		None	None	2,000,000	2,000,000
	$30,000,000		$30,000,000	12 Avg		$14,519,167	$25,475,092	$70,000,000

Column "C" plus "F" plus "G" equals column "H". Columns "B" and "E" equal total bonds which had been issued on any given year.

safe, due to the probable increasing traffic, to estimate that reconstruction costs will be less than the original construction cost, but, with $1,500,000 annually available for reconstruction after the thirty-eighth year, the entire system can be reconstructed every twenty years at its original cost and still set aside $500 per mile for maintenance and repair after the thirty-eighth year.

Maintenance vs. Reconstruction—If it be argued that the maintenance costs are estimated too high, the money saved can well be spent on reconstruction of the system at an earlier date than these computations will permit; and if it be argued that maintenance costs are estimated too low, either an extra appropriation for maintenance will be required for a few years or the retirement of the last of the bonds deferred.

There can be little argument as to the general proposition that after the lapse of thirty-five years from the beginning of construction or thirty years after the average date of completion that the average annual expenditure for maintenance and reconstruction will not be equal to $6\frac{5}{8}$ per cent of the original investment. In any event a proper amount for maintenance and reconstruction covering every year of a thirty-four year period can be estimated from any given proposed construction program and used as a basis for a similar computation without altering the principles herein expressed.

A second assumption has been introduced that in a construction program of $30,000,000 it would be inadvisable to attempt to construct the same in a shorter period than five years so that the bonds would be issued at the rate of $6,000,000 per year. This, of course, could be modified to meet any given situation without altering the principles involved. Under this plan $2,000,000 would be raised annually by taxation. Figuring interest at 4 per cent, $240,000 would be required the first year for interest; the balance, $1,760,000, would be deducted from the first bond issue. The third year, assuming $25,000 for maintenance, the interest would amount to $585,976, leaving a balance of $1,383,024 to retire an equal amount of two year serial bonds. Similar computation for each successive year would retire the last installment of the bond twenty-nine years after they were issued and thirty-four years after the bond issue was authorized, leaving $2,000,000 available for maintenance and reconstruction during the thirty-fifth year and all succeeding years.

It is interesting to note that half of these bonds will be retired at the end of fourteen years, none of which will have been in existence over eleven years, and that two thirds of these bonds will have been retired at the end of nineteen years, none of which will have been running more than fifteen years.

If contributions by the federal government are injected into the computation it will not affect the ultimate amounts of money needed for maintenance at the end of thirty-five years, nor will it materially affect the amount of mileage which can be maintained unless the federal government will assume permanently a portion of the reconstruction charges. I am firmly convinced, however, that no state, county, town, city or village should blindly plunge into a road construction program which will eventually give them a mileage of highways greater than posterity can afford to maintain in as good condition as it was handed to them, and the only logical way to prevent such an outcome is to limit the construction program to the mileage of highways the municipality can afford to maintain permanently.

Reversible Manhole Covers to Replace Solid Type

Chicago Sewer Department Develops a Three-Piece Cover Lighter and Stronger than Standard—Tests Made

ENORMOUSLY increased cost of castings for manhole covers during the war started the Chicago Sewer Department on a hunt for a lighter design than the standard used for 25 years. Finally there was designed a cover in three pieces—base, ring or curb and lid—in which the curb can be reversed without tearing up the adjacent pavement after the ledge supporting the lid has worn appreciably.

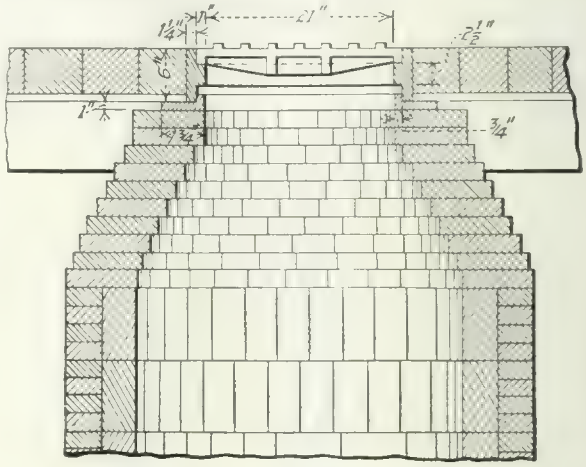


FIG. 1. REVERSIBLE MANHOLE COVER IN PLACE

The new cover is about 90 lb. lighter than the standard design. The cost of restoring pavement due to replacing wornout two-piece covers is high since for a minimum pavement repair the charge is $20. In the downtown district this repair work required one bricklayer, three men and a team at least half a day. Installation of covers or replacements of the old type, including charge for restoring pavements, costs an average of $56.50. The first replacement of the reversible type, which means simply prying out the curb and turning it over without disturbing the pavement, costs $5.50. After both shoulders of the ring or curb have been worn down the ring can be replaced at a cost of about $6, plus $5.50 for labor. With

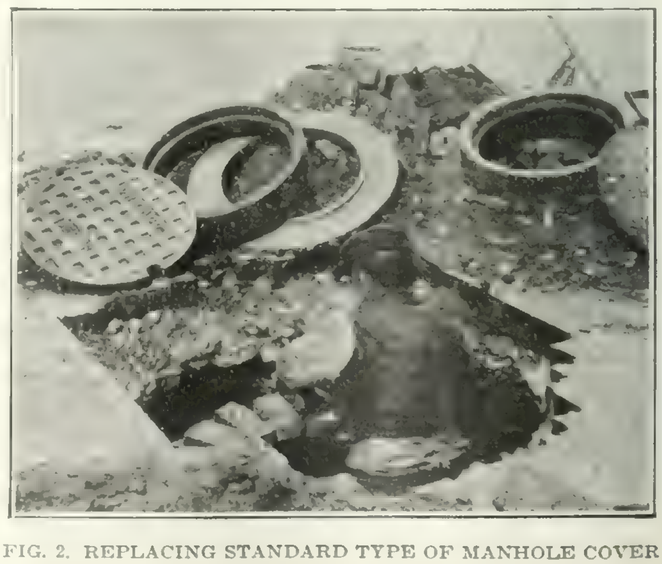


FIG. 2. REPLACING STANDARD TYPE OF MANHOLE COVER
Takes one-half day, interrupting traffic and costing $56.50.

the new cover the base is set on the masonry and remains permanently in place. Resting on the base is the curb which has two flanges or ledges exactly alike, either one of which may be used to support the lid. This feature doubles the life of the cover and saves the adjacent pavement. The first of the new covers was placed two years ago in front of Marshall Field's on State St. and about 200 have been set in the most congested portions of the business district.

FIG. 3. REVERSING RING
Ring pried out of pavement and turned over at cost of $5.50.

For experimental purposes some of the newly installed curbs have been reversed without any effect on the pavement. The operation of prying the ring up out of a wood block pavement and hammering down the adjacent pavement with a maul was carried out for a representative of *Engineering News-Record* to photograph on Monroe St. between State St. and Wabash Ave. without interrupting the continuous line of traffic on either side. A serious pavement difficulty attends this kind of replacement in that traffic cannot be kept from the new patch. In consequence, settlement of the concrete base is almost sure to result. Due to the large increase in motor vehicle traffic the old covers, of which the sewer and water departments have about 300,000, are wearing out rapidly. Few covers in the downtown district last more than fifteen years and it is now the practice to install new ones when pavements are relaid. The life of pavements in the downtown district averages seven years. One of the photographs shows the worn and broken ledge of a cover on Monroe St. near the other two shown. This cover was considered extra hazardous to traffic and ready for replacement after eight years.

RESULTS OF DROPPING 1,200-LB. WEIGHT ON STANDARD AND REVERSIBLE MANHOLE COVERS

	Weight Lb.	Resistance in Ft.-Lb.	Ft.-Lb. per 100-Lb. Metal	Remarks
Heavy Type, Curb and Bases 21 in. in Diameter				
Reversible	315	20,400	6,476	Not broken
Reversible	316	19,200	6,076	Cracked (base only)
Reversible	313	20,400	6,517	Not broken
Standard	416	13,200	3,173	Broken
Standard	418	14,400	3,445	Broken
Standard	417	14,400	3,453	Broken
Medium Type, Curbs and Bases 21 in. in Diameter				
Reversible	281	20,400	7,224	Not broken
Reversible	283	20,400	7,209	Not broken
Reversible	283	20,400	7,209	Not broken
Standard	415	14,400	3,470	Broken
Standard	413	12,000	2,905	Broken
Standard	416	13,200	3,173	Broken

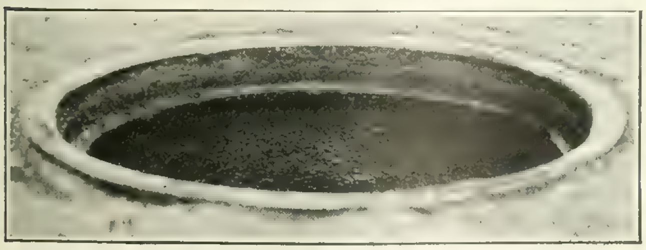


FIG. 4. LEDGE OR CURB WORN TO DANGER POINT
This cover was replaced in January. Pavement dropped about ⅜-in. for an area of more than a yard around it.

Tests of the old and new manhole covers have been made at the plant of the Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., by dropping on them a 1,200-lb. weight various distances. For testing the curbs a heavy cast-iron base was provided with the top grooved to receive the manhole curb casting. The curb fits the base close enough to prevent any lateral movement of the curb. A layer of riddled sand 1 in. deep was placed between the base plate and the casting under test to insure an even bearing. The anvil was a heavy casting with the base machined to fit the curb in place of a standard lid. After each drop the casting was inspected for any cracks or distortion of metal which were considered the point of failure. Castings of the different designs were poured from the same ladle to make the tests comparative. For curbs the drop started at 6 ft. and was increased by 1-ft. increments until the casting broke or the limit of the electric hoist, 17 ft., was reached. For lids the test started with a drop of 18 in., which was raised by 3-in. increments until the casting failed.

FIG. 5. TEST APPARATUS FOR BREAKING MANHOLE COVER BASE AND CURB

Heavy lids weighing 155 to 158 lb. broke at a load of 3,300 ft.-lb. and medium lids weighing 116 to 118 lb. broke at 3,000 ft.-lb. All lids broke at the same height of drop, but the lighter sections deflected under the blow and the weight rebounded after striking. Before breaking the medium lids dished $\frac{3}{16}$ to $\frac{1}{4}$ in. at the center.

Maintenance of Chicago sewers is handled by George E. McGrath, superintendent of the sewer department. The new cover design was worked out and patented by Frank Shanley, in charge of sewer construction, Bureau of Sewers.

Flood Protection Needed in Indianapolis

Flood dangers in Indianapolis were reported upon recently by a committee of the Indianapolis Chapter of the American Association of Engineers, with the result of showing that channel improvement work and enlargement or clearing of bridge waterways is urgently needed if the risk of inundation and serious property damage in extreme high-water periods are to be avoided. The work to be done lies chiefly between the mouth of Fall Creek near 10th St. on the north side and the Belt R.R. bridge near Raymond St. on the south side. Several bridges are of insufficient length, and one railroad trestle is almost certain to clog with debris in an extreme flood and go out; another bridge is too low. Protection can be secured by building flood walls instead of clearing the channel.

Arch Dam Temperature Changes and Deflection Measurements

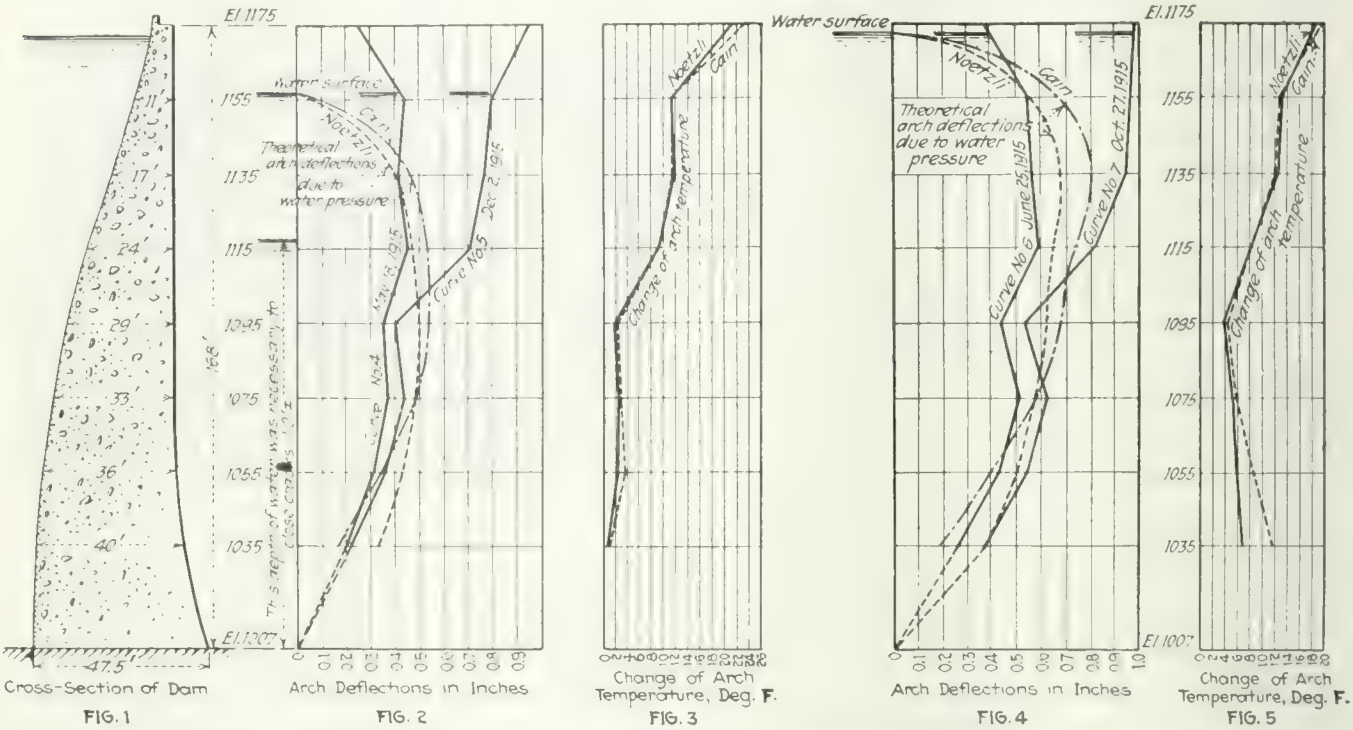
A Suggested Method of Experimentation With Full Size Structures Which May Give Information Useful in Design

By Fred A. Noetzli
Chief Engineer, Bissell and Sinnicks, Consulting Engineers, San Francisco, Calif

CONSIDERABLE tension stress and probably open cracks occur in some existing arch dams, both in vertical as well as in horizontal planes. Several kinds of forces and other influences, such as temperature, shrinkage, etc., may occur in such dams, besides water pressure. It is the object of this article to call the attention of engineers to the importance of such often-neglected influences, and to indicate ways and means of analyzing their effect. As temperature variations are probably of primary importance besides the water pressure itself, special attention will be given in this article to temperature phenomena, and a method will be shown by which the change of temperature in arch dams can be estimated from measured deflections.

It is a well-known fact that temperature variations in the concrete of arch dams are responsible for deflections which under certain conditions may be larger than the deflections due to the water pressure itself. An increase in the arch temperature will push the arch crown in an upstream direction while a decrease corresponds to a downstream deflection. It is evident that such movements, which may occur entirely independent from the water load, will result in additional bending moments and stresses being put up in the arches, and they are, therefore, of a certain importance for the design of structures of this kind.

So far as the writer knows there are no direct measurements of temperature variations in arch dams available which would furnish a reliable record of the fluctuations of the temperature during the seasons and at various elevations between base and crest. Some measurements have been made on certain dams of the gravity type, notably the Arrowrock Dam (see *Transactions*, Am. Soc. C. E., Vol. LXXIX, 1915, p. 1225 and Vol. LXXXIV, 1921, p. 109), but it is doubtful if the conditions in the enormous masses of concrete of gravity dams are truly representative of what may occur in this respect in the arches of a slender arch dam. It is therefore most desirable that characteristic series of temperature measurements be also made on dams of this kind. However, such investigations may be delayed for a considerable period of time before new structures have been built and equipped with adequate measuring devices, not to speak of the time it will take from there on, to obtain the truly representative series of figures, which may require years of careful observations.



FIGS. 1 TO 5—DEFLECTIONS AND TEMPERATURE CHANGES OBSERVED IN THE SALMON CREEK DAM

It is possible, however, to estimate the temperature changes in arch dams from deflection measurements, and it is the purpose of this article to demonstrate a method leading to fairly accurate results by very simple calculations.

The elastic theory of the arch permits to figure the deflections of an arch if the loads, changes of temperature, shrinkage, etc., are known. Consequently, if all the unknown quantities, except one, are kept constant, the measurement of the arch deflections which are then due entirely to the one variable quantity, may lead to estimating the size of this unknown quantity. For example, if for an arch dam the deflections have been measured during various seasons when the water in the reservoir stood at exactly the same elevation, it is then reasonable to assume that any difference in the deflection at the two moments of observation is due mainly to a variation of the arch temperature. Of course, the elementary arch slices of arch dams are not free to slide one over the other, as is generally assumed for theoretical investigations, and the arch deflections at the various elevations may therefore be influenced some-

what by this fact and also by vertical cantilever action. Nevertheless, such investigations may be of assistance in forming an idea as to the importance of temperature changes in arch dams.

In a paper, entitled "The Circular Arch under Normal Loads," by Professor William Cain (*Proceedings*, Am. Soc. C. E., October, 1921, p. 285), an exact formula is developed by which it is possible to calculate for a change of arch temperature the crown deflection of a hingeless elastic arch. Based upon this formula, the change of the arch temperature for a measured deflection may be calculated for an arch slice of 1 ft. thickness by the equation,

$$T = \frac{(\phi + \frac{1}{2}\sin 2\phi)\left(1 + \frac{k^2}{R^2}\right) - \frac{1 - \cos 2\phi}{\phi}}{hc\sin\phi\left[(1 + \cos\phi)\left(1 + \frac{k^2}{R^2}\right) - 2\frac{\sin\phi}{\phi}\right]} D \quad (1)$$

in which

T = uniform change of arch temperature in degrees F.;
D = deflection of arch crown;
c = coefficient of expansion;
R = radius of center line of arch;
h = rise of center line of arch;
k = radius of gyration of arch section $= \frac{1}{12}t^2$;
t = thickness of arch;
ϕ = half central angle of arch.

All dimensions are measured in feet.

In a paper entitled "Gravity and Arch Action in Curved Dams" (*Transactions*, Am. Soc. C. E., Vol. LXXXIV, 1921, p. 12), the writer has developed an approximate formula for arch deflections resulting from temperature changes,

$$D = 1.56\,RcT$$

from which

$$T = \frac{1}{1.56\,Rc} D \quad (2)$$

The notation is the same as given above.

By measuring the deflection, D, in inches, as is usually done, and by assuming for average cases the coefficient of expansion $c = 0.000\,0055$, there results the simple formula,

$$T = 10{,}000\ D/R \text{ (approximately)} \quad (3)$$

Equation (3) is about as simple as possibly may be expected for a problem which theoretically is as complicated as is well illustrated by Equation (1). Nevertheless, the approximate formula (3) furnishes fairly reliable results for the upper parts of most arch dams, and for which the proportion between thickness and rise of arch is less than about 0.8. For thick and flat arches this formula cannot be expected to furnish other but rough approximations, and in extreme cases the value of T by (3) is only about 50 per cent of T calculated by Equation (1).

It is of importance to note that in the above formulas for temperature variations the modulus of elasticity of the arch material does not occur, and, consequently, a factor of considerable uncertainty is thus eliminated. It would appear, therefore, that the only assumptions to be made are with regard to the "fixity" of the arches and the coefficient of expansion, c. For a dam under pressure the arches may be assumed as rigidly fixed at the abutments unless calculations or observations should indicate the occurrence of open cracks. The coefficient of expansion, c, may probably be judged within 10 per cent to 20 per cent and therefore the accuracy of equation (1) would appear to be also within such limits for the freely arching parts of arched dams and for uniform temperature changes.

Example—A very interesting set of deflection measurements was made on the Salmon Creek Dam in Alaska. The deflection curves of this structure were published and discussed by L. Jorgensen (*Transactions*, Am. Soc. C. E., Vol. LXXXIII, 1919-20, p. 316), who is the designer of the dam. Some of the curves which are of particular interest with regard to the subject of the present article are shown on Figs. 1 to 5.

It is of interest to note that Curve No. 4 of May 18, 1915, and Curve No. 5, of Dec. 2, 1915 (Fig. 2) represent deflections of this dam with the water level in the reservoir being very nearly at the same elevation on both dates. This is also the case for Curve No. 6 of June 25, 1915, and Curve No. 7, of Dec. 27, 1915 (Fig. 4), respectively. From a comparison between each set of curves in Figs. 2 and 4, it is evident that other influences besides water pressure must have been at work to cause such large variations in the arch deflections for the same water load.

It is most probable that the chemical heat of this comparatively slender arch dam had been lost during the severe winter which intervened between the completion of the dam in the summer of 1914 and the date of the measurements relating to these deflection curves. Apparently the dam had also taken its "initial set" prior to these measurements, as indicated by the note that the pressure of about 110 ft. of water in the reservoir was necessary to keep the construction joints closed. The influence of lateral expansion (Poisson's ratio) and of swelling, etc., was probably the same for each of the two sets of deflections, so that with reasonable certainty it may be assumed that the difference in deflection at the various elevations was due entirely to the difference of the arch temperature on the two respective days that the measurements were taken.

TABLE SHOWS TEMPERATURE EFFECTS ON SALMON CREEK DAM

Elevation	Radius of Arch Axis	Thickness of Arch	Central Angle	Curves 4 and 5			Curves 6 and 7		
				Temperature Deflection	Difference of Arch Temp Degrees Fahr		Temperature Deflection	Difference of Arch Temp Degrees Fahr	
	R	t	2φ	D(inch)	Cain	Noetzli	D(inch)	Cain	Noetzli
1	2	3	4	5	6	7	8	9	10
Crest 1175	328 ft	6 ft	114°	0 70	22 6	21 3	0 62	20 0	18 9
1155	322	11	100°	0 37	11.5	11 5	0.42	13.0	13 1
1135	303	17	92°	0 30	11 7	11.9	0.38	12 4	12 5
1115	282	24	88°	0.26	9 3	9 3	0 23	8 2	8 2
1095	260	29	85°	0.05	2.1	1.9	0.10	4.3	3.9
1075	236	33	86°	0 06	2 8	2 5	0 12	5 7	5.1
1055	208	36	76°	0 05	3 5	2 4	0 12	8 4	5 8
1035	174	40	69°	0.01	1.0	0 6	0 11	11.4	6 3
Base 1007									

Furthermore, it is probable that for this particular dam the arch action is much less restrained by vertical cantilever action, than might be assumed otherwise, because calculations made by the writer (published in the papers referred to previously) seem to indicate that the vertical cantilever of this dam is broken at various elevations. These considerations may justify the use of Equations (1) and (3) for determining the variations of the arch temperature which apparently was responsible for the difference in the arch deflections, and they may give confidence in the reliability of the results without a special investigation for combined cantilever and arch action being necessary.

The accompanying table gives the arch elements for various elevations, and also the difference of the arch temperatures as determined by Equations (1) and (3).

(Slide rule accuracy.) The values for T were plotted on Figs. 3 and 5. The remarkably close coincidence between the results obtained by the theoretically exact Eq. (1) and by the approximate Formula (3) is well illustrated by the lines of Figs. 3 and 5. A considerable discrepancy exists only for the lower thick and flat arches of this dam for which the approximate formula probably should not be used if a maximum degree of accuracy is desired.

In the above investigations it was assumed that the variation of the arch temperature occurred uniformly over the whole cross-section and along the entire length of each elementary arch slice. It is obvious, however, that a marked difference may exist at certain times between the temperature of the arches on the water and on the air side respectively. Such differences, of course, could be determined only by careful measurements of the temperature of the dam body itself.

The deflection and temperature curves in Figs. 2, 3, 4 and 5 show clearly the influence of the air temperature near the crest of this dam. At El. 1095 a "knee" occurs both in the deflection as well as in the temperature curves. The construction of the dam had been interrupted during the winter when the dam had reached El. 1095, and concreting was continued only in the following spring. Thus, the arch ring below El. 1095 which had been constructed during the cold season did shrink less than the other arches above or below. Consequently, it took a greater portion of the load when the arch came under pressure and some load was transferred by shear and vertical beam action to this portion both from above and below. This load distribution may have been changed somewhat by a variation of the temperature conditions, and this probably accounts for the irregularity of the temperature curves. At the same time this phenomenon illustrates the necessity of co-ordinating design and construction of such a dam.

From the table and the curves of Figs. 3 and 5, it is seen that the average temperature of the body of the Salmon Creek Dam varied for about 15 deg. to 25 deg. near the crest and for approximately half this amount near the base. Of course, it cannot be assumed that the deflections were measured at the seasonal maximum and minimum which for this dam occur probably in August and February, respectively. Those figures nevertheless indicate the large variations of temperature which may occur in slender arch dams.

For the sake of comparison between theoretical and actual deflections, the arch deflection curves resulting from water pressure alone, are shown in Figs. 2 and 4. These deflections were calculated by Professor Cain's exact and the writer's approximate deflection formulas for water pressure. These formulas may be found in the papers referred to previously.

Conclusions—The investigations published in this article with regard to temperature changes in arch dams were made less for the purpose of illustrating the conditions of the Salmon Creek Dam, than with the aim of inducing engineers to measure the deflections of existing arch dams more frequently and more systematically than has been done in the past. The formulas given (and others published in the papers referred to elsewhere) may further be used as simple but very powerful instruments for determining by observations the effect of certain still somewhat obscure actions, such as shrinkage, swelling, flow of concrete, ice pressure, etc., in dams under various load and temperature conditions.

The deflection of an arch dam may in the main part be due to the following reasons: Water pressure; cantilever action; change of temperature; shrinkage of concrete; swelling; "flow" of concrete; lateral expansion (Poisson's ratio); ice pressure; etc. In many cases it may be possible to predetermine, measure or keep constant all the unknown quantities except one, and then measure the deflections and calculate the size of the unknown factor.

Such an example has been given for the Salmon Creek Dam with regard to temperature, and for future investigations, such calculations might be supplemented by measuring the air and water temperatures at various depths and comparing with the calculated arch temperatures. Ice pressure could be determined similarly if the water pressure is kept constant and the arch temperature is either measured or estimated, for instance by comparing with observations made previously.

Shrinkage of the concrete may be determined either by measuring and adding all the visible cracks, or by observing the deflections when the dam comes under pressure for the first time and at the instant when all the visible shrinkage cracks are being closed.

Flow of concrete might be detected by measuring the increase of the arch deflections, when load and arch temperature are being kept constant, etc. Ultimately, it may even be possible to get also some information with regard to the modulus of elasticity of large dams.

It is not claimed that all of the above-mentioned unknown quantities are capable of determination within close limits of accuracy. Some of them, such as temperature and coefficient of expansion, cantilever action, shrinkage, flow of concrete and ice pressure will probably in time be brought fairly well under control. Some others may defy all attempts or possibly be found of such small influence that they may be either combined, or neglected all together. In any case, it will require long series of very accurate observations covering a wide range of conditions in order to crystallize out some final and reliable results.

Thus, there offers itself to hydraulic engineers a most interesting and fascinating field of activity, and it is to be hoped that members of the profession who have the opportunity to make deflection measurements of arch dams will avail themselves extensively of the opportunity to enlighten our present limited knowledge on this subject and thus to help for future progress to be made in arch dam design.

Suit for Damage to Bridge Pier by Blasting

The Supreme Court has decided that the Keokuk & Hamilton Bridge Co. is entitled to only nominal damages for injury to a protection pier of its bridge over the Mississippi River due to blasting by the government in channel work. The lower courts were sustained by the decision. It was held by the lower courts that the damage to the pier could have been repaired for $1,000. Instead of repairing the pier, however, the bridge company decided to rebuild the bridge to stand heavier traffic and brought suit against the government, alleging that the pier had been destroyed and in that way had been taken by the United States. This contention was not upheld by any of the courts.

Urges Co-operation Between Railroads and Motor Trucks

Railroad Executive Seeks Solution of Terminal and Branch-Line Problems in Joint Motor-Truck Delivery and Short-Haul Service

By W. H. Lyford
Vice-President, the Chicago & Eastern Illinois Ry., Chicago, Ill.

In an address delivered before the second national conference on education for highway engineering and highway transport, held in Washington, D. C., on Oct. 28, 1922, W. H. Lyford, vice-president of the Chicago & Eastern Illinois Railway Co., analyzed the present freight transportation problem of the country and outlined some of the methods by which he believes they will be solved. Mr. Lyford stressed the inadequacy of terminal facilities and the resulting inefficient use of railroad equipment, and developed his ideas with regard to more effective collection and delivery and a more economical allocation of freight traffic to railroad and highway carriers. The following is an abstract of Mr. Lyford's address.—Editor.

In this discussion the term "complete transportation" will be used to describe the handling of goods all the way from the premises of the shipper to those of the consignee. The term "trader" will apply both to shipper and to consignee. The trader is concerned only with complete and trustworthy transportation available at a cost that will be low enough to avert the danger of curtailing his trade. Charges, therefore, must be as low as is consistent with the maintenance of adequate, regular and prompt service.

Complete transportation cannot be furnished regularly and promptly, however, unless the charges of the carriers are high enough to pay all the expenses of carriage plus a profit sufficient to warrant the investment of capital and energy to install the service and to keep it abreast of increasing traffic demands. In normal times, the volume of freight traffic in this country increases at a rate of not less than 6 per cent per year.

Classes of Transportation—Transportation of goods falls into four general classes: Parcel post, express, less-than-carload or package freight (commonly called l.c.l.), and carload freight. The essential difference between carload and l.c.l. freight is that the former is loaded and unloaded on an industry track or a team track at the expense of the trader, while l.c.l. freight is loaded and unloaded and passed through a station at the expense of the railway. Carload rates, therefore, are substantially less per ton than l.c.l. rates for carrying the same goods.

Collection and Delivery—In all these classes the railway actually performs the entire transportation service except the movement between the premises of the traders and the stations of the railway company. As the collection and delivery of freight must be performed at the expense of the trader, industries have been located as closely as possible to railway stations, which practice results in congested districts at such points. In a large city, a distance of two miles between two locations for a station may make a difference of 300 per cent in the interest charges on the necessary real estate. In Chicago, for example, the interest charge alone on real estate at 12th St., on which a freight station is located, is more than $2.50 per ton of freight handled through the station. If the station were located at 33rd St., such interest charge would be reduced to about 80c. per ton. The amount of interest saved by moving this station would pay the cost of well organized cartage between the 33rd St. station and the premises of the trader.

Under present operation, outbound freight is brought to the stations by whatever method and at whatever time the traders choose. Inbound freight is removed from the station in like manner on an average of about three days after its arrival. This necessitates using the railway station for storage, which would be unnecessary if collection and delivery service were controlled by or operated in co-operation with the railway. In this case a narrow roofed platform having tracks on one side and a highway on the other would meet every need. The function of railroads is to furnish transportation, not storage, which rarely is profitable to the company and seriously interferes with its legitimate functions.

With few exceptions, freight stations in large cities are now so congested that unless more traffic can be passed through them or, by extravagant expenditures, they can be enlarged or multiplied, the roads will be unable to handle the normal increase in freight traffic.

The Railway and the Highway—Complete transportation of goods by either highway or railway alone can be furnished only in limited fields. Although most industries and residences are connected with each other by highways, such transportation is economical only when limited to a distance, placed by competent truck experts as anywhere between 25 and 150 miles. Under emergency, longer hauls may be justified for highway traffic, but these are negligible in considering the whole field.

On the other hand, comparatively few industries and practically no residences are connected with each other by railways. The field for complete transportation of goods by railway is restricted therefore to the movement of carload freight between industries having direct rail connections. An example of this is the movement of coal from a mine to an industry located on a side track.

Competition—In this country, parcel post, the express company, the railway, and the trucker all are competing for the transportation of the same goods. Although the parcel post and express are transported over railways, the government and the express company compete with each other and with the railway for the carriage of packages weighing 70 lb. or less; and the trucker competes with the other three agencies.

Competition for the local carriage of goods within city and suburban areas should be welcomed by the railways as they perform this service at an actual loss while the trucker can do it at a profit. On the other hand, competition with the railway for the carriage of goods to rural districts along main lines of railways is harmful to the railway and unprofitable to the trucker.

Co-operation—With the parcel post there is complete co-operation between railways and highway transportation as the government has its own cartage system. The same is true for the express company. For freight traffic, however, there is hardly any co-operation between the railways and the motor truck. Unless there is a radical change from present practice in railway transportation in the United States, our transportation system will become a hindrance to the development of this country.

Five years ago when the railway system was placed under federal control its progress was halted and it has never regained its stride. Development has not kept pace with industrial development, as net revenues have not been sufficient to attract the capital needed to finance normal additions and betterments to road and equipment. Although existing rates are not high enough to produce the net operating income to which the Interstate Commerce Commission has determined the railways are entitled, the tendency is to reduce rates with no reasonable hope of increasing them.

Inadequate Terminal Facilities—The limitation on the

traffic the railroads can move is a matter of terminal facilities. These cannot care for the traffic that could easily be transported over the main lines of the railways. Under existing rates, the line haul of freight would be highly profitable if the revenue were not absorbed by increasing terminal expenses. If the railways are to remain solvent, therefore, and carry the traffic for which transportation is demanded they must find a way: first, to reduce terminal expenses, and second, either to enlarge their terminal facilities or to pass more traffic through the existing facilities.

The Present Evils—This is the most important problem before the American people, and it can be solved only by remedying the following evils: (1) Too low compensation to the railroads for carrying parcel post and express matter on passenger trains; (2) Lack of organized collection and delivery service, making necessary unreasonably large and costly freight terminal facilities and an unreasonably large supply of freight cars; (3) The use of box cars for the transfer of l.c.l. freight between railway stations and large terminal areas (this could be done more economically by trucks, releasing thousands of box cars from unprofitable service and substantially increasing the carrying capacity of the railways); (4) The use of box cars as trap-cars for moving l.c.l. freight through terminal areas for industries that have rail connections and the absorption by the railways of trap-car, subway, and lighterage expenses, which is equivalent to furnishing free cartage to the favored few large traders in discrimination against the average trader who is obliged to provide his own cartage; (5) The operation of branch lines on which the traffic is too light to sustain railway transportation and which could be better served at less expense by the motor truck.

Advantages of Co-operation—The most important field for co-operation between the railway and the truck is the collection and delivery of l.c.l. freight in large cities. Comparatively few trucks are now used, first, because there is no co-operation between the truckers, and second, because there is no co-operation between the truckers and the railways. Under present conditions the delay through handling freight at railway terminals makes the use of motor trucks unprofitable, so most of the service is performed by horse-drawn vehicles. Trucks are profitable only when they can be kept moving most of the time. No single road, moreover, handles freight to and from every part of a large city in sufficient volume to make profitable its collection and delivery by a trucking organization. The combined l.c.l. freight of all the railways in a city, however, could be collected and delivered by a properly equipped trucking organization at less cost than now paid by the traders for cartage and still yield a profit to the trucking company.

In the principal cities of Canada the railways handle collection and delivery under separate cartage tariffs and the president of one of the largest of them has stated that his railway could not possibly handle its traffic through present terminal facilities without this service.

In the United Kingdom the railways handle collection and delivery at practically all their stations. The chief executives of several British railways have expressed the following conclusions: First, that in terminal cities and large industrial centers the collection and delivery of freight by a single trucking organization is absolutely essential to the most efficient operation of freight stations, and that with the co-operation of such a trucking organization, the railway company may control the time of collection and delivery of freight. It is enabled thereby to operate its stations throughout the 24-hr. day if necessary and to use the same platforms and forces for handling inbound and outbound freight. Second, that collection and delivery can be furnished under a separate tariff at rates high enough to produce an actual profit from the cartage operations after paying all expenses, and low enough to induce 95 per cent of the traders to use the organized collection and delivery service, rather than perform it themselves. Third, that in England, where the general conditions are substantially like those in New England, the railways and the traders have prospered under unified cartage systems without any substantial additions to station facilities.

American and British Systems Contrasted—Contrast the operations of a large terminal freight station in the United States with a typical British station. In this country inbound freight is handled over one set of platforms by one working force and outbound freight over another set by another working force. Each of these is operated through the entire business day. The inbound platform is piled with freight awaiting delivery, interfering with the movement of freight across the platform. When the inbound cars are unloaded they must be pulled out of the station and set into the outbound station for loading the following day.

In a typical British station the same platforms are used for handling not only the inbound and outbound traffic, but also a third class of traffic, and they are operated throughout the entire 24-hr. day. When the day force goes on at 8 a.m. cars loaded with inbound freight stand on one side of the platform and a line of trucks or "lorries" is backed up at the other side. The city is divided into districts and the freight for each district is loaded into one or more lorries, there being more of these at the platform than there are districts. When a lorry is fully loaded a driver is summoned by telephone from a nearby stable. He brings a heavy Clydesdale horse and drives away with a three-ton load to the proper district where he makes delivery. An empty lorry is backed in the place of the one that has left, which in turn is loaded and driven away.

Before noon all inbound freight has been removed from the cars and delivered. At 1 p.m. the station platform is clear and ready to receive outbound freight, which is collected and delivered by the same drivers who deliver the inbound freight in the morning. Before 5 p.m. all outbound freight is collected, loaded into cars, and dispatched before midnight. The platform is then clear and ready to receive the heavy fish and vegetable traffic which begins to arrive at 1 a.m. and is delivered to the market before 6 a.m. At 8 a.m. the platform is again clear and waiting for inbound merchandise.

In this country demountable truck bodies or trailers doubtless would be used instead of the British lorries, and tractors would be substituted for the horses. On our platforms we doubtless would use four-wheel trailer trucks drawn by electric tractors, instead of the two-wheel trucks used in Great Britain. With American methods applied to the British system of collection and delivery, much greater efficiency would be obtained and better service would be rendered than is now rendered there. In London, three of the great English railways have combined their collection and delivery service with satisfactory results, the manager of the combined service declaring that if all the roads reaching London would join in the combination even greater economies could be effected.

The average railway manager in this country fears to encourage the establishment of this service because of the danger that the railway will be required to pay its cost, and thereby increase terminal expenses. This service should not be forced upon the trader but rather be offered to him under a separate cartage tariff at rates that would be less than present cartage expense.

Collection and Delivery of Carload Freight—A second field for co-operation between the motor truck and the railway is the organized delivery of carload freight from public team-tracks in large terminal areas. This freight is now handled at the expense of the trader, who is allowed from two to five days within which to unload cars after he has received notice that they are ready.

Generally speaking, there is a shortage of team tracks in the central districts of large cities and it is next to impossible to build more. Cars must be held in the outer yards until there is room for them and then they must be held on the team track until it is convenient for the trader to unload them. This means that large terminal districts are full of idle cars, and the average time that box cars are delayed at the Port of New York and in the switching district of Chicago is ten days per trip. If all cars that carry loads into New York, Chicago and other large terminal areas could be unloaded and loaded out on the day of their arrival or on the following day, the present freight-car

equipment of the railways would be sufficient to meet all transportation needs for several years to come. Competition between railways in according privileges to traders has crippled freight-car supply and thereby has injured the trader more than he is benefited by the allowance of an unreasonable unloading time.

A new system of delivering carload freight must be adopted, and it will require the co-operation of railways, truckers, traders, warehouse men, Interstate Commerce Commission, and state utilities commissions. Free time for holding loaded and empty cars for the convenience of traders should be modified to insure unloading of cars within 24 hr. after they are ready and loading within 24 hr. after they are placed. This would deprive the trader of a substantial amount of free storage and require him to pay warehouse charges on inbound freight that he is unable to receive on the day of its arrival. These disadvantages, however, could be to some extent offset by cheaper cartage furnished by an organized collection and delivery service, and the warehouse charges might be reduced substantially by co-operation between railways, truckers, and warehouse men. The average time required by a freight car in carload freight service to make a round trip is about 20 days. Of that time, the car is actually moving in line haul, loaded or empty, only 2.2 days, and it is actually earning revenue only 1.5 days.

Branch-Line Service—Another field for profitable use of the motor truck is transportation of freight between communities served by branch lines of railways on which traffic is too light to pay expenses. These lines were built before motor transportation was perfected. They have performed a necessary public service but have outlived their usefulness as the transportation can now be performed better and more cheaply on the public highways. In several cases in which railways have contemplated branch lines, they found they could better afford to establish their own truck service, and the proposed branches have not been built. All such losing branch lines along which transportation by truck over existing highways could be furnished at less expense should be abandoned, and better and less expensive truck service substituted by the railway company if the truckers will not occupy the field.

Who Will Benefit?—Five parties are interested in these changes: The general public would be benefited in that the city streets would be relieved from the congestion caused by wagons and trucks carrying small lots of freight to and from the railway stations. The new rural highways would last longer as the co-operation of railway and truck would put an end to long-distance trucking. The trader would get better service at less cost. The motor-truck industry and the truckers who would co-operate with the railways would increase their field for profitable operation. The warehousemen would profit by the addition of the storage now furnished by railways. Railways would cut down terminal expenses and increase capacity for service.

The trucker has an advantage over the railway in that highways are constructed by the general public through taxation, while the railway is constructed at the private expense of the railroad company. In the early history of the country public lands and moneys were contributed to a few railway companies to promote the building of railways, but such donations have long since been repaid by the enhancement in the value of taxable property resulting from the operation of the railroad.

The railroad pays through taxation a large share of the cost of building and maintaining highways, while truckers pay no part of the cost of building and maintaining railways. If the trucker is to compete with railways, either he should pay a substantial part of the cost of constructing and maintaining highways, or the railway should be relieved of taxation for highway purposes.

If, however, the trucker would take over that part of transportation now performed by the railway at an operating loss, on which he could make a reasonable profit; and, second, would cease to compete with the railway for the traffic that the railway can carry at a profit, on which the profit to the trucker is very doubtful; and third, would co-operate with the railway in handling traffic which requires transportation both by rail and highway—in other words, if the truck would supplement the railway service instead of competing with it, it would be to the interest of the railway that the expenses of the trucker should be reduced to the lowest limit. Then the railway could well afford to pay substantial taxes for highway purposes and offer no objection to the free use of the highway by the trucker.

There is a steady growth of public sentiment in favor of imposing upon the trucker a more substantial part of highway expense, which, it is said, is caused by heavy trucks. If the public is satisfied that the truck is used only where a railway could not furnish so good a service, the public would cease demanding that greater burdens be placed upon the trucker.

Diversity of Problems—No scheme of operation will fit all terminal situations. The New York situation demands the use of motor trucks with demountable bodies or trailers to move the freight by way of ferries and city streets between railway terminals on the New Jersey shore and inland, offtrack stations in the various industrial centers of New York. By the use of ferry boats and inland offtrack stations, instead of freight cars on car floats, the railroad would be able to release large holdings of valuable dock property for the docking of ocean steamships. The inland stations could be constructed on less valuable property, and if used jointly by all railways and steamship companies would offer possibilities of joint warehouses and industrial buildings.

Real estate men are ready to undertake to secure sites for such stations in all parts of New York and to construct thereon buildings in which the first floor would be adapted for railway stations. They would be willing to guarantee that the station floors would be leased permanently to the railway companies at nominal rentals, on condition that the occupants of the upper floors might have access by elevators to the station floor for the receipt and delivery of freight without expense for cartage. An organized truck service would substantially reduce the traffic now passing through the streets of New York and the cost would be much less than the cost of the present car-float operations.

The Chicago situation is more complex. The distances are so great and the railway systems so completely cover the city that railways must supplement the truck service for long-distance movement.

In Cincinnati an organized truck service is in operation to handle most of the transferring of freight between the city stations of all the railroads centering there. All stations are equipped with machinery for handling loaded and empty five-ton demountable truck bodies, which are loaded and unloaded on the station platforms and moved on chassis under the control of a dispatcher. This station-to-station service could easily be extended through the industries and some of the largest traders in Cincinnati have requested such service.

At St. Louis, organized motor-truck service with trailers and semi-trailers has long been in operation between the freight stations at East St. Louis and inland stations in St. Louis. This service conforms closely to that outlined for New York, except that the trucks cross the river on bridges instead of ferries.

At St. Paul and Minneapolis, the Great Northern and Northern Pacific Rys. for many years have used large box cars at freight stations for outbound l.c.l. freight in different parts of both cities. When the cars are loaded they are switched to a common transfer station about half-way between the Twin Cities where the freight is transferred from the station cars to line cars for any destination on either railroad.

The Chicago, Milwaukee & St. Paul Ry. uses a similar service in the Twin Cities. The president of that road has said that by substituting that service for the separate stations previously used in each city, his company had been able to move its increasing freight traffic with 40 per cent less cars than were previously required for movement from separate stations in each city.

In each city there is a practical solution which, with the

full co-operation of railways and trucks, would result in the movement of freight through the city stations more promptly and thus enable the railway to furnish much more transportation service without increase of facilities and without increasing transportation charges.

Summary—Trucks should supplement the railways and not compete with them. Wherever complete transportation can be furnished by the truck more efficiently and cheaply than by the railway, the truck should be used. Wherever the railway service is adequate and profitable and less expensive than truck service, the railway should perform the service. Where the best and cheapest service can be furnished profitably by the railroad and truck combined, the railway and the trucker should co-operate in furnishing that service. The railway and the truck should keep out of each other's special territory and less expensive service.

Concrete Alley Paving Practice in Milwaukee

Rich Dry Mixture Required—All Aggregate Passes a One-Inch Ring—Tamped Surface Finished With Dry Mortar Floated In

CONCRETE pavement for alleys has been developed by superior construction to a high degree of serviceability, at a moderate cost, by the Milwaukee Department of Public Works. In 1921 pavement of the section shown by Fig. 1, and of 1:2:3 concrete, was laid at an average price, for 147 blocks, of $1.80 a square yard. This price includes a longitudinal joint, with a bituminous filler; transverse joints, with filler, at least every 25 ft., and joints, with filler, where the sides come against masonry building walls or where telephone poles or similar obstacles have to be encircled by the concrete. With a moderate demand at first, householders are now putting in applications for alley pavements more than twice as fast as the bureau of streets can construct them.

A high quality of construction has been laid down as the first requirement. In no respect are the engineers of the department or the contractors who do the work permitted to consider alley concreting as second-class paving. Indeed, the specifications for materials and workmanship are quite as exacting as for concrete pavements for main-traffic streets. A three-year guarantee is demanded of the contractor against defects due to improper materials or inferior workmanship. Only the best sand and coarse aggregate are allowed, the consistency is rigidly controlled and the rules for finishing are precise and exacting.

As shown by Fig. 1 the pavement slab is dished transversely and is separated longitudinally by a filled joint along the center line. Instead of a uniformly thick slab, which is the more general practice, the two halves of

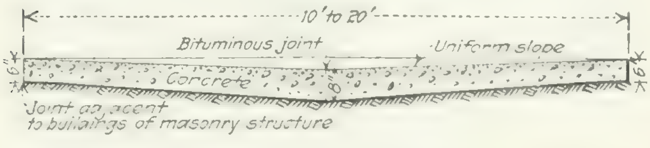


FIG. 1—SECTION OF CONCRETE PAVEMENT FOR ALLEYS, MILWAUKEE, WIS.

the slab taper from 8 in. at the center joint to 6 in. at the edges. This is a heavier pavement than is common for alleys where usually the traffic is light and the speed of vehicles is slow. With the rather poor soil and not very good subsoil drainage in Milwaukee, this heavier

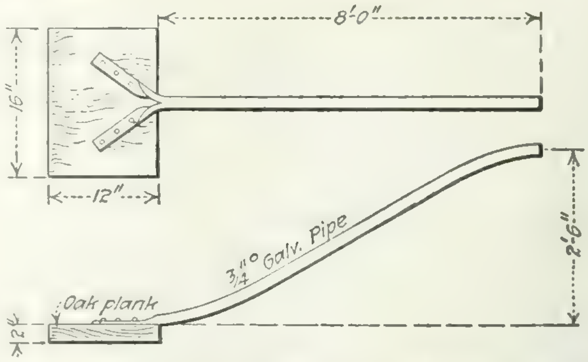


FIG. 2—FLOAT FOR WORKING DRY MORTAR INTO SURFACE

pavement was considered wise. Besides the longitudinal center joint there are transverse joints every 25 ft., and, as stated, a joint filler is used where the pavement abuts building walls or where manhole tops, poles or other structures project through the pavement.

Alley pavements are 10, 15 and 20 ft. wide in Milwaukee, which, with the joint arrangement indicated, give a structure of rather small, separate slabs and a correspondingly large latitude for expansion. Cracking has not been entirely avoided by this construction but on the whole there are very few cracks of serious characteristics. The required thickness of joints is ½ in. The transverse joints are fiber matrix and bitumen and the longitudinal joints are either the same construction or a bitumen filler which will not flow in hot weather or become brittle in winter.

A rich, dry mixture, with small-size and an especially clean, well-graded aggregate is insisted upon. A coarse washed sand is used and if the coarse aggregate is gravel it has to be washed and screened. All aggregate must pass a 1-in. round ring and no more than 5 per cent of the coarse aggregate may pass a quarter-inch screen. A one-minute mix is required and a dry mixture is absolutely demanded, one that requires vigorous tamping to bring the water to the surface.

In placing the pavement, the subgrade is brought to the exact profile shown by Fig. 1 and when any fill is required it is rolled with a 10-ton roller or tamped with a 50-lb. tamper having a face not exceeding 100 sq.in. The concrete is placed between a center and side forms and surfaced, with a strike-board, one side at a time, using the forms as guides. A finishing operation follows which is a special feature of practice in Milwaukee.

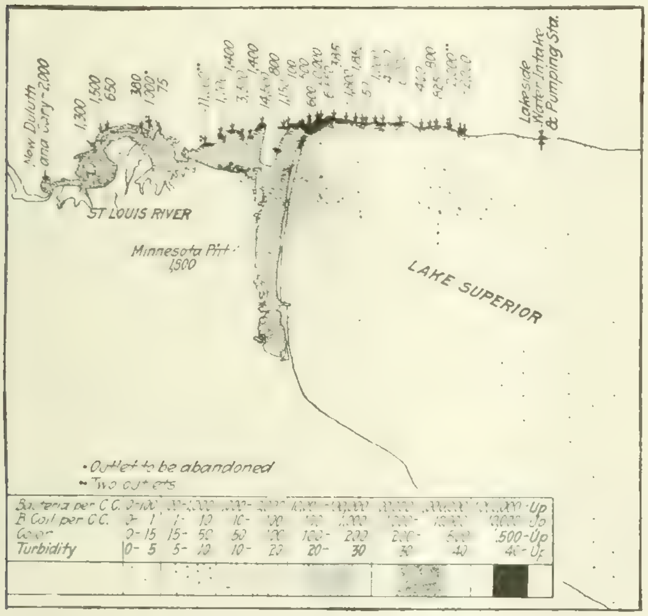
When the slab has been brought to the proper contour with the strike-board, it is tamped, using a 12 x 16 x 2-in. wooden tamper with a 1½-in., 4½-ft. handle. The tamping is continued until the water is flushed to the surface. Then a 1:1 mixture of cement and sand—all passing a No. 8 screen—is evenly spread over the surface in an amount sufficient to absorb the water. This surfacing is then floated, with floats constructed as shown by Fig. 2, until the dry mortar is thoroughly incorporated with the concrete. At least one sack of cement is used for each 30 sq.yd. of surface. If this does not absorb the water, another coat is applied.

Altogether the surface is gone over five times with the float, until at the last floating the mortar top is pasty and adhesive and is slightly drawn along with the float.

Filters for Duluth Water Supply Considered Unnecessary

Intensive Investigation by State Board of Health Engineers Indicates Filtration Not Warranted at Present

FOR nearly two years sanitary engineers and water analysts of the Minnesota State Board of Health have been investigating the water supply of Duluth, Minn. The principal fact to be determined was whether chlorinated water from Lake Superior 1,500 ft. off shore in 60 ft. of water and 8½ miles from the center of the main business section is safe or whether it would be advisable to install filters, to improve storage or distribution methods or to make changes in the treatment or disposal of the sewage. While definitely stating that it is not against filters the board goes on record with the statement that the expense is not now warranted.



RESULTS OF DULUTH WATER AND SEWAGE SURVEY

Figures at the top show the position of sewer outlets and the tributary population. In the table at the bottom is indicated the amount and character of contamination.

The board has been watching the supply for 12 years and several recommendations for improvement have been made. A hypochlorite plant installed at the board's request in 1912 was replaced by liquid chlorine in 1916. A city laboratory was established in 1921 but analyses have been carried on since 1912 in the branch laboratory of the state. The Edison reservoir is being covered to prevent dust contamination. Emergency intakes and cross-connections with other sources have been eliminated.

The present survey consisted in sampling the water from selected points 2 miles apart in the western end of Lake Superior and from the St. Louis River to determine the extent of the pollution from sewers. Sanitary conditions at the various sewer outlets were also investigated. The accompanying map shows the extent of indications of contamination. Analytical data of raw and chlorine-treated water at the Lakewood pumping station show conclusively, states the board, that indications of contamination are removed and that the water comes within the limits fixed by the U. S. Treasury Department. Filtration would only reduce the normally low turbidity to zero.

No very definite conclusions as to the permissible nearness of the sewer outlets to the intake are established by the board but the statement is made that the city would be acting on the side of safety to permit no sewer outlets within 3 miles of the intake. Other definite recommendations rising out of the survey are as follows: Watertight covers for reservoirs; a traveling, self-cleaning screen for the intake well; transportation for the bacteriologist to permit him to investigate all parts of the system; a temporary auxiliary chlorine plant until the only one of the reservoirs uncovered is covered; investigations to be continued indefinitely; disinfection of new mains; separation of parallel water mains and sewers by at least 6 ft. of compact earth; extension of 15 sewer outlets immediately and 9 soon (the remaining 13 are satisfactory). The work was carried out under the general direction of H. A. Whittaker, director, Minnesota State Board of Health, by J. A. Childs, engineer.

Court Denies City's Right To Condemn Power Source of Another City

A DECISION handed down in California Nov. 6 by the United States Circuit Court of Appeals establishes a precedent that will have an important bearing on future legal conflicts over water or power sites between two municipalities or between a municipality and a privately owned public utility. The suit was brought by the City of Los Angeles which sought to condemn for its own uses a power site on Owens River already partially developed by the Southern Sierras Power Co. and used for supplying power to communities in the southeastern part of the state. This company does not serve Los Angeles, nor do its transmission lines pass nearer than sixty miles from the borders of the county.

The decision was written by Judge William W. Morrow and reverses a decision of the United States District Court rendered in July, 1921, by Judge William C. Van Fleet. The lower court held that the City of Los Angeles had a superior interest in a power site comprising 320 acres and extending a mile along the river in that portion known as the Owens River Gorge and had fixed the condemnation price at $525,000.

In reversing the lower court the Circuit Court held that "property of a private corporation appropriated to the public use in one county may not be appropriated to a public use by any other county or city and county while such property is so appropriated and used." The decision stated, further, "the question we have to determine is not whether the City of Los Angeles has the right to condemn the property of a private corporation appropriated to a public use in the service of the City of Los Angeles and its inhabitants, but whether the City of Los Angeles has the right to condemn the property of a private corporation appropriated to the public use of some other county, municipality, incorporated city and town and inhabitants thereof."

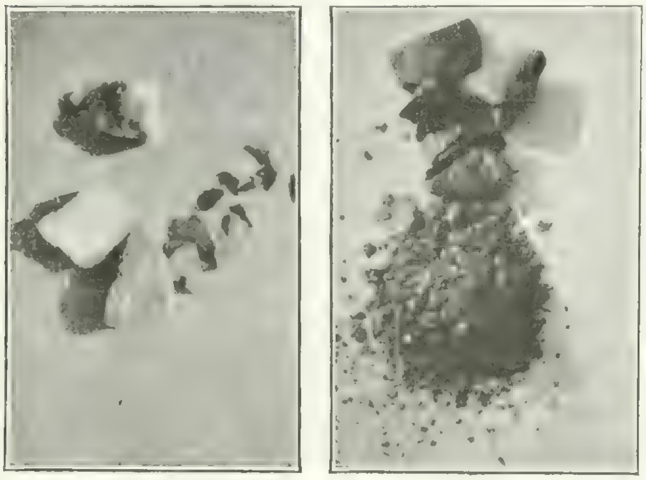
The decision of the higher court fully upheld the contention of the Southern Sierras Power Co. that the needs of six counties and numerous cities and towns throughout the southeastern portion of the state, served by this company, are equally as important as the needs of Los Angeles.

Testing Sprinkling Filter Stone by Freezing and Thawing

Limestones Practically All Disintegrated Rapidly After 34 Alterations in Temperature —Granite Unharmed

INVESTIGATIONS on the durability of stone available for use in the sewage sprinkling filters now under construction at Lincoln, Neb., have been made by alternately freezing and thawing the material. An attempt was made to approximate conditions to which the stone in the filters would be subjected. Samples after a thorough soaking in water were placed in a cold storage house where a temperature of 8 deg. F. was maintained. Every morning the stone was thawed out with warm water, then cooled down with cold water and returned to the cold room. The samples were alternately frozen and thawed 34 times. The following results were obtained:

A sample of stone from one quarry at Louisville, Neb., was dark blue in color and somewhat porous



STONE FROM QUARRY NO. 1, LOUISVILLE, NEB., BEFORE AND AFTER FREEZING AND THAWING

in appearance. It was broken to such a size that all pieces would be retained on a ¾-in. screen. At the conclusion of the test 56 per cent was retained by a ¾-in. mesh; 19 per cent was retained on a 4-mesh screen and 25 per cent passed a 4-mesh screen. Had the test been carried on further probably all of the stone would ultimately have disintegrated almost to a powder.

From a second quarry near the one noted above, at Louisville, Neb., a pure white stone, not overly porous, is obtained. The sample could be considered an average or above average one as regards the entire face of the quarry. This is the same stone which was used in the sprinkling filters at Broken Bow, Neb., and at Harvard, Neb. The stone was broken to such a size that it was retained on a 1½-in. mesh screen. At the conclusion of the test the stone had disintegrated so that only 27 per cent was retained on a ½-in. mesh screen, 25½ per cent passed a 1½-in. mesh screen and was retained on a ¾-in. mesh screen, 36.1 per cent passed a ¾-in. mesh screen and was retained on a 4-mesh screen and 11.4 per cent passed a 4-mesh screen. This stone would undoubtedly have continued to go to pieces if the test had been carried out for a longer time.

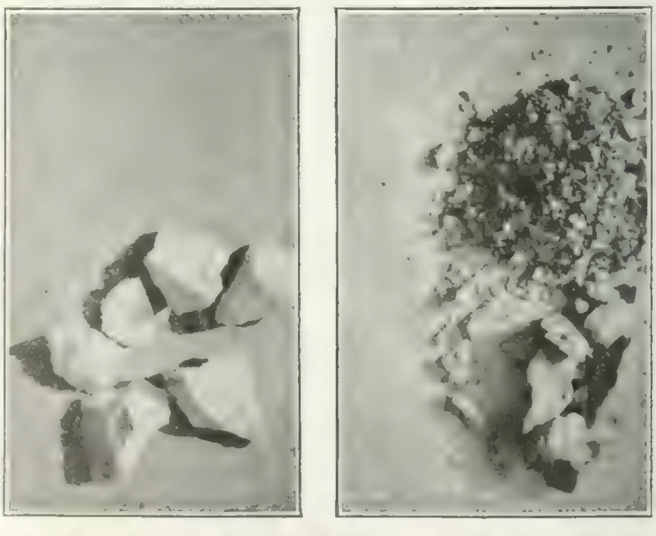
The method used in testing these stones is shown to be a fair one by an examination of the stone in the filters at Broken Bow and at Harvard. Each of these filters has been subjected to exposure for two winters. The stone is badly disintegrated and will undoubtedly need replacing within the next few years. The stone is splitting apart exactly as occurred in the tests under discussion. The filter at Harvard shows identically the same condition as exists at Broken Bow.

The sample from a quarry near Weeping Water was obtained from the upper ledge, having a thickness of about 9 ft. The stone was broken to such sizes that 52 per cent would pass a 5-in. mesh screen and be retained on a 3-in. mesh screen. About 30 per cent would pass a 3-in. and be retained on a 1½-in. mesh screen and the balance would pass a 1½-in. mesh screen and be retained on a ¾-in. mesh screen. After the test 52 per cent would pass a 5-in. mesh screen and be retained on a 3-in. mesh screen, 28.4 per cent would pass a 3-in. mesh screen and be retained on a 1½-in. mesh screen, 15.2 per cent would pass a 1½-in. mesh screen and be retained on a ¾-in. mesh screen, 2.7 per cent would pass a ¾-in. mesh screen and be retained on a 4-mesh screen and the balance or 1.7 would pass a 4-mesh screen.

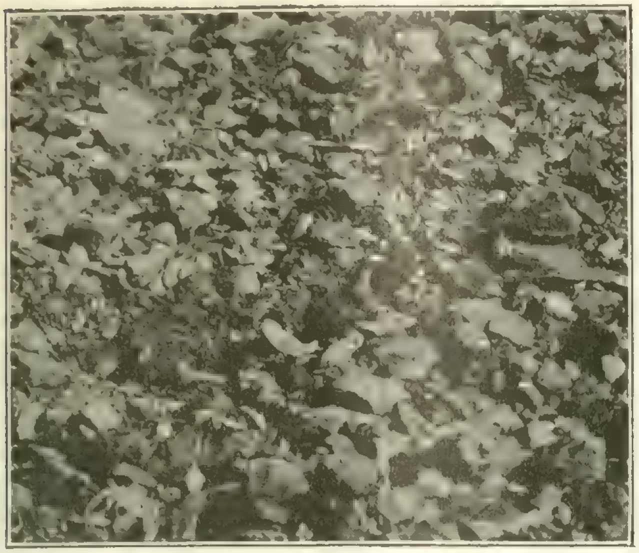
From the above figures it is clearly evident that the Weeping Water stone disintegrated much less than did the ones previously discussed. However, the figures do indicate that there was a loss of 4.4 per cent in the weight of the stone which would pass a ¾-in. mesh screen. The loss seemed to be a gradual chipping off of the surface of all the pieces, while the smaller pieces broke up somewhat by splitting apart, one of the largest stones showed a crack across it which probably would have caused a complete separation if the test had been carried longer.

The gravel from Meadow, Neb., tested was of such a size prior to the test that it was all retained on a 4-mesh screen, but after the test 7½ per cent had so broken up that it passed a 4-mesh screen.

The sample of Sioux Falls (So. Dak,) quartzite had a granite-like structure and seemed to be very dense. It was of such a size that it would all pass a 3-in. mesh screen and be retained on a 1½-in. mesh screen. Upon the completion of the test the stone showed no evidence of any disintegration. Stone of this same type although not from the same quarry was used in a sprinkling filter at Geneva, Neb., where it has been in use for two winters. An inspection of this filter disclosed no change in the appearance or size of the stone.



STONE FROM QUARRY NO. 2, LOUISVILLE, NEB., BEFORE AND AFTER THIRTY-FOUR FREEZES



PARTIALLY DISINTEGRATED STONE IN SPRINKLING FILTER AFTER TWO WINTERS' EXPOSURE

Red sandstone from Lyons, Colo., was used in a filter at Minden, Neb., and an inspection of this filter recently made showed that there is a slight disintegration due to the splitting of the stone along cleavage planes. This indicates that any stone in which cleavage planes are well defined will not stand up under alternate freezing and thawing.

From Ernest Boyce, assistant engineer, Kansas State Board of Health, it was learned that the sprinkling filter stone at Neodosha and Newton was standing up satisfactorily. The Newton rock was secured from a limestone quarry at Moline, Kan. For the Neodosha plant a blue-gray limestone was obtained from the city quarry 2 miles from town. In 20 or more contact beds in Kansas hard limestone and flint rock are the most common materials used and are satisfactory in most cases, but the softer limestones disintegrate somewhat.

Iowa plants use Sioux Falls granite and limestone. The first is approved by the State Board of Health. H. V. Pedersen, civil and sanitary engineer, indicates that it is entirely satisfactory. It is his opinion that cities should be allowed to use limestone if they thoroughly understand that the limestone may need replacing every 10 or 15 years and it is found cheaper to do this than to ship in granite. Limestone in use 6 years at Mason City, the largest plant in the state, shows some disintegration but will last many more years, in the opinion of Mr. Pedersen.

All the trickling filters in South Dakota have used Sioux Falls quartzite according to A. H. Wieters, director of the division of sanitary engineering of the State Board of Health, the quartzite in the Aberdeen filter plant having been in use for 8 years without any indication of disintegration.

It is probable that the Sioux Falls quartzite will be used in this filter inasmuch as climatic conditions in Nebraska are similar to those in North Dakota and Iowa, where the winters are often severe. The plant will be completed next spring ready for the reception of the stone, of which 33,000 tons will be required.

The tests and investigations were made by Grant, Fulton and Letton, engineers, Lincoln, Neb., who are associated with Alvord, Burdick & Howson, engineers, Chicago, in the design and construction of the sewage disposal plant.

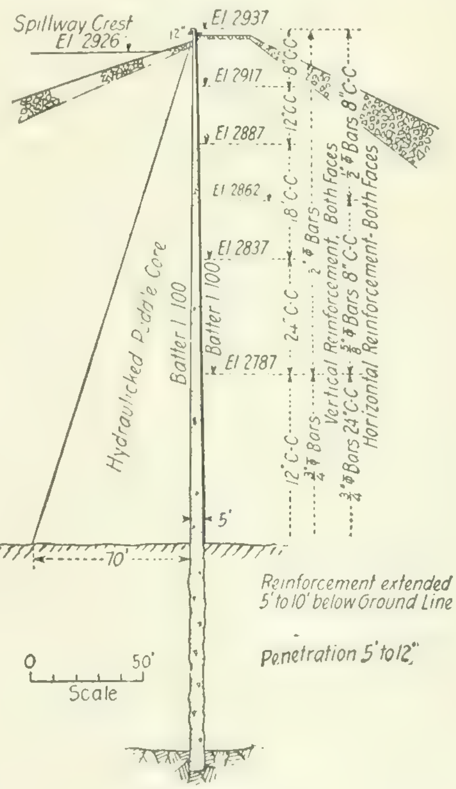
Core Walls for Dams of the U. S. Reclamation Service

Description of Five Core Walls Including a Combined Concrete and Puddle Wall in New 220-Ft. Tieton Dam

Extract from Paper by C. H. Howell, Engineer, U. S. Reclamation Service, Denver, Colo., in the August "Reclamation Record"

THE masonry core walls built by the U. S. Reclamation Service are all of concrete and in general are comparatively thin sections. The highest in service at the present time is in the Strawberry Dam, Strawberry Valley Project, Utah. The maximum section of this wall is shown in the accompanying illustration.

The Tieton Dam, Yakima Project, Washington, now under construction will be the highest earth dam built by the Reclamation Service. It will be an earth-and-rock fill section, approximately 220 ft. high with both a concrete core wall and a hydraulicked puddle core. The puddle core will have a maximum width of 70 ft. at base of dam. It will be placed against the upstream face of the concrete core wall. The concrete portion of the core wall extends to a maximum depth of about 100 ft. below the river bed. In general it will be founded on andesite, although a small portion will rest on shale. A minimum penetration of 5 ft. into both shale and andesite is specified which is to be increased, if necessary, according to the character of the material which may be encountered. Where the foundation is in shale the

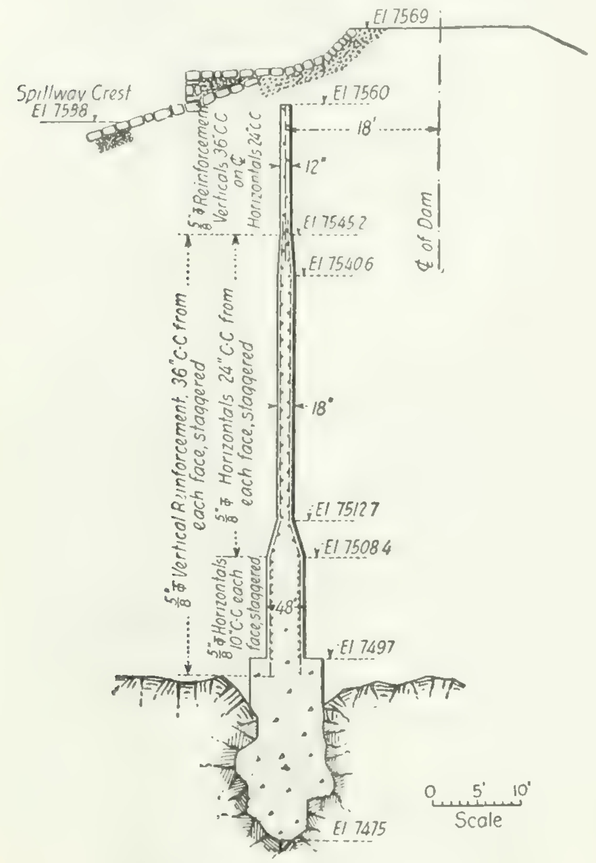


COMBINED CONCRETE AND PUDDLE CORE WALL TIETON DAM

footing will be spread out to limit the pressure due to the weight of the wall itself to 8 tons per square foot. The reinforcing of the spread footing will consist of 20-lb. rails on 12-in. centers. On andesite the maximum thickness will be 5 ft. The design of the maximum section is shown in the drawing.

Only two dams have been constructed by the Reclamation Service with puddle cores in the strict sense of the term and these were constructed by hydraulicking. The Conconully Dam on the Yakima Project was constructed by the

hydraulic method, but as the fill increased in height it was found impossible to secure a central impervious portion of sufficient thickness due to the decreasing percentage of fines and the narrowness of the pond. Loam therefore was borrowed from the valley floor and then sluiced into place between wooden forms which were placed to prevent strata of sand being washed in from the other material. This puddle core is 8 ft. thick at its base 14 ft. above the base of the dam; the thickness at its top is 5 ft. In section this core is not vertical, but slopes upstream about 30 ft. from



MAXIMUM SECTION CORE WALL STRAWBERRY DAM

its top, which is under the upstream edge of the crown. Its vertical height is about 40 feet.

The Bumping Lake Dam was built by hauling the material on to the dam, then separating and consolidating it by hydraulicking, the fines being sluiced toward the center to form a puddle core. The puddle was built by this method up to about spillway level, a distance of 50 ft. from the bottom.

At this elevation similar difficulties in the hydraulic method developed as on the Conconcully Dam and the remainder of the puddle material was dumped and worked by shovels. The maximum height of the Bumping Lake core is about 60 ft. The horizontal dimensions are variable; in the hydraulicked portion they range from 20 ft. near the bottom to 2 ft. at the spillway elevation. The portion placed by hand averages 4 ft. thick.

The core walls and puddle cores constructed by the Reclamation Service have proved adequately tight, and so far no trouble due to saturation has developed in the upstream portions of the dams in which they are built. Somewhat extended reading indicates that the above is generally true of other well designed and constructed dams. Both types have been in service for years and doubtless will continue to be used in the future, offering practical and economical solutions when more theoretically correct sections are not feasible.

A most unusual core was built in the Sherburne Lakes Dam by the Reclamation Service as a part of the drainage system of the dam. This drain consists of a core of screened gravel, 5 ft. thick at the top, 10 ft. thick at the bottom and about 83 ft high, with side slopes of 3:100. This core is placed approximately under the downstream edge of the crown and extends the full length and height of the dam. The most impervious material in the dam is placed above the core and the coarser below. A cast-iron pipe with open joints is laid in the bottom of the core and connects with transverse discharge drains, which lead back into the stream. This construction thus far has proved satisfactory, although it has not yet been thoroughly tested, having been subjected to a head of only 45 ft. while the design is for 68 feet.

New Standards for Municipal Employment

Abstract of a report submitted to the National Municipal League on Nov. 22 by its Committee on New Standards of Municipal Employment, W. E. Mosher, secretary.

THE chief recommendation of the committee is that there should be centralized employment supervision and control in the public service and that the civil service commission is the natural agency to perform this function.

On the ground that co-operation, the basis of sound personnel administration, has not been realized between the responsible officials and the typical civil service commission, and further that it is not likely to be realized under the present system, the committee recommends that the civil service commission itself be reconstituted, as follows:

1. That a single civil service commissioner be appointed with indeterminate tenure of office.
2. That the mayor (or commissioner or city manager) appoint the commissioner from an eligible list of three, which list results from the competitive examination given by a special examining board to candidates qualifying as employment managers.
3. That the examining board consist of three persons, all of whom are experienced in employment management and at least one of whom must have been or be an official of a civil service commission.
4. That one of the members of the examining board shall be named by the mayor, one by the local superintendent of schools and the third by the first two.
5. That the salary of the commissioner be commensurate with the salaries paid other administrative officials performing comparable functions.
6. That the appropriations for the work of the commission be materially increased, so that the commissioner may have a staff qualified to co-operate effectively with the various administrators.
7. That removal shall be possible after the filing of charges and a public hearing before the executive.

The assignment of equal power to the superintendent of schools and the mayor in the appointment of the special board of examiners is due to the conviction that the superintendent of schools is the public official in the municipality who is most unlikely to be swayed by political considerations. It is believed that his co-operation in the matter of appointing the board will generally guarantee that considerable weight will be given to merit in the work of the board. The committee is also of the opinion that an employment specialist selected because of competency and accepted by the officials because of his contributions will probably further the interests of the merit system more than a partially outside body, such as the typical civil service commission, which is bi-partisan in origin, subject to continuous change, and untrained in handling employment problems.

Finally the committee recommends that the civil service commission bring about the appointment of personnel committees, consisting in equal parts of staff representatives and those elected by the rank and file of the employees. It is proposed that these committees should meet with and advise the civil service commissioner in the development of the employment policy and in the improvement of the standards of public service. This recommendation is quite in line with recent developments in private industry, where it has led to a better spirit of co-operation and improved standards of efficiency.

[The full report will appear in "The National Municipal Review," published by the League at 261 Broadway, New York City.—EDITOR]

Progress Being Made in Study of Marine Borers

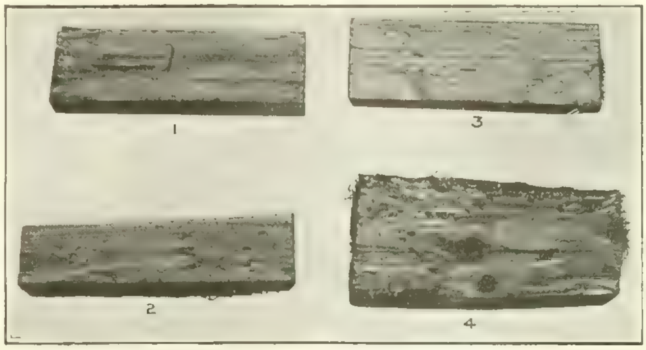
Committee of National Research Council Has Assistance of Government Bureau—Test Blocks Show Wide Prevalence of Borers

GOOD progress is being made by the committee on marine piling investigations of the National Research Council in its study of the marine borer. This committee has received a large proportion of its financial support from the railroads. Perhaps one-third of the voluntary work has been done by the engineering departments of the various roads owning or operating terminals on salt water. However, the federal government is now contributing considerable in the way of observations and investigations of actual conditions. The Coast Guard of the Treasury Department, the Bureau of Yards & Docks and the Bureau of Construction & Repair of the Navy, the Bureau of Lighthouses and Bureau of Fisheries of the Department of Commerce, the Forest Products Laboratory of the Department of Agriculture, and the Corps of Engineers and Quartermaster Corps of the War Department are all now aiding in the work. The Bureau of Yards and Docks, the Corps of Engineers, and the Bureau of Lighthouses have sent out exhaustive questionnaires designed to develop information as to previous experience with marine borers and with various methods of protection against them, as well as with concrete and other substitutes for wood.

Plan of Work—There has been found surprisingly little information as to the species of marine borers existing on the American coasts or the distribution of those that were known to exist or the rapidity with which they work. In order to devise means of protection and to know where the conditions are such as to render borer action probable, a system of test boards accompanied by chemical tests of the water has been designed. The test board contains a number of blocks and is hung overboard at sea-water stations on all coasts of the United States. One block is removed from the board on the first and fifteenth of each month and sent either to Harvard University, the University of California, or the American Museum of Natural History for determination of the species and the rapidity of their growth in various harbors. Of these boards 230 have been made.

The examination of blocks so far removed shows the presence of teredo navalis at Provincetown, Mass., Newport and Providence, R. I., Mystic, New London, South Norwalk, Westport and Guilford, Conn., West Sayville, Fire Island, New York Bay and Jamaica Bay, N. Y., Bayonne, Perth Amboy, Point Pleasant, Barnegat Bay, Beach Haven and Atlantic City, N. J., Norfolk, Va., and San Francisco, Calif. The rate of destruction by this species as shown by the blocks was greatest at Providence, R. I. Next in order of activity are the locations along the north shore of Long Island Sound, and along the New Jersey coast. The accompanying view shows the penetration of one of the blocks at a New Jersey station in less than two months' time.

Limnoria were found in test blocks all the way from York Harbor, Maine, to Mazatlan, Mexico, and in San Francisco. Bankia are present from Barnegat, N. J., clear down to Mazatlan, Mexico, and in San Francisco. Spaeroma have been found at Provincetown, Mass., Tampa Bay, Fla., and Pass Manchao, La. Teredo of species other than navalis have been found in test blocks and specimens in southern stations (Georgia, Florida, Texas, Virgin Islands, Cuba, Hawaii, and also in San Francisco).



RAPID PROGRESSIVE ACTION OF TEREDO IN TEST BLOCK AT POINT PLEASANT, N. J.

Board installed Aug. 16, 1922; test pieces removed as follows: (1) Sept. 22; (2) Oct. 5; (3) Oct. 23; (4) Nov. 3, 1922.

Several of the species discovered are new to science and little, if anything, is known of some of the others. The first boards were placed in New England the first week in June and some others have been so recently placed that no blocks have been received from them. In another year the distribution of species should be fairly accurately known and the breeding season of the various species should be determined with considerable accuracy. It has already been found that teredo navalis breeds in Jamaica Bay, N. Y., as late as Oct. 1, which is much later than had been previously supposed.

The studies are being carried out under the direction of Col. W. G. Atwood, supervised by the committee of which R. T. Betts, of New York, is chairman.

European and American Transit Practice

From observation of European municipal transit conditions Daniel L. Turner, consulting engineer of the Transit Commission of New York City, stated before the New York Chapter of the American Association of Engineers on Nov. 14 that transit in the old world differs from ours physically, socially, and psychologically. Comparisons between transit conditions and methods on the two sides of the Atlantic are for this reason difficult. This applies to tram, bus, and rapid-transit (subway or elevated) practice. In particular, rapid-transit condition in New York City differ fundamentally from those found in any European city. With the most fully developed rapid-transit system in Europe, London serves only about one-fourth of its city area, and the total city area is less than one-third that of New York City (117 against 350 sq.mi.). Rapid transit is confined almost wholly to the northwest part of the city, about 40 sq.mi., while the New York system serves the entire city except Staten Island. Density of traffic is very much lower in European cities, moreover, and this is true of street vehicle traffic as well as of transit. Only in Paris is crowding of the rapid-transit trains as serious as in New York. Perhaps the controlling factor in establishing the difference between European and American transit conditions is the difference in building heights, the cities of Europe are generally of three to five-story heights, in the business as well as in the residence districts, and the tremendous concentration of rush-hour demand produced by the large office buildings of American cities is absent.

Highway Design, Maintenance and Finance

Abstracts of Committee Reports Made to the Advisory Board on Highway Research of the National Research Council, Washington, D. C., Nov. 23-24, 1922

Structural Design of Roads

BY A. T. GOLDBECK
Chairman Committee No. 2, Advisory Board on Highway Research

THE three principal investigations carried on for the purpose of securing information which would lead to the rational design of roads, are the Pittsburg test road, Pittsburg, Calif., the Bates experimental road, Springfield, Ill., and the Bureau of Public Roads experiments at Arlington, Va. In addition to these investigations, and as supplements to them, there are being carried on at the testing laboratories at Springfield, Purdue University, and the University of Maryland, investigations of fatigue of concrete.

Preliminary reports of fatigue investigations indicate that up to a certain per cent (about 50 per cent) of the ultimate load, concrete will withstand any number of repetitions of stresses, but beyond that percentage a definite number of loads will cause failure.

While the final reports of the Pittsburg, Bates and Arlington experiments have not been published, from preliminary observations it can be said that: (1) The least resistant part of the slab is the corner. (2) The position of the load which causes most serious stress in the slab is at the side edge, either at or near the corner.

It has not been definitely settled whether the greatest tension is produced in the top or the bottom of the slab. An unsettled question also is that of the impact effect of moving vehicles on the slab. We have information to show that under moving loads the actual deflection at one point is less than under the load remaining at rest at that point. This does not indicate, however, that the stress is less under the impact, since the area of distribution of the deflection might be different under impact and static loads. This phase is being investigated.

From the preliminary reports it would seem that the best way of increasing the strength of the slab without increasing the total amount of concrete would be to thicken the edges.

The point to be investigated is the determination of the relation of the center to the edge thickness so that the strength of the slab will be more or less uniform. The question of reinforcement also has not been settled, that is, should the principal reinforcement be longitudinal or transverse, and if it is better to have one layer or two layers, and, if one layer, where should it be placed, at the top or the bottom of the slab?

With this question of proper reinforcement is also concerned the strengthening of the corners. On both the test roads it was found that the corners were less resistant to traffic at night than in daytime, the reason for which (warping) has been frequently discussed. It is possible that proper reinforcement will considerably reduce this warping which we have reason to believe occurs in the main only very near to the corners. Proper reinforcement also will strengthen the corner by distributing the load to the adjacent slab. After the direction and position of the reinforcement have been determined, the next question to be settled is how this reinforcement should be distributed; for instance, if a certain section of steel is required, should it be all in one bar or will several bars answer the purpose better?

Gravel Road Surface Maintenance

BY W. H. ROOT
Chairman Committee No. 7, Advisory Board on Highway Research

STUDIES of dust prevention and wearing surfaces on gravel roads interlock closely as all suitable wearing surfaces also act as dust preventives. The University of Michigan and the Michigan State Highway Department have just completed extensive research work with various bituminous surfaces and dust preventives for gravel roads. Their final report is being published. The work was done by G. C. Dillman, Deputy Commissioner of the Michigan State Highway Department, and Herschel C. Smith, Assistant Professor of Highway Engineering, University of Michigan, under the direction of Prof. A. H. Blanchard. Their preliminary report shows that experiments were conducted on three test roads having a total length of about 18 miles. Roads were chosen which carried a traffic of from 500 to 2,500 vehicles per day and which had from ¼ in. to 1½ in. of loose material on the surface. The test sections were one-half mile in length and the following materials were used:

High carbon tar, ¼ gal. per sq. yd.
Special refined tar, light grade, ¼ gal. per sq. yd.
Special refined tar, light grade, ⅛ gal. per sq. yd.
Light oil, ⅛ gal. per sq. yd.
Heavy oil, ¼ gal. per sq. yd.
Cut back oil, ¼ gal. per sq. yd.
Cut back asphalt, ¼ gal. per sq. yd.
Flake calcium chloride.
Granular calcium chloride.

The preliminary report gives the following conclusions:

1. Any surface treatment of gravel roads for dust prevention should extend the full width of the traveled way rather than over a portion of the center of the road, such as 16 feet.

2. For general use as a dust palliative on Michigan gravel roads, calcium chloride is the most satisfactory from the point of view of general applicability, application by unskilled labor and adaptability to various types and conditions of road. It is impossible, based upon these service tests of one season, to reach conclusions as to its effectiveness and economy compared with other dust palliatives investigated.

3. No distinction can be made between granular and flake calcium chloride as to effectiveness.

4. Calcium chloride supplied in the 100-lb. bag containers is more economically handled than that supplied in the 350-lb. metal drum and it appears that it might be profitable for the necessary storage to be provided so that this economy could be realized.

5. The use of calcium chloride has a tendency to cause the surface to pit and become rough, which slightly increases the cost of blade maintenance above that of a similar road on which calcium chloride is not used.

6. It appears that a light oil can be used on a gravel road even under a traffic of 1,500 vehicles per day, in case there is a sufficient amount of loose material on the surface to absorb at least 75 per cent of the oil.

7. Where the light oil is applied in a greater quantity than that which the loose material will absorb, it forms a thin glazed surface on the compacted portion of the road and the loose material which is quickly swept from the road cannot be successfully replaced as there is no tendency for material returned to the surface to adhere and become incorporated in the surface.

8. It is impossible, as yet, to standardize the use of light oil as a dust palliative for Michigan gravel roads because of the necessarily exact relation that should exist between the amount of oil applied and the amount of loose material. In no case should more than ⅛ gal. per square yard be applied and the amount should vary with the amount of loose material on the surface.

9. The heavier bituminous materials cannot be used for a dust preventive on Michigan gravel roads except as a material for forming a bituminous surface.

10. Regardless of the material used, a successful bituminous surface cannot be formed on a gravel road unless there is first a firm, even, hard surface on the gravel road which is free from loose material.

11. Bituminous surfaces formed within the limits of conclusion number 10 and with the materials and amounts used in these tests, do not disappear uniformly.

12. It appears that bituminous treatments made without top dressing and expected to disappear annually, although apparently satisfactory during the summer months when used on a high type gravel surface, will leave the road in such shape that succeeding treatments will be impracticable unless the roadway surface is reconstructed, and furthermore will impair the quality of the surface if it is to be maintained thereafter as an untreated gravel road.

13. It appears that it would be possible, however, to develop a bituminous surface, using a suitable metal top dressing on firm, even, hard, well cemented gravel roads.

Rhythmic Corrugations in Gravel Roads—The most extensive research work in connection with this most perplexing problem has been done by the U. S. Bureau of Public Roads. George E. Ladd, Economic Geologist for the Bureau, has written a report covering their investigations. Studies were made in Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New Jersey, Michigan and Wisconsin. It was found that the distance from crest to crest averages about 31 in. and that the maximum height from the bottom of the trough to the top of the crest is 1½ in. The causes of the corrugations are:

1. The kick back of surface materials arising from the spin of the rear wheels of automobiles as they descend after a bounce over some obstacle of depression.
2. From impact of both the front and the rear wheels of automobiles.

This latter class of corrugation is more prevalent when the clay condition of the gravel is high and especially where the gravel particles are well rounded. In the case of the first named corrugations, the location remains fixed. In the case of the second class they seem to swing on an axis located near the center of the road. In some cases the swinging movement was so great that corrugations which were originally at right angles to the road took a position only a few degrees from the axis of the road. Gravel roads subject to a traffic of not more than 200 or 300 cars per day remain practically free from corrugations, if occasionally dragged. As soon, however, as traffic reaches 400 or 500 cars per day corrugations develop very rapidly.

The fact that these corrugations are so general and occur in all sections of the United States makes it evident that nearly all gravel roads are subject to the development of this nuisance and menace, if they serve sufficient traffic, although the methods of construction and kinds of gravel vary widely. The situation, however, is not hopeless. Several highway officials have expressed the opinion that less corrugation trouble is found where the gravel is angular than where it is composed of highly rounded particles. It is also claimed that where the road is constructed of gravel more uniform in size than pit run, and especially where everything over 1 in. is excluded, that corrugations are slower in developing and more easily eliminated by maintenance methods. During the investigations in the state of Maine it was noted that roads with a relatively high per cent of clay-silt binder were comparatively free from corrugations.

* * *

Highway Finance Requires Research

By J. G. McKay
Chairman Committee No. 6, Advisory Board on Highway Research

Highway financing is typified by lack of agreement in methods and in the distribution of the costs of highway improvement between the sources of highway revenue. Neighboring states have entirely distinct systems of highway financing, and as a whole, fundamental principles of public financing are neglected. No uniformity of principles exist *due largely to the lack of evidence upon which to build rational systems of financing.*

During the past years distinct opposition to the growth in the yearly highway bill has developed.

The current criticism of the large sums raised for the improvement of the public highway system is a criticism of the inequalities and unfairness of the present methods of financing rather than a criticism of the amount of highway funds expended yearly. The public is not questioning the amount raised, but who ought to pay and how much.

The question which must be answered according to principles of equity is: *What percentage of the total highway revenue shall be raised from each of the sources of highway funds?* The problem is not whether a given state should make use of credit or raise funds from current revenue; it is how much of the total highway bill property owners and motor vehicle owners should contribute. The solution depends largely on the results of research, and research should be along the following lines:

1. A survey of present methods of highway financing. Accurate knowledge of the existing state systems must be preliminary to intensive research. We must know the present methods before attempting to recommend changes.
2. A comparative analysis of highway funds raised in states using the several methods of financing highway improvements. This information will indicate the proportionate amounts of revenue that can be raised by different systems of financing.
3. Comparative analysis of highway expenditures and the sources of highway funds in typical states to determine the share of the total highway improvement costs each contributing share produces. This information is necessary to show what part of the costs each source of revenue bears.
4. *Analysis of the share of the total highway improvement costs each contributing source of revenue should produce, based on the benefit and ability theories of taxation.*
5. Surveys of the contribution of urban and rural sources of highway revenue. Data of this type are necessary to determine whether or not it is necessary to differentiate between urban and rural taxation for the purpose of rural highway improvement.
6. Research in highway bond financing.
(a) The total highway bond indebtedness, state and county; (1) The types of issues; (2) Maturity, rates of interest and marketing factors and (3) Methods of amortization.
(b) General principles determining the necessity for the use of credit.
(c) The distribution of the cost of bonding, principal and interest, between the sources of highway revenue.
(d) The cost of different types of highway bond issues according to maturity and amortization.
7. The amount of personal property taxation of motor vehicles.
8. Analysis of the relative merits of present methods of motor vehicle taxation.
9. The relative benefit to vehicle transportation of the different types of highway improvement. This data is usable as one of the measures of motor vehicle contribution to highway improvements.
10. The average benefit to rural land per acre due to highway improvements. This will serve as a rough measure of real property taxation for rural highway improvements.

Responsibility for Protruding Pier Stub

Affirming the decisions of lower courts, the U. S. Supreme Court has decided that the Southern Pacific Co. and the California Pacific Bridge Co. are not liable for the sinking of a dredge owned by the Olympian Dredging Co. In 1895 a new bridge was constructed over the Sacramento River. Under regulations approved by the Secretary of War, the piers of the old bridge were to be cut down so as not to menace navigation. The facts show the piers were cut deeper than required, three or four feet below the bed of the river. Later, the government dredged the river to improve the channel and the pier stubs protruded above the new river bed. In 1918, a dredge struck a stub and was lost. The decision is to the effect that the defendants complied with all regulations and had no means of knowing of the change in the river bed that had taken place, and hence were not liable for damages.

Boston Asks Students' Aid in Solving City Problems

Four Prizes of $500 Each To Be Given to Boston "Tech" Students for Best Plans for Municipal Improvements

THE City of Boston through Mayor James M. Curley has offered $2,000 in four prizes of $500 each for the "best reports and working plans for solving certain municipal problems and improving the administration of certain municipal functions and activities." The competition is open to any student enrolled at the Massachusetts Institute of Technology in 1922-23 and is to be concluded May 1, 1923. The subjects covered are street traffic, street cleaning, malodorous and insanitary nuisances and fire protective building construction.

As a part of the conditions of the contest it is stipulated that a prize award carries with it full rights, with no further payments, to the use of the devices or methods proposed. One judge is to be selected by the Mayor, one by the head of the Department of Civil and Sanitary Engineering at the Institute and the third by the two so selected.

In outlining the conditions of the competition Mayor Curley gave the following explanation:

To the end that the hazards, congestions and delays of street traffic may be diminished, that the dangers to public health from polluted waterways and offensive trades and enterprises may be minimized, that dangers to life and property by fire and wreck may be decreased by improving the safeguards in building construction, and that the interests of the city's industry, commerce and retail trade may be conserved and its prosperity increased by relieving them from the handicaps imposed by the evils indicated, the City of Boston, desirous of securing a larger measure of efficiency in the administration of the municipal departments and agencies having these functions and activities in their charge and care, will pay the sum of $500 for the best report and working plan or plans submitted by a student of the Massachusetts Institute of Technology on any of the four subjects indicated in a list below.

1. *Street Traffic*—How best can the flow of vehicles be made to move more quickly and continuously, so as to avoid blockades and congestions, minimize danger to foot passengers, remove delays and difficulties, provide parking facilities and prevent undue dawdling with the least public inconvenience—without impairing the efficiency of commercial service or checking the expansion of the business of the retail trade section of Boston? Having in mind the financial limitations of the municipality, and the imperative necessity of relieving the congestion of the narrow streets of a crowded business section of meager limits—how would you proceed to secure relief and keep it? Widening streets, removing sidewalks, substituting arcades without destroying the superstructure of buildings, eliminating certain classes of vehicles, regulating deliveries and shipments by time restrictions or how?

2. *Sanitation*—How can the streets of Boston and the lanes, alleys and ways tributary to them be kept clean, sanitary and safe, at a minimum of cost and maximum of results? In working out this problem have in mind the public peace and convenience, the prompt and final disposal of waste and insanitary material collected, the question of hours when the work should be done, the character and kind of machinery and vehicles to be used, and some practical suggestions for retrieving useful and merchantable by-products to offset some of the costs of administration.

3. *Sanitation*—What is the best method controlling and regulating necessary but offensive industries and enterprises situated inside the jurisdiction of the municipality,—garbage plants, rendering establishments, oil refineries,—so that their malodorous and insanitary features may be rendered innocuous their waste be sterilized and prevented from polluting the soil and water adjacent to them and their detrimental influence on the health and values of neighboring localities be corrected or minimized?

4. *Protective Construction*—Section 32 of chapter 550 of the Acts of 1907 directs that in building construction fire protection shall consist of: (*a*) Concrete, and describes the method of protection. (*b*) Terra cotta, and describes the method of protection. (*c*) Brickwork to be set in cement mortar. (*d*) Any material or form of construction that will resist the action of flames and a heat of 1,700 deg. F. for at least two hours without raising the temperature of the material to be protected above 550 deg. F. through a thickness of 2 in. as determined by fire and water tests for fireproofing construction adopted by the American Society for Testing Materials.

The problem here for the student is to ascertain whether or not a better and more effective method of protecting steel construction from heat can be secured, a method that can be applied in a simpler and less expensive manner and which will not add to the weight the construction should carry nor to the cost of material. The nature of the material and the manner of its application should be fully described and the reasons for its superiority and desirability be clearly explained. There are many systems in the market; can the student suggest a better one and why?

Percentage of Water Pumped Which Produces Revenue

How a Water Company Raised the Revenue-Producing Percentage from 48 to 90 Per Cent of Water Pumped

By H. F. Huy
General Manager, Western New York Water Co., Buffalo, N. Y.

IN THE determination of rates for water, gas and electricity, utility commissions and courts have often raised the question, "What percentage of the commodity furnished is revenue-producing?" Several authorities have given their opinion on this subject. For water-works the percentage has been placed at from 50 to 70 per cent of the total pumped. Such opinions are based on the experience of different cities and have been accepted by various communities and corporations on the assumption that the larger plants of cities and corporations were conducted on the most economical lines and should show the best results. The average water-works man was content to know he met average conditions. Lately a prominent engineer, in testifying before a utility commission, stated that of water pumped 75 per cent should be revenue-producing or accounted for in legitimate use. Although he had heard, he testified, of an isolated case in which it was claimed that revenue was received for 90 per cent of the water pumped, he questioned the correctness of the claim. To disprove the widespread belief that only a comparatively low percentage of water supplied can be made revenue-producing the following information has been prepared:

The Western New York Water Co. operates in the suburbs of Buffalo, N. Y. The system comprises approximately 160 miles of mains of 4- to 24-in. pipe; 75 per cent of the distribution mains are 6 in. in diameter and over, the average size being near 12 in. The territory supplied has a population of 60,000 people and the service is furnished through 6,000 domestic taps and 130 industrial and commercial services. The fire protection to the communities is furnished through 648 fire hydrants. In addition to the domestic and industrial consumers, the company furnishes water at wholesale through meters at the boundary lines to three

villages that own distribution systems comprising a total of 3,000 services. The water is pumped by electrically-driven centrifugal pumps, under an average pressure of from 60 to 90 lb. The output is recorded by Venturi meters. Fifty per cent of the water pumped by the main pumping station is repumped at pressures varying from 60 to 130 lb. The plant is 100 per cent metered, including the 3,000,000 gal. a year of water supplied without charge. The record for the last four years follows:

TOTAL WATER PUMPED AND REVENUE PRODUCING PERCENTAGES

Year	M. G. D. Pumped	Percentage of Water for Which Revenue Is Received
1918	[illegible]	88
1919	8.2	92
1920	9.1	90
1921	8.3	88

The plant has been in operation for about 22 years and was 100 per cent metered at its original installation. About 10 years ago, when the writer was called in consultation, the amount of revenue-producing water had dropped to 48 per cent and it was very desirable that steps be taken at once to remedy this condition.

Meters Put in Order—Some of the large commercial meters of an obsolete type were replaced or repaired. Upon test it was found that some of them did not register on normal low flows and only about 60 per cent of the quantity of water passed at or above the average-flow rates.

The domestic meters, many of which were out of order or under-registering, were also overhauled. After the larger meters were repaired and many of the smaller meters were repaired or replaced, the percentage of revenue-producing water was increased to 73 per cent.

Inspection—A careful pitometer survey of the distribution system of the company was made. At the same time commercial meter readings were taken and allowance made for domestic consumption in each survey district. In this manner leakage and losses in the various districts were determined. Inspections were also made of the pipe lines for possible leaks showing on the surface. The microphone was applied to the various valves and hydrants. In sections where mains were located under paved streets and there was no nearby listening connection, the microphone was employed directly over the water main which was determined by the wireless pipe-locating device. A leak on the main has been located within a foot of the actual leak through 5 or 6 ft. of earth. Mains, 4 and 6 in. in diameter, resting on rock have been broken by the vibrations set up by large trucks. By this inspection the revenue-producing water was increased to 78 per cent of the water pumped.

Mains and Services—While the pitometer survey showed the general location of the unaccounted-for water lost, it was so evenly and widely distributed in the territory supplied that the exact location of the various points of leakage could not be readily observed. A careful house-to-house inspection of services was then carried on by listening on all the service pipes for leaks. A large amount of the unaccounted-for water was traced to leaky service pipes, especially under brick and asphalt pavements or where service pipes and sewer pipes had been laid in the same trench and the settlement of the sewer had broken the water pipe, the water finding its way into the sewer system. A careful check was kept on the flow past various sewer manholes in an endeavor to locate leaks.

A considerable portion of the piping system had been installed in the communities before they became thickly populated, and no careful record had been kept of the location of the pipes. Often other utility company structures interfered with the accessibility of the water mains. A large leak under a telephone manhole was finding its way into the conduit-manhole drain.

After completion of the house-to-house inspection, and making the necessary repairs, the revenue-producing water was increased to the percentage shown in the table, varying from 88 to 92 per cent in the last four years. While the years 1920 and 1921 show a decrease of 2 per cent each in the accounted-for water, the total quantity of unaccounted-for water is very near the same.

Allowable Leakage—The leakage on a well maintained distribution system should not exceed 3 per cent of the total quantity pumped. One per cent should cover the amount required for fire purposes. This estimate is based on fire records in the communities supplied—length, time and number of fire streams used. The allowable under-registration of meters on a well maintained metered system, should not exceed 5 or 6 per cent. It is therefore the writer's judgment that on a carefully operated and inspected 100 per cent metered system, 90 per cent of the water pumped should be revenue-producing, providing there is no free water furnished for municipal or other purposes.

Precautions—Too often no attention is paid to the service connections to the mains; the plumber is allowed to purchase the material and install it. The only time the water company's representative is on the work is to make the tap at the main. Many leaks on service lines occur at wipe joints and it is now the practice of this company to allow no wipe-joint connections to be used; lead-flanged union connections only are permitted. Service lines are often not laid the proper depth and are frozen. The service pipe is often laid in the sewer trench or on a supposed shelf alongside the sewer. This should not be permitted. It has been found advantageous to have the water pipe at least 5 or 6 ft. from any sewer lateral connections. Too much importance cannot be laid on water-works employees either installing the service connections themselves or having careful supervision over plumbers making the installation.

Unmetered fire connections were found to be a distinct loss of revenue, as many of these connections lead to large plants which have extensive lines over which the water company has no careful supervision. In every instance in testing an unmetered fire connection, an indication of water being used or wasted was observed. After the company installed meters on these fire lines, it received revenue from the water passing through the meters.

The meters of all industrial and corporate consumers are read monthly and of domestic users every three months. This enables the water company to check its revenue-producing water each month. Any drop-off is immediately noticed and steps taken to learn the reason.

The results outlined above should be obtainable in any carefully operated water-works plant, as they are due to carefulness, patience and perseverance in looking after the leaks and in maintaining the meters in good registering condition.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Colloidal Clay, Color and Turbidity in Water

Sir—In *Engineering News-Record* of Oct. 12, p. 625, F. B. Marsh "hazards the guess that colloidal clay neutralizes the color and that something connected with the color neutralizes the clay and thus both the turbidity and the color (of the water) are eliminated."

That this "guess" is substantiated by theoretical and experimental facts is clearly shown by a consideration of the turbidity (chiefly clay) and the coloring matter (chiefly humus or humic acids) as colloids. T. Hardy (1899) has shown that colloid particles, which always carry electric charges, will coagulate and precipitate when they are made electro-neutral, at the so called "iso-electric" state. This would point to an immediate general solution of the problem were it not for the fact that the same colloidal substance may appear either as positive or negative, depending upon the condition of the dispersion medium. In other words, we cannot expect the same results with acid and basic waters.

It is, however, highly possibly that clay, usually electronegative or acid, and humus, always electro-positive or coagulated by acids, do mutually precipitate each other, since adsorption compounds are formed after the electric charges are neutralized. Nature uses a similar method to precipitate the clay at the mouth of rivers and form deltas, the neutralizing and precipitating agent being salt. There is no doubt that a careful analysis of the constituents in the turbidity and in the coloring matter will point to the proper chemicals for complete precipitation. It must be remembered that such a method for water purification will remove the inorganic materials only (although coagulating colloids will encase and carry down large amounts of organisms); that careful and skilled supervision will be required to allow for changing conditions; and that each case must be studied separately. JACOB FELD.

Brooklyn, N. Y., Oct. 23.

Packing New Joint for Gas Main

Sir—In regard to my article on "Methods and Cost of Laying Gas Main with New Joint" in *Engineering News-Record* of Oct. 5, p. 572, a number of men have asked me what was the thickness of the three strands of yarn which were placed in the back of the bell. In order to get the maximum strength from the "B" bell it is important to use as little yarn as possible. The face of the yarn must be back of the foot of the inclined plane or apex of cone which forms the bead of the spigot. Unless this is done the additional strength of the joint, due to shear, will be lost as the bead will bear against the comparatively soft cushion of the yarn instead of the cement.

St. Louis, Mo. JACOB D. VON MAUR,
Nov. 10, 1922. Supt. of Distribution, Laclede Gas Co.

A Warning to Contractors

Sir—It might be well to call contractors' attention to the fact that before starting work they should see that the bonds that were issued for the work were sold and the money available for the work to be done.

The last session of the Maryland Legislature passed bills permitting different counties of the state to issue bonds for improvements such as schools, bridges, etc. Washington County issued $300,000 worth of school building bonds, advertised and sold and got the first payment from purchasers of bonds. After the first payment was made the purchasers discovered that the legislative vote had not been counted at time of passage of bill and thereby the issue was invalid. The County Commissioners sued the bankers for the deferred payments and the courts decided in favor of the bankers.

The board of education awarded contracts for two schoolhouses in the county and work was about half done when the board of education found it had no money to pay the contractors for work done. For the contractors to stop meant a loss and to go ahead meant doubt as to when they would get pay for their work.

The county commissioners came to the rescue of the board of education by some means of adding to the next tax collections enough to pay the contractors for work done. The school building program is held up till the next session of legislature can vote on the bond issue.

A contractor may get stung if he starts work for which the bond issue has not been passed on and found legal in every detail. THOMAS SHEAHAN.

Hagerstown, Md., Nov. 3.

A Dam Is as High as It Dams

Sir—Replying to your query, "How High Is a Dam," discussed editorially in your issue of Nov. 2, p. 728, my answer would be: a dam is as high as it *is* a dam. That is to say, its height is so much of its vertical dimension as is physically effective to restrain the flow of a fluid. Hence the standard of comparison for height of dams might be considered the unbalanced head against the structure—the difference in water level between low water in the stream bed and high water in the pond—the vertical offset in the hydraulic gradient occasioned by the dam.

Since there is tail water or ground water in the stream bed at the toe of practically all dams, the point of departure for height measurement would commonly be the natural stream bed, or low-water mark, and the upper objective would be the top of parapet on the dam wherever that is a solid wall integral with the main structure; otherwise the crest of the dam proper where the parapet is an open balustrade. You are certainly right in claiming the solid parapet of Arrowrock Dam as part of the effective height.

You are most emphatically right in stating: "Difficulty of construction legitimately calls for overall heights, etc." Difficulty, cost, and general grief of dam building should be reckoned to increase as the square of the depth below stream bed, and plotted on a fashionably logarithmic scale. Anybody who has fought his way foot by foot of excavation down to the bitter bottom in bedrock of a pit 100 ft. below river level, and up again inch by inch of masonry, against a time limit between floods, must have realized that the veritably controlling factor in the whole dam business is depth below stream bed, rather than the most ambitious skyward penetration. Therefore your conclusion is utterly sound, that the constructor should be given credit for overall height.

My conclusion then is that no single word or figure can tell the height of a dam relative to all other dams, but you must set up a double standard of comparison, suggesting: (1) Extreme Height; (2) Effective Height. Extreme height would be the difference in elevation between the lowest and highest points of the structure. Extreme effective height would be the difference of elevation between low water at toe and high water at crest of dam—noting that this difference would be subject to unimportant variations according to whether the dam were an overfall structure or whether a separate spillway would hold all floods below the crest of the main dam. In the case of overflow dams the additional head in the pond would be approximately balanced by increased height of tail water, so that the net hydrostatic head would not be widely variable for full reservoir conditions.

According to these definitions you are right in answering Mr. Wegmann that Arrowrock Dam, as yet, overtops them all in extreme height. But the Don Pedro Dam, now nearing completion, in Tuolumne River, California, has set a new superlative with its effective height of approximately 280 ft. above stream bed.

Among all dams of high degree, now built, building, or proposed, the Shoshone remains unique in that its height

is its greatest dimension; and this is true whether its extreme height of 328 ft. or effective height of about 240 ft. is considered, since the extreme length at top is only 200 feet.

San Francisco, Calif. D. W. COLE.
Formerly Engineer in U. S. Reclamation Service in charge of Shoshone and Lahontan Dams

Montana's Highway Policies

Sir—Unless we are very careful we will fall into the habit of thinking that the completion of the so-called 7 per cent system of federal-aid highway projects through the country will solve the road problem. I am inclined decidedly to a contrary opinion. In Montana today we are convinced that any highway program or policy suggested by the department must recognize the local importance of roads not on the trunk-highway system. We believe too that present knowledge of highway construction, highway economics and the trend of traffic does not justify the assumption that the road problem can be solved for all time by any single effort.

For several years I have felt that the public would react against the enormous expenditures that have been made for expensive highway improvements, particularly when the cost of such highways was dictated by the necessity for serving truck traffic. To a certain extent I believe this reaction is already apparent in several states in the West.

In view of the public demand for retrenchment and for a reduction of expenditures—and this demand seems to disregard the ultimate economy of or profit from the expenditure—it is comfortable for us here in Montana to remember that we have not been stampeded into any costly paving program, but have confined our efforts to the building of a large mileage of serviceable gravel highways. This policy has been maintained in the face of ridicule and the suggestion that we were decidedly behind the times. About the only change that I can anticipate in the prosecution of the state's road program is one which will permit the state to go forward more rapidly toward the development of the state and county road systems.

One of the fundamental principles underlying the management of public works departments is this: You can not spend money any faster than the public will provide it nor for any purpose which the public does not approve. It is not at all significant that the public's conclusions may be erroneous and non-supportable by economic arguments. In my opinion we have not exhausted the possibilities of educating the public to the need for and the cost of improved highways. JOHN N. EDY,
Chief Engineer, State Highway Commission.
Helena, Mont., Nov. 14.

Mineral-Oil Paint for Galvanized Sheets

Sir—In your Nov. 2 issue F. H. Thomson, of Kilmarnock, Scotland, brought up the question of painting galvanized sheets. It happens that I recently had occasion to investigate this subject and I encountered a surprising lack of authoritative information and a diversity of views. The consensus of opinion seems to be that paint will not adhere to fresh galvanizing on account of the oily film. The methods suggested for removing this film range from the simple but time-consuming expedient of several months' exposure to various complicated formulas for "washing" it off. All of these methods result in a destructive, or more properly a corrosive, action on the zinc.

While in theory galvanizing is a protection against ordinary corrosive action of the elements, in reality the present-day product is not of a quality to withstand several months' exposure to weather without serious effect on the zinc, especially if subjected to the action of salt air. The copper-acid combinations mentioned by Mr. Thomson are perhaps efficient as oil removers, but coming in contact with the zinc they produce an electro-chemical action in which the zinc is decidedly the sufferer. Inasmuch as the zinc is applied as a protection, obviously anything which tends to destroy it is objectionable. The logical solution is a paint which will adhere to fresh galvanizing without the necessity of any previous treatment of the surface.

Investigation developed the fact that the usual linseed or other vegetable oil paints will not adhere to fresh galvanizing because the mineral oil composing the film on the zinc mixes with the vegetable oil in the paint and prevents, or at least greatly retards, the hardening of the latter. Mineral oil does not oxidize like the linseed oil, and when added to linseed oil paint makes it permanently sticky and incapable of hardening to a firm film. The surface may appear hard, but underneath the paint remains soft and sticky and therefore does not adhere firmly to the metal.

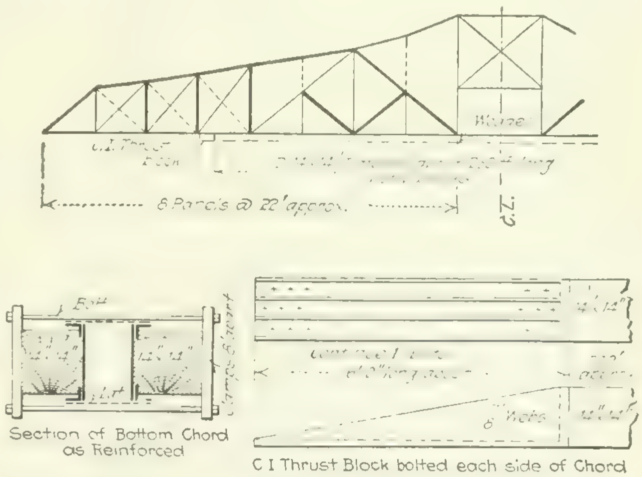
On the other hand a properly mixed paint of the proper mineral oil constituents will absorb the mineral oil on the galvanized surface without in any way impairing the efficiency of the paint, or retarding its setting and drying properties. As the mineral oil paint has moisture and acid-resisting properties superior to those of the vegetable oil paints, and yields an extremely tough film, there need be no hesitation in using it instead of the linseed oil paints or the commercial substitutes now so generally used.

Strangely, this is not a new development, but a paint of this kind has been used for years on galvanized roofs and other exposed galvanized surfaces with entire success. I have seen it applied to fresh galvanizing with perfect results as to adhesion and effective covering.

HARRY CARLTON.
Harry Carlton & Associates, Sales Engineers.
New York, Nov. 24.

Doubtful Bridge Reinforcement

Sir—The accompanying sketches show a method of alleged strengthening of the trusses of a swing bridge in Oregon. This bridge was originally designed, in 1904, for a plank roadway about 32 ft. in clear width, including two street-car tracks. In 1921 the span was paved with asphalt while the draw was over its rest during other



BOTTOM-CHORD REINFORCEMENT OF PIN-CONNECTED SWING SPAN

repairs, but upon swinging the draw the extra load of the asphalt was discovered to have depressed the free ends about 7 in. below the approaches, requiring slight inclines to match the ends. While a new draw rest was being built this year, the contractor "discovered" that the bottom chords were "buckled" and secured an emergency contract for strengthening them as per the sketches herewith, the work being under the charge of two county officials licensed under the Oregon law to practice engineering.

Aside from the impossibility of wood and steel acting in unison under changes in temperature, the alleged reinforcement actually weakens the bridge by about 15 per cent in the service position with bottom chord in tension, due to the boltholes.

This weakening, together with the excess dead load of asphalt paving, reduces the live-load capacity of the bridge by about 40 per cent. Even before the paving was laid, this bridge was alleged to be unsafe for its traffic. Such is one example of the workings of an ill-advised license law. GEORGE RAE.
Portland, Ore., Oct. 21.

NEWS OF THE WEEK

New York, November 30, 1922

Army Camp Builders Sued for $21,500,000

Government Would Recover From Thompson-Starrett, Fuller, Bentley, and Hardaway Companies—Other Suits Imminent

Suits to recover $21,500,000 alleged to have been fraudulently obtained in the construction of cantonments during the World War were begun Nov. 24 at the direction of Attorney-General Daugherty. Though information is given that other suits may follow, whether suits will be instituted against contractors who erected other army cantonments remains a matter for conjecture. Twelve other cantonments were built comparable in size to the four involved in the suit described herein. The firms, the cantonments involved in the suits, and the amounts the government would recover in each case are: Thompson-Starrett Co., Camp Upton, (Yaphank, Long Island), $6,000,000; George A. Fuller Co., Camp Funston (Fort Riley, Kansas), $4,000,000; Hardaway Contracting Co., Camp Jackson (Columbia, S. C.), $6,500,000; and A. Bentley & Sons Co., Camp Sherman (Chillicothe, Ohio), $5,000,000. The suit against Thompson-Starrett Co. was filed in Brooklyn, N. Y.; that against the Fuller company at Topeka, Kan.; against the Hardaway company at Columbia, S. C., and against the Bentley company at Columbus, Ohio.

The amounts the government would recover represent a substantial percentage of the total cost of construction of the camps, and in the case of Camp Jackson the sum sought is more than half. The government paid $12,710,720 for the construction of Camp Jackson; $15,370,820 for Camp Upton; $13,247,620 for Camp Sherman, and $11,715,520 for Camp Funston.

According to the announcement of Attorney-General Daugherty the suits represent investigations begun by the Department of Justice more than a year ago and carried on by the department until the Special War Branch was organized and by that body with certain aid from the department until the present time.

Fraud, inefficiency, waste and gross negligence are alleged in the general complaint to have resulted not only in a loss of large sums of money by the government but in the embarrassment of its war program. The department made public a copy of the complaint in the case against A. Bentley & Sons Co. and announced that that complaint was similar to those filed against the other defendant construction companies.

The Bentley complaint alleges that the "defendant misrepresented to plaintiff that defendant had experience in the execution of similar work and an organization suitable for the performance of such work." It is further alleged that the defendant company "did knowingly, illegally and fraudulently violate and abuse such confidence and trust and breach said contract in that it did not complete its said undertaking in accordance with its terms and true tenor and spirit, and that the plaintiff was compelled to let additional contracts to others at added cost and expense to the plaintiff for the completion of such contract."

It is also alleged that the Bentley company (and presumably the other defendants) sold to and in some instances purchased and resold to the government at a profit large quantities of material and equipment, some of which was needed and some unnecessary, and that their "illegal and unwarranted claims" and vouchers in payment for alleged useless material were presented and paid by the plaintiff.

Miscellaneous Charges

Other points in the general complaint are: (1) That defendants allowed large amounts of useless and unnecessary work to be done by employing so many workmen that congestion occurred, delaying work; (2) that workmen were employed without reference to skill or experience, thereby disturbing the morale of the entire construction force; (3) that unskilled workmen were paid the same wages as skilled mechanics and in the majority of cases wages were paid in excess of the then current scale; (4) that adequate inspection and supervision of workmen were lacking, conditions which resulted in a great loss of efficiency; (5) that payment was obtained for superintendents and others acting in supervisory capacities at exorbitant rates and for time in excess of that during which they were engaged; (6) that motor trucks were often rated in excess of capacity so that the company might collect the added allowance.

In ending its complaint the government made the charge that all the foregoing was done with the "knowledge and connivance of the defendant company," causing excessive cost to the government and securing for the defendant the maximum rather than a reasonable compensation.

Application to Build Mexico-New Mexico Road Filed with I.C.C.

The customary applications in connection with proposals to build a new line of railroad have been made to the Interstate Commerce Commission by the Colorado, Columbus and Mexican R.R. Co. The proposed line is to extend from Columbus on the Mexican border, 65 miles west of El Paso, through Deming to Farmington, N. M., where it will connect with the Denver and Rio Grande R.R. The proposed line would be 550 miles long. John Philips of Wichita Falls, Texas, is the financial agent of the enterprise. George Estes is president and general manager of the company, with offices at Deming.

Civil Service Problems a Topic at Municipal League Meeting

Civil service problems and progress were the subjects of an entire session of the annual convention of the National Municipal League held at Philadelphia, Nov. 22-24. A wide range of other subjects was considered in the fields of local, state and national government. Col. Henry M. Waite, of New York City, formerly city manager of Dayton, Ohio, and before that city engineer of Cincinnati, was re-elected as president. Among the members of the council elected at the meeting was M. N. Baker, associate editor, *Engineering News-Record*. The permanent secretary of the organization is H. W. Dodds, 261 Broadway, New York City.

The civil service problems already mentioned were discussed under the general title, "New Standards of Public Employment." A committee with the same name submitted a report in which "centralized employment supervision and control in the public service" was recommended, and it was proposed that the administration of municipal civil service should be intrusted to a single commissioner and an examining board. Morris L. Cooke, formerly director of public works of Philadelphia, said that he could not conceive of efficient municipal government without civil service. Positions of importance, he said, are not readily filled except by detaching men already at work. He declared that there are not two or three or four or five best men for an important position, but only one.

In the course of a lengthy and detailed paper, entitled "Progress and Selective Tests and Public Employment," Dr. L. B. O'Rourke, in charge of psychological tests, U. S. Civil Service Commission, stated that large organizations are changing to quantitative tests of candidates instead of leaving the selection of employees to foremen as was done formerly. The tests show that slow workers are much less accurate than rapid workers.

To Electrify 30-Mile Section of Vera Cruz-Mexico Railway

Contract for the electrification of 30 miles of track on the Mexican Ry. Co. Ltd., between Orizaba and Esperanza on the main line from Mexico City to Vera Cruz has been announced by the International General Electric Co. The project calls for the expenditure of between $2,000,000 and $2,500,000 and will be financed through London.

The system will be operated by 3,000-volt direct current which will be supplied by the Pueblo Tramway, Light and Power Co. from its hydro-electric plant about five miles from Orizaba. The present contract includes ten 150-ton locomotives, equipment for one substation, overhead conductors and accessories. The ruling grade on the electrified section will be about 4.7 per cent.

Second Hearing Is Held on Carquinez Straits Bridge

Proposal to Cross San Francisco Bay With High-Level Bridge Again Heard by Army Engineers

A hearing was held in San Francisco on Nov. 14 before Col. Herbert Deakyne, Engineers Corps, U. S. A., on the application of the Rodeo-Vallejo Ferry Co. for approval of a plan to construct a high-level suspension bridge for highway traffic across Carquinez Straits from Valona to Morrow Cove. This site is a short distance downstream or west of that selected by the San Francisco Transit Co. whose application for a permit was reported in *Engineering News-Record*, Sept. 28, p. 537.

The Rodeo-Vallejo Ferry Co. which now operates automobile and passenger ferry boats across the straits has recently secured an amendment to its charter giving it the right to build and operate bridges. Charles Derleth, Jr., engineer for the company, presented preliminary plans for the proposed structure and described it as a three-span suspension bridge with a 1,600-ft. main span, two 800-ft. supporting spans and a clearance of 135 ft. above high water. The estimated cost is $4,000,000.

Plan Opposed

Opposition to the plan was offered by navigation interests and owners of wharves above the proposed location. The California-Hawaiian Sugar Co. claims that the south pier would make navigation dangerous in the swift tidal currents through the straits and would discourage deep sea traffic to wharves beyond the bridge.

In opposition to this it was shown that the ferry traffic across the straits in four years had increased from 300,000 to 1,000,000 passengers per year and from 100,000 to 400,000 automobiles per year. At this rate it was claimed the number of ferry boats soon required would create a navigation menace exceeding that offered by the bridge piers. Admiral J. S. McKean, commandant of Mare Island Navy Yard, spoke in favor of a bridge and rated increased ferry service as a greater menace than that offered by the bridge. Several presentations were made requesting that only one permit be granted for constructing a bridge across Carquinez Straits.

Representations were received at this hearing on five bridge projects other than that of the Rodeo-Vallejo Ferry Co. Three of these crossings, proposed by Captain John G. Little are, respectively, from Oleum to Vallejo, from Martinez to Benicia, and from Antioch to Sherman Island. The two other appearances were entered by the San Francisco Transit Co. and by the Dillon Point Development Co. for a high-level bridge at Dillon Point within a mile of the San Francisco Transit Company's site. The Dillon Point structure would also be a three-span suspension bridge for highway traffic and would have a 1,750-ft. main span with supporting spans of unequal length, one being 450 ft. long and the other 750 ft. long. The estimated cost is $2,700,000.

In accordance with the usual custom, Col. Deakyne's report on the hearing is to be transmitted to the Chief of Engineers, U. S. A., at Washington.

The Engineer in Public Life

CHARLES HANSEL

For four years the Civic Board of Cranford, N. J., has had an engineer, Charles Hansel, as its president. The board's main object has been to create sentiment in favor of a county park system and has resulted in the organization of the Union County Park Association, of which Mr. Hansel is vice-president. This work bore fruit in the form of the establishment of a permanent county park commission, with authority to expend a sum not exceeding $2,500,000. Mr. Hansel was the guest of honor at a dinner given last spring by the Civic Board of Cranford in recognition of his public service in connection with the park movement.

He is a consulting engineer, with offices in New York City, and has been prominent for many years in the field of railway valuation. Mr. Hansel was chief engineer of the Wabash Railway from 1884 to 1899, and later made appraisals for the States of Illinois, Michigan and New Jersey of railroads and canals. He has also served as consulting valuation engineer for the Pennsylvania, the Philadelphia & Reading, and Jersey Central railways.

Court to Rule on Powers of Cleveland Terminals Co.

Argument as to the right of the Cleveland Union Terminals Co. to appropriate property for the proposed Cleveland Union Station was begun on Nov. 27. The controversy hinges on the alleged intention of the Terminals Co. to sublet the air rights over the railroad facilities to the Terminals Building Co. for commercial development.

The Terminals Co. is backed by the New York Central, the Big Four and the Nickel Plate railroads through whom was obtained the authority of the Interstate Commerce Commission to issue $60,000,000 in bonds to finance the terminal. The Terminals Building Co. is said to be controlled by the Van Sweringen interests which initiated the station project and later interested the railroads in it.

Owners whose property the Terminals Co. seeks to appropriate contend that under the circumstances the right of eminent domain cannot be invoked. The testimony offered during the hearing by the Terminals Co. has aimed to prove that it has made no plans for the construction of offices or stores over the station and that all of the property sought is needed for strictly terminal purposes. Against this the property owners point to pictures used to promote the enterprise in 1919, to evidence offered to the Interstate Commerce Commission as to prospective revenues from commercial rentals and to the contract between the railroads and the Terminals Co., all of which, they assert, substantiates their contention.

Cement Association Reviews Twenty Years' Work

Announcement of New Technical Activities Made at Annual Meeting

On Tuesday and Wednesday of last week the Portland Cement Association held in Chicago its twentieth anniversary meeting. Outstanding in interest were the announcements that the association's laboratory was beginning a study of the constitution of portland cement and that the facilities of the laboratory were to be increased by the addition of a 2,000,000-lb. testing machine. Reports of the board of directors and of the president disclosed a satisfactory year in the industry, with total shipments for 1922 estimated at 110,000,000 bbl., or 12 per cent above the country's previous high record. The attendance was the largest in the association's history—302 individuals, representing 72 of 86 member companies.

The address of the retiring president, L. T. Sunderland, of the Ash Grove Lime & Portland Cement Co., Kansas City, laid stress on the opportunities ahead, contending that there is not only much need for broader and more persistent educational work but for additional research into the uses and character of the product. He declared that the association's newspaper advertising has been effective in informing the public regarding the industry.

Committees Report

The Committee on Technical Problems, besides announcing the research into the constitution of portland cement (which will be carried on by Dr. J. C. Witt), placed stress on the importance of a comprehensive study now being made of the action of alkali on concrete. Field tests under a wide variety of conditions and with many mixes, as well as laboratory studies, are under way. The laboratory staff, now numbering 35, was strengthened this fall by the addition of H. F. Gonnerman. Gratification was expressed at the widespread acceptance and use of the proportioning tables based on the Abram's cement-water theory.

The Committee on Conservation listed a number of studies under way looking to economy in production.

A history of the portland cement industry, written by Robert W. Lesley and John B. Lober, past-presidents, was announced as having been completed.

F. W. Kelley, of Albany, N. Y., president of the Helderberg Cement Co., was elected president of the association for 1923. With him will serve as vice-presidents, Blaine S. Smith (Universal) and L. R. Burch (Atlas), as treasurer, Col. E. M. Young (Lehigh), and as newly-elected directors, Carl Leonardt (Southwestern), W. D. Lober (Vulcanite), L. T. Sunderland (Ash Grove), C. B. Condon (Hawkeye), F. H. Smith (Lawrence) and Loring A. Cover (Security).

A gala banquet in honor of the close of the first twenty years of the association's life terminated the meeting. John R. Morron, president of the Atlas Portland Cement Co., New York, and Rev. David J. Evans, Th.D., of Kansas City, were the speakers. Mr. Morron paid high tribute to those who had successfully led the association in the past, and recalled that at the association's inception, in 1902, the industry's an-

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Power Commission Makes Second Report

Construction on Projects Totaling Nearly Million Horsepower Under Way—More Licenses Issued

Progress under the federal water-power act is detailed in the second annual report of the Federal Power Commission covering the period up to July 1, 1922. Due to the many years' delay in securing adequate federal legislation it was but natural that a flood of applications should have followed immediately upon approval of the act. Nevertheless, during its second year there have been filed with the commission applications aggregating a net total of 5,000,000 hp. of proposed installation. This amount, added to the applications of the preceding fiscal year, makes a grand total of 357, involving in excess of 21,100,000 horsepower. Nearly one-half of the aggregate is represented by applications upon the St. Lawrence, Columbia, and Colorado Rivers, upon which, in general, action has been suspended. The St. Lawrence involves international relations and may require a treaty before action can be taken. The Columbia has been under investigation by a special board to determine, before applications are approved, the relation between water power, irrigation, and navigation upon that stream. Action on the Colorado River is awaiting the findings of the Colorado River Commission. There has been criticism in certain quarters that the definition of navigable waters as contained in the Act is not sufficiently clear, and that the Act should be so modified or the definition so interpreted by the commission that the limit of navigability on any stream may be determined with such exactness that no one need ever apply to the commission for its determination.

"The question of navigability," says the report, "is not one of mathematical formulas, and there is no more probability that it can be removed from the domain of individual judgment than that our laws in general can be drawn with such precision that the services of the courts in their interpretation can be dispensed with. The decisions of the commission in the individual cases presented to it will establish precedents which will gradually clear the situation. Three re ent cases on interstate streams, the Saco River, running from New Hampshire into Maine, the Connecticut, a boundary between New Hampshire and Vermont, and the Menominee, a boundary between Wisconsin and Michigan, are indicative of the policy the commission is pursuing. The first two are actually carrying property in interstate commerce in considerable quantities in the form of logs and pulp wood, and the third is suitable for such use. All three are, therefore, technically navigable; but due to the fact that in each instance the laws of the state afford full protection to such commerce, and that the proposed dams would not obstruct it, the commission made formal finding that the streams were not 'navigable waters' within the definition of the Act, that the proposed dams would not affect the interests of interstate commerce, and that, therefore, no federal license was required for their construction. The commission does not propose to extend its jurisdiction in this respect beyond the point where some substantial interest of interstate or foreign commerce is involved."

Of the power projects authorized up to June 30, 1922, work has been started and in some cases completed on 27, with a total power capacity of 853,448. Of these the table herein details the data on those having a power capacity of over 5,000 hp.

POWER PROJECTS STARTED UNDER WATER POWER ACT

License No.	Owner	River	Power Capacity Hp.	Installed Hp.
16	Niagara Falls Power Co	Niagara River, N. Y....	341,505	572,230
20	Utah Power & Light Co		5,120	21,000
67	South. Calif. Edison Co..........	Big Creek, Calif........	158,000	545,000
78	Western States Gas & Elec. Co...	American River, Calif	6,400	8,100
82	Alabama Power Co............	Coosa River, Ala....	21,700	100,000
96	San Joaquin Light & Power Corp.	San Joaquin River, Calif..	10,250	45,000
108	Wisc.-Minn. Light & Power Co...	Chippewa River, Wis........	10,043	20,000
120	So. Calif. Edison Co..........	San Joaquin River, Calif..............	55,000	195,000
135	Portland Ry., Light & Power Co....	Clackamas River, Ore................	25,300	30,000
175	San Joaquin Light & Power Corp	Kings River, Calif	161,000	266,000
184	El Dorado Power Co............	American River, Calif.......	30,000	100,000

I.C.C. Denies Advance Access to Valuation Field Notes

The Interstate Commerce Commission has denied to the Chicago, Rock Island & Pacific R.R. and the St. Louis-Southwestern R.R. advance access to the field notes taken by its employees on valuation work, until a formal hearing either before it or before a court of competent jurisdiction. These roads sought copies of the notes on accounting, engineering and land appraisal.

The commission held that it would not be in the public interest to reveal to any railroad in advance of the hearings the data upon which its tentative valuations have been based. Such a course, it asserts, would unduly prolong the valuation and make it difficult to obtain uninfluenced expert opinion. The railroads contend that they should know before the hearings the identity of the experts whose views have contributed toward the establishment of the tentative valuations, which have been determined without consulting the roads.

I.C.C. Resumes Investigation of Railroad Brake Equipment

The Interstate Commerce Commission on Nov. 8 resumed its investigation of air-brake systems, begun last May. This is the second session on the subject. One or two other hearings will be held later and the investigation probably will be concluded in January. The first days of the November session were devoted to direct and cross-examination of representatives of the Automatic Straight Air-Brake Co., who placed forty-eight exhibits before Examiners Mullen and Borland.

All corporations producing and marketing power-brake systems for railroad rolling-stock will be heard before the examination is concluded, as well as representatives of users.

Heavy Power Demands Are Made on Niagara System

It is officially announced that owing to the rapid increase in the power load of the Niagara system the Ontario Hydro-Electric Power Commission has notified consumers that their present demands must not be exceeded until the fourth generator of the Queenston plant has been installed. The amount of power generated and purchased by the commission is now in excess of 525,000 hp., of which approximately 183,000 hp. is being supplied by the three Queenston generator units.

The work of completing the installation of the fourth unit is being pushed with all speed and it is expected it will be ready for service about Dec. 1. The commission hopes to have sufficient power with which to meet all requirements of the system during the peak-load period of the winter months.

Gregory Commission Reports on Ontario Hydro Activities

The Hydro-Electric Inquiry Commission, locally known as the Gregory Commission, has issued an interim report covering its investigations into the Nipigon power project of the Hydro-Electric Power Commission of Ontario, Canada. The Gregory commission was appointed by the lieutenant-governor of the province to inquire into all power developments undertaken by the Ontario commission, general matters of expenditure and administration.

The report just issued deals with the history of the Nipigon venture and reports that the Hydro-Electric Power Commission of Ontario omitted to publish an estimate of the maximum price at which power would be supplied, and of the probable cost of the development. The original project, the report continues, was for a $3,000,000 development at Dog Lake. After the by-laws had been passed, however, the Hydro-Electric Power Commission of Ontario changed its plans, entering into a $12,000,000 enterprise at Cameron Falls on the Nipigon River.

The original rights on the Cameron River were held by the Great Lakes Pulp & Paper Co. and the chairman of the Hydro-Electric Power Commission, anxious to secure those rights for the commission, negotiated a deal with the Great Lakes company obligating the commission to supply the company with power. However, it failed to bind the company to take power when it was available, a failure which has been a severe blow to the commission's revenue. As a result of these losses and others, the present deficit, according to the Gregory Commission, is $340,000 a year and is likely to be three-quarters of a million annually before the tide turns.

State Buys Havre de Grace Bridge

On Nov. 22 the Susquehanna River bridge between Havre de Grace and Perryville, Md., was bought by the State of Maryland for $585,000. The structure was formerly used by the Pennsylvania R.R., and was sold by it to private parties some years ago when the railroad built a new bridge. Since then it has been operated as a toll highway bridge, and with the growth of automobile traffic it is said to have returned large earnings

Cement Association Reviews

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nual production was only 17,000,000 bbl. whereas this year it will be in the neighborhood of 110,000,000. As for the future, he suggested that the industry should have a man who would stand to it as Will Hays does to the motion-picture industry and Judge Landis to baseball.

An index to the industry's contribution to the public, he said, was furnished by data showing that "a bushel of wheat, a bushel of corn, a ton of hay, a pound of butter, a barrel of flour, a tierce of lard, a side of bacon, a barrel of salt, a pound of sugar, a bushel of potatoes, a bale of cotton, a ton of coal, a ton of steel rails, a thousand bricks, or the wages of a laboring man, in July, 1922, would purchase from 30 to 250 per cent more cement at the plants, than in 1892.

Mr. Morron also showed that bituminous coal delivered at his company's largest plant during three months of 1922 cost more per ton than was received for the manufactured product in which the coal was used.

Industry's Importance

"The cement industry," continued Mr. Morron, "handled millions of tons of stone, inert and useless, blasted from field and hillside; guided through scores of intricate processes, and converted at last into impalpable powder shipped to every nook and corner of our land. As if by the magician's wand, transformed again to stone,

"to make safe and sanitary the isolated home of the farmer;

"to house the product of his field in silo and in elevator;

"to span alike stream and river and chasm;

"to revitalize the value of town property in making possible the massive and towering architecture of our cities;

"to build the tunnels and subways through which the weary worker speeds in comfort and in safety to his country home;

"to girdle the hemisphere with permanent roads as smooth and hard as the floors of palaces;

"to cut in two the maritime distance from coast to coast and to make possible the union of our Atlantic and Pacific oceans;

"yes, and to build the very foundation upon which rests our Goddess of Liberty who beckons and guides the oppressed of other nations to our shore.

"Broadcast and advertise these facts, and the government will join with the public, not in criticism but in marveling at what one industry has added to the progress of the generation without undue profit and without undue gain."

Dr. Evans, in a discussion of industrial progress, called attention to the tendency of leaders of industry to take leadership, as well, in matters of social progress. Only by industry itself righting its wrongs—of low wages, excessive hours, unhealthful working conditions, etc.—could it hope to ward off the interfering hand of government. Co-operation in industry had accomplished much, as the work of the Portland Cement Association showed, but he believed that a further step was desirable, in a "roundtable of industry," at which the leaders of many industries could come together for the solution of the broader industrial problems.

New President of Portland Cement Association

F. W. Kelley, president of the Helderberg Cement Co., Albany, N. Y., was elected president of the Portland Cement Association at its annual meeting in Chicago last week. He comes to the highest office in the organization after many years of service as its treasurer and as chairman of its Committee on Technical Problems. An engineer by education (Cornell, M. E., '93) Mr. Kelley's first work was in the experimental department of the Consolidated Car Heating Co., of Albany, of which, by gradual promotion, he soon became general manager. His connection with the cement industry began in 1900 when he was made vice-president and general manager of the Helderberg company, just then in the process of changing its mill from a natural to a portland cement plant. He became president of the company in 1914.

The many difficulties involved in the manufacture of the more exacting product first aroused that interest in the technical problems of both production and use of cement which has characterized his work in the Portland Cement Association and which won for him his ten-year chairmanship of the Committee on Technical Problems. The bearing of that committee's activities on the association's work is readily appreciated by recalling the technical basis which has underlaid the major efforts of the association. Outstanding in the committee's accomplishments is the establishment of the Structural Research Laboratory.

Civic Activities

Mr. Kelley's energies, though heavily drawn on by his principal business and his association duties, have extended to many other fields. A leader in his own business community, he is now president of the Albany Chamber of Commerce, vice-president of the Albany Hospital, trustee of the Albany Medical College, director of the National Commercial Bank & Trust Co., and trustee of the City Savings Institute. His services to the Albany Hospital have been especially notable in that with the support of the professional staff he has been instrumental in introducing business standards into the accounting and hotel features of the institution.

His varied business activities have been matched by his work in professional societies. He is a member of the A.S.M.E. (chairman of its Cement Section), the A.I.E.E., the A.S.T.M. (on the executive committee of C-1), of the Joint Committee on Concrete and Reinforced Concrete, the Albany Society of Engineers, and of the Society of Engineers of Eastern New York (holding the presidency this year).

Rounding out his many sidedness is a sustained interest in rowing at Cornell, an interest born of his year in the freshman and two years in the varsity boat and capped by a long presidency of the Cornell Crew Association. Characteristic of the man is his belief that he owes much of his business progress to this crew experience—robust health and never-to-be-forgotten lessons of teamwork and concentration.

North Carolina Water-Works Men Meet at Gastonia

Special Correspondence

The North Carolina Section of the American Water Works Association met at Gastonia, Nov. 14-16, on the lower floor of the city's new 2-m.g.d. water filtration plant. The registration was 120, of whom 47 were superintendents, filter plant operators, etc. This large attendance led to the hope that the section would retain for another year the Hill cup, given annually to the section of the parent association that shows the largest membership increase during the previous year.

The chief discussions were brought out by J. O. Craig on "Water Rates," by W. McK. Moffitt and J. S. Bennett on "Universal Pipe," by M. N. Boyles on "Experience with Wood Stave Pipe," and by W. D. Gates on "Water-Works Superintendents' Responsibility for Fire Fighting." Mr. Gates stated that in the recent serious fire in Atlanta, the threads on hydrants had been so badly worn by use of hydrants for street flushing that their service for fire fighting had been greatly impaired.

A non-technical talk on what hydrogen-ion determinations mean to the water-works operator and the lines along which studies are being prosecuted to make this determination of greater practical value was given by Dr. E. J. Theriault of the U. S. Public Health Service. G. H. Cattlett, sanitary engineer, State Board of Health, and George D. Norcom, sanitary engineer of the Wilmington Board of Health described some investigations being conducted in North Carolina on hydrogen-ion determinations. Whereas Dr. Theriault had found that a pH value of 5.5 gave generally optimum conditions for precipitation of a floc from aluminum sulphate in North Carolina waters, the pH value for good precipitation ranged from 4.2 at Wilmington to 6.6 at other places.

The officers elected for 1922-3 are: President, E. B. Bain, Raleigh; vice-president, J. O. Craig, Salisbury; secretary and treasurer Prof. Thorndike Saville, Chapel Hill, N. C. The next annual meeting will be held at New Bern.

Prizes Offered for Best Essays on Municipal Government

Competition for the Morton D. Hull and the William H. Baldwin prizes for the best essay on municipal government have been announced by the National Municipal League. The Hull prize of $250 is "for the best essay on a subject connected with municipal government" and is open to post-graduate students in municipal government in any college or university in the United States where courses in the subject are given. The Baldwin prize of $100 is open to undergraduate college or university students registered where direct instruction in municipal government is offered. The subjects for 1923 are: (1) City Managership as a Profession; (2) The Non-Partisan Movement in American Cities; (3) The Functions of Municipal Bureaus of Information, Complaint and Legal Aid. Baldwin prize essays must not be over 20,000 words and Hull prize essays not over 10,000 words in length. Competitions for the Baldwin prize close Sept. 15, 1923, and for the Hull prize April 15, 1923.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.
AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.
AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-18.
AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.
ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

The New York State Assembly, American Association of Engineers, at its annual meeting held Nov. 11 at Albany, N. Y., elected the following officers: president, Gloster P. Hevenor, Rochester; first vice-president, W. L. Everett, New York; second vice-president, J. G. Norton, Binghamton, and secretary-treasurer, Lewis B. Smith, Rochester. The membership of the New York State Assembly is composed of the following chapters: New York City, Buffalo, Rochester, Albany, Binghamton, Utica, Hornell, Syracuse and Poughkeepsie. Total membership is about 2,000.

The Buffalo Section, American Society of Civil Engineers, at the bimonthly meeting on Nov. 23, was addressed by Gen. R. C. Marshall, jr., general manager of the Associated General Contractors of America, on "The Relation of the Engineer and Contractor in Construction." All the contractors of Buffalo and vicinity were invited as guests of the society.

Personal Notes

G. A. Crayton has resigned as office engineer with the South Dakota State Highway Commission and has accepted a similar position with the Illinois Division of Highways.

George Hubbell, West Norwalk, Conn., has been appointed building inspector of the City of Norwalk, Conn.

W. B. Honska, formerly resident engineer in charge of federal-aid work in Republic County, Kan., has been appointed county engineer of Rawlins County, Kan.

Charles H. Lee has been appointed lecturer in civil engineering at the University of California for the year 1923 and will conduct the course in water-supply engineering ordinarily given by Charles Gilman Hyde, professor of sanitary engineering, who will be absent from the university during the first half of 1923 on sabbatical leave. Mr. Lee will carry on the university work in addition to his regular consulting practice in San Francisco.

Chris P. Jensen, county surveyor of Fresno County, Calif., is a candidate for the office of director of public works of the State of California, an appointive position. During his incumbency a reduction of $250,000 in engineering supervision of road work has been secured. Also he is credited with the victory over the Warren Bros. Co., paving contractors, resulting in a saving to the county of more than $200,000 in royalties on a type of pavement designed by Mr. Jensen which was claimed to be an infringement on the Warren patents. In 1909 Mr. Jensen was appointed city engineer of Fresno, occupying that position for four years. In 1919 he took the office of Fresno county surveyor which he has held since.

Robert Isham Randolph, of the Randolph-Perkins Co., consulting engineers, Chicago, addressed the recent Chicago meeting of the Southern Commercial Congress, on "The Business and the Function of the Consulting Engineer." His purpose was to explain the important relation of the engineer and his work to public health and welfare, and to commercial progress.

J. S. Bentley, formerly a field engineer of the Kentucky State Highway Department, has been appointed county road engineer of Pike County, Ky., and will be in charge of road construction in that county after Jan. 1, 1923. This is Mr. Bentley's third appointment to this office, his first appointment having been made in 1916.

Joseph G. Shryock has just been appointed chief engineer of the Belmont Iron Works, designers, manufacturers and exporters of structural steel with plants at Philadelphia and Eddystone, Pa. Mr. Shryock has been at various times in the bridge and construction department of the American Bridge Co.; the engineering department of the Virginia Bridge and Iron Works, Roanoke, Va., and with the Belmont Iron Works as designing engineer.

John W. Shaffer will succeed E. E. Terrell as county engineer of Hennepin County, Minn., as a result of the general election held Nov. 7. Mr. Shaffer has maintained engineering offices in the New York Life Building in Minneapolis. Another change in county engineers will be that in Ramsay County, in which St. Paul is located, Paul N. Coates having been elected to succeed R. R. Godfrey.

A. Traver Newman, formerly with A. L. Webster, consulting civil engineer, New York City, has established consulting offices at 136 West 50th St., New York City. He will specialize in the preparation of plans and specifications for drainage, water supply, sewage disposal, supervision of installations, and special field identification of wrought iron and steel pipe. Prior to his association with Mr. Webster, Mr. Newman was with D. E. Waid, consulting architect for the Metropolitan Life.

W. M. Vandersluis has been appointed electrical engineer for the Chicago electrification and terminal improvements of the Illinois Central R.R., succeeding Hugh Pattison. Mr. Vandersluis was formerly signal engineer of the Illinois Central R.R., and later secretary of the commission appointed by the railroad to decide upon the system of electrification, as noted in *Engineering News-Record*, Nov. 16, p. 841.

Charles L. Andros, who has been in the office of the New York Commission of Highways for several years, has resigned his position as engineer to take up the practice of law.

Lorenzo C. Dilks, former vice-president of the George A. Fuller Co., New York City contractors, and prior to that president of the Carolina Shipbuilding Corp., and of Milliken Bros., Inc., has been made vice-president of Starrett Bros., Inc. The firm with which Mr. Dilks has lately become associated was recently organized to carry on a general contracting business. Mr. Dills' office will be in Chicago.

Daniel C. Cooper, former city engineer of Elkins, W. Va., has been appointed construction superintendent with the United States Gypsum Co. He is located at Oakfield, N. Y.

James C. F. Shafer has established a construction firm in Cleveland that will handle industrial construction particularly. Mr. Shafer for the past ten years has been in that general line of work both in civilian and military life. When he entered the service prior to the beginning of the World War he was general manager of the Dayton office of the Structural Concrete Co. Since his discharge from the army he has been vice-president of the Boldt Construction Co., Cleveland.

Obituary

John T. Dalton, of the firm of Ziegler and Dalton, general contractors of Junction City, Kan., died last week at his home in that city aged 67 years. Mr. Dalton's firm was widely known for construction work throughout the country at U. S. Army posts.

Lawson Bennett Bidwell, who retired in 1905 from active professional service, died in his home in Hyde Park, Boston, Nov. 19, aged 90 years. Mr. Bidwell was a former president of the Boston Society of Civil Engineers, had served as park commissioner of Hyde Park and had been active in railroad engineering in New England for a number of years prior to his retirement. He started engineering work with the Hartford, Providence and Fishkill R.R. at the age of 19. Subsequently, he became assistant engineer of the road, leaving in 1863 to work upon the construction of the Union Pacific R.R. He returned the following year to the Hartford, Providence and Fishkill, becoming chief engineer of that road eventually, in which position he continued until 1898 when that road was absorbed by the New York, New Haven & Hartford. He then became assistant engineer in charge of one-half of the system.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Federation Report Against 12-Hour Day

Three-Shift System Favored as Result of Survey of Forty Continuous Industries

RESULTS of a survey of forty continuous industries made by the Committee on Work-Periods in Continuous Industry of the Federated American Engineering Societies bear out the contention of John D. Rockefeller, Jr., that the two-shift system with its 12-hr. day is economically unnecessary and socially unwise. In a statement just issued by Dean Mortimer E. Cooley, of the University of Michigan, it was asserted that the views of Mr. Rockefeller represented "a tendency prevailing throughout the world" and that the United States was falling in line with Europe and Asia. The findings of the engineering committee, according to Bradley Stoughton, chairman of the Iron and Steel Committee of the American Institute of Mining and Metallurgical Engineers, applied generally to the steel industry.

Mr. Stoughton, formerly adjunct professor of metallurgy in Columbia University, conducted a special inquiry into hours of labor in the steel industry and reached the conclusion that three shifts of 8 hr. each should be adopted both from the standpoint of the industry itself and of the general public.

Favor Three Shifts

Horace B. Drury, of Washington, former member of the faculty of Ohio State University, who directed the general investigation of the engineering federation, asserted that, while "there is a natural divergence of opinion as to the advantages and disadvantages of the three-shift operation, the weight of the evidence and the most positive statements are in favor of the three-shift operation."

Dr. H. E. Howe of the National Research Council, Washington, who was chairman of the engineering federation's Committee on Work-Periods, said that the engineering view, based upon two years of scientific inquiry, was shared by high officials at Washington. Dr. Howe predicted that the engineering report on hours of labor, which, he said, would soon be presented in complete form, would engender industrial experimentation that might prove of advantage to the nation. The work of the engineer, he said, should be a large factor in bringing about a closer understanding between capital and labor.

J. Parke Channing and L. P. Alford, members of the Committee on Work-Periods, said that the general advantages accruing from the 8-hr. day compensated for any extra cost involved in the transition from the two-shift system of 12 hr.

Brick Manufacturers to Meet

The National Brick Manufacturers Association will hold its annual convention at Cleveland, Feb. 5-10, 1923.

To Show Centrifugal Process of Making Pipe in Movie

The centrifugal process for the manufacture of cast-iron pipe will be illustrated in a moving picture at the luncheon meeting, Dec. 6, of the New York Section of the American Water-Works Association. The session is scheduled for 12:30 p.m. on the eighth floor of the Palais des Beaux Arts, 40th St. and 6th Ave. After the picture has been shown there will be general discussion.

Engineers End Discussion of Winter Buying of Pipe

Opinion Indicates Feasibility of Equalizing Demand by Cutting Seasonal Peak

BELOW is given the concluding discussion by water-works engineers of the proposal made in *Engineering News-Record* of Oct. 19, p. 675, to reduce the cost of production of cast-iron pipe by equalizing the demand throughout the entire year instead of concentrating orders for delivery during the summer months:

> *In next week's issue the manufacturers of cast-iron pipe will submit a statement in rebuttal to the comment by the users of pipe and will make an important announcement of policy whereby both manufacturer and buyer will benefit.—Editor.*

CALEB M. SAVILLE
Manager and Chief Engineer,
Board of Water Commissioners,
Hartford, Conn.

From a manufacturer's standpoint the spreading of pipe purchases over the entire year would undoubtedly tend to lower production cost. Whether or not this would be appreciably reflected in the price to the consumer is problematical. From the theoretical viewpoint of conservation and as tending toward that general economy and efficiency of production which seems to offer the best means for promoting deflation of currency and lowering the price levels of commodities, the proposition of the pipe manufacturers seems basically sound. What is needed now is a practical working connection between producer and consumer—constructive suggestions. What follows is along the line of destructive criticism, but it is presented more as a warning of pitfalls than as an argument against the suggestion.

From the consumer's point of view, in the northeastern section at any rate, I am unable to find any benefit, and my observation would indicate increased costs and lessened economy. The desirability of avoiding disruption of pipe-laying gangs by cessation of

(Continued on p. 954)

Fabricators Form Institute of Steel Construction

Chief Work Will Be to Standardize Working Stresses and Design Tables

AFTER a year of active organizing work since its formation in 1921 the National Steel Fabricators' Association, at its meeting in Pittsburgh Nov. 23, changed its name to American Institute of Steel Construction in order to give better expression to the range of activities which the organization proposes to take up. Its present membership is 113 fabricating shops. J. L. Kimbrough was elected president, W. M. Wood vice-president and treasurer and the following as new directors: C. W. Russell, H. A. Dyer, A. B. Klingelhofer, C. A. Schneider, W. M. Wood and G. E. J. Pistor. L. H. Miller continues as managing director.

Addresses to the meeting were made by M. B. Lane, of the Census Bureau, and W. A. Durgin, of the Division of Simplified Practice, Department of Commerce. Mr. Lane requested the institute to co-operate with the Census Bureau in collecting data and statistics relating to the structural steel fabricating industry. Mr. Durgin offered the aid of the Department of Commerce in establishing uniform unit stresses and uniform practices, and in bringing about a reduction in the number of rolled sections used in the industry with a view to reducing the enormous industrial waste of the nation.

The principal work to be undertaken by the institute during the next year is the formulation of standard working stresses for structural work and for tanks, and the preparation of design tables for all steel sections based on these stresses; agitation for the adoption of uniform building law provisions relating to steel; extension of the uses of steel; and the discussion of questions arising between steel users and fabricators, such as uniform calculation of contract weights of steel.

A total producing capacity of about 2,000,000 tons of steel per year is represented in the institute, with an average of nearly 16,000 tons per shop. Records gathered by the managing director indicate that despite a steady growth in the country's fabricating capacity there has been 50 per cent decrease in the use of structural steel in the nine years from 1912 to 1921. Much of this decrease is believed chargeable to restrictive conditions unrelated to efficient building, which the institute will aim to change.

Invoke Anti-Dumping Law Against Canadian Building Felts

The Treasury Department has issued an order under the anti-dumping act against roofing and deadening felts imported from British Columbia, acting on information that such importations tend to injure the industry of manufacturing building felts in the United States. It was reported to the department that the imports were being sold at less than their fair value. Under the act, collectors of customs will place an additional duty on each importation of such felts, sufficient to equalize the price at which they are sold in the home market and in the United States.

End Discussion of Winter Buying of Cast-Iron Pipe

(Concluded from p. 953)

work during winter is often a problem of moment. Several years ago the plan was tried of working the pipe gangs after the frost had gone well into the ground. Streets were chosen where conditions were similar to those on work done during the summer and sufficient work was done to be assured that a fair comparison could be made. The cost was found to be about 15c. per foot more than in the summer—say between 9 and 10 per cent increase. To meet such increase on the basis of $55 per ton of pipe the foundry would have to offer a reduction of at least $6.32 per ton (0.15 x 2000/47.5 lb. per ft.) of Class B 8-in. pipe.

In Connecticut from the middle of December to the middle of March ordinarily there is frozen ground to a depth of from 3 to 4 ft. and in exceptional years it will go a foot lower. Excavated material thrown on the bank freezes solid during the night and will not usually thaw out during the day sufficiently to be shoveled without picking. When possible to pick out it is in lumps with size depending on the time taken to break it up. Backfilling with these lumps leaves a high and dangerous trench unless a large portion is left out. When the frost goes out in the spring there is considerable settlement which must be filled at an additional cost to the work. This phase is not included in the cost difference above.

Winter's Effect on Labor

The cost of trench work is only one item. Labor as a whole is much less efficient on cold days with short daylight than during the summer. When main and service pipe work is necessary under pavements in the winter time it is often necessary to entirely backfill with unfrozen gravel or sand brought from a distance, and then haul away the excavated material. This adds still another item to the cost. Comparatively little pipe is laid in swampy ground, but with a pair of horses and a stone boat for small jobs, and a caterpillar tractor if the work warrants, the cost of hauling would be about as cheap in summer as in winter, even if the soft places did not dry out. Besides this the danger of loss from breaking pipe in handling is less in summer than in winter.

It might be inferred from some of the text that much pipe is installed in country byways, or through uninhabited localities. In New England most of the pipe is laid in property developments, except supply mains, and is not laid then until there is a considerable prospect of getting proper returns. This means that the streets are laid out, often rough-graded, and must be left in passable condition, which is much easier of accomplishment in summer than in winter.

As to buying early and stringing out a long pipe line: At $55 per ton for pipe at f.o.b. Hartford, for every month that 8-in. pipe lies on or in the ground without use there is an added cost of ⅔c. per linear foot (1.32 x 0.06/12), or about 28c. per ton per month, for interest (6 per cent). For four months' receipt prior to laying this would amount to $1.12 per ton. In order, therefore, for it to be an attractive proposition to lay in a stock of pipe much in advance the purchaser would have to be assured that he was getting his pipe at least a dollar or so a ton less than it could be purchased in the spring. Under present conditions there seems no inducement for a consumer to purchase in the fall for use four or six months ahead, with no certainty that the base price may not be less the following spring.

The matter of a working connection between manufacturer and consumer presents many difficulties. As a suggestion, however, possibly the pipe manufacturer, in order to get work for the winter and make deliveries during that season rather than stock up his own yard, would be willing to bid on a discount from the market price in the spring. I realize that many objections will at once occur to many readers and probably they will have sufficient weight to render this proposition untenable. Nevertheless, if the suggestion of the pipe manufacturers is a sound one, and in principle it seems to be so, some way will be found to put it into practice.

From a water-works management viewpoint, it appears to the writer that in the northeastern portion of the country at least maximum efficiency and economy are best served by keeping watch of the market; purchasing only so far ahead in late fall as will give a reasonable supply of pipe for beginning work in the spring; placing ample orders for pipe early in the spring for definite delivery; and following these orders energetically to be assured that some more active or insistent pipe customer does not get his order run in ahead of yours at the foundry; and finally, prompt payment of pipe bills.

Plans Complete for Power Show

Arrangements have been completed for the National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City, Dec. 7-13. While the fundamental purpose of the exposition is to bring together exhibits of various manufactures of power and mechanical equipment so that engineers and executives may have an opportunity of becoming acquainted with the latest devices, the advisory committee has also kept in mind the need for a greater understanding of the importance of power and the need for the conservation of the resources used in power development. Accordingly, the educational nature of the exposition has been stressed.

The large number of technical societies interested in power and mechanical engineering problems have been invited to attend. Members of these societies will be admitted on displaying their badges or membership cards.

October Motor-Truck Production Shows Increase

Production of motor vehicles in the United States during October of this year exceeded September's production by 20 per cent, according to a report received Nov. 1 at a meeting of directors of the National Automobile Chamber of Commerce in New York. The total output for October is estimated at 244,000 cars and trucks; the best previous October record was 200,000 in 1919.

C. L. Berger's Death Ends Career of Noted Instrument Maker

Christian Louis Berger, well known as a maker of surveying and scientific instruments and head of the firm of C. L. Berger & Sons, Boston, died Nov. 19. While engineers are more familiar with the transits and levels which the Berger organization manufactured, other types of instrument developed by Mr. Berger were those for astronomical observations, current meters, pendulum apparatus, micrometers, spectrometers, and deep-sea thermographs used in sounding sea bottom. It was with instruments produced at the Berger factory that Rear-Admiral Peary made his observations during his expedition to the North Pole in 1909.

Mr. Berger was born in Stuttgart, Germany, Sept. 26, 1842. At the age of fourteen he was apprenticed to Christian Saeger, the well-known manufacturer of surveying instruments and chemists' scales, where he remained four years. From that time until he came to the United States in 1866 he served with the master instrument makers of Germany and England, including G. Schubart of Marburg, Breithaupt & Sons of Cassell, J. Lohmeyer of Hamburg, A. & G. Repsold, and Cook & Sons, of York, England.

Arriving in Boston at the age of twenty-four he became associated with E. S. Ritchie, of Brookline, Mass., manufacturer of physical and mathematical apparatus and nautical instruments. Here he served four years and after one year at John Upham's instrument establishment in Boston he entered business for himself in Boston in 1871 as a manufacturer of surveying, engineering, mining and astronomical instruments. Here, in a one-room establishment, began the growth of the business which has made the name of Berger a byword among engineers and scientists and has resulted in a manufacturing plant covering an extensive site in Roxbury, Mass.

In 1898 Mr. Berger took into partnership his two sons, William A. and Louis H., the firm name becoming C. L. Berger & Sons. Plans for enlargement of the present plant are now under consideration.

Business Notes

Arthur P. Denton has resigned as sales manager, Pacific Portland Cement Co., to become district engineer for the Portland Cement Association with headquarters at the San Francisco office.

Frank Nickerson, for nine years connected with the San Francisco office of the Midvale-Cambria Steel Co., has severed his connections with that company to accept the position as southern California manager for the Bethlehem Steel Corp. about Jan. 1 with an office in the Washington Building, Los Angeles.

Power Specialty Co., New York, builders of Foster superheaters, economizers and oil heating and cooling equipment, announces the opening of new branch offices in the Dime Savings Bank Building, Detroit, in charge of L.

Lanyi, and at 2324 Fourteenth St., Boulder, Colo., in charge of R. B. Nutting, who was formerly Chicago district manager.

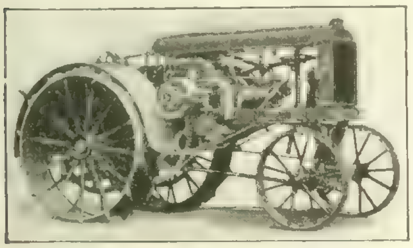
General Motors Truck Co., Pontiac, Mich., announces the appointment of Harry S. Whitehair to its national sales division. He will devote his time to sales to national organizations which use large fleets of trucks in all section of the country, paying special attention to companies which have headquarters outside of New York and Chicago, where other national sales division representatives are stationed.

Equipment and Materials

Improved Tractor Has Increased Power and Direct Drive

As a feature of its 1923 line of construction equipment the Avery Co., Peoria, Ill., announces the improved 20-35 hp. tractor. As shown in the accompanying view of this new model the cab has been eliminated, the fenders cover the full width of the rear wheel and extend from the platform more than half their circumference.

The hood running back from the radiator incorporates the fuel tanks



and affords a cover protection for the motor. The tractor is finished in French gray with red wheels.

Chief among the improvements in this model are the increasing of the power of the motor by 25 per cent, the adoption of a cooling system with cellular radiator, water pump and fan, and the use of the Madison Kipp mechanical lubricator for oiling the working parts of the motor. The tractor has a 4-cylinder opposed Avery motor with bore and stroke now 4¾ x 7 in. It has valves-in-head, renewable inner cylinder walls, centrifugal gasifier for burning kerosene, adjustable main crankshaft bearings and extra large crankshaft.

This machine also has the direct-drive transmission by means of which all the power of the motor is delivered to the belt and the greatest per cent in the drawbar. The weight of the tractor is 7,500 lb., making it, according to its manufacturer, one of the lightest weight tractors per drawbar efficiency.

Self-Propelling Nozzles for Cleaning Sewers

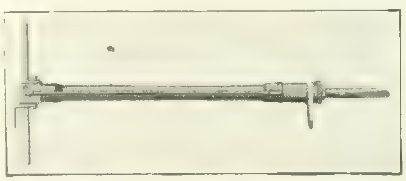
For removing obstructions in sewers and drains a revolving self-propelling nozzle has been developed by the Self-Propelling Nozzle Co., Inc., New York. It is made of bronze and consists of two castings, one threaded to connect with pipe or hose and the other the nozzle head. The parts are connected by a ball bearing swivel. The head, in which are a series of diagonal vanes to produce a rotary motion, has a small opening at the front and a series of larger holes at the rear, as shown in the accompanying drawing. Streams of water escaping through the rear holes propel the nozzle forward, while the stream from the forward opening loosens the material in the line of

travel. A pressure of at least 25 lb. per square inch is required for the efficient operation of this tool. The nozzles are manufactured in two sizes, the first with an outside diameter of 2½ in. and the second with an outside diameter of 3¾ in.

In using the nozzle it is customary to attach one end of the hose to a fire hydrant and insert the nozzle at the other end into the opening to be cleared. When water is turned on the nozzle travels under its own po r until it reaches an obstruction, dragging the hose after it. The forward stream of water bores a hole into any soft material in its path while the rear streams break up the blockade and wash it away. This nozzle has also been used for boring into piles of soft coal and extinguishing fires.

New Type of Rivet-Cutter

On the principle that when cutting rivets, a number of comparatively light, rapid blows cause more vibration and therefore more distortion of steel plates than a few intermittent, heavy blows, the Chicago Pneumatic Tool Co., New York, has designed and manufactured a new type of rivet-cutter known as the "Boyer Superior." It consists of a dead handle, a throttle handle of the crank design, a throttle valve of the taper type, a back head screwed onto the cylinder and secured by a locking device, a cushion chamber in the rear end of the cylinder, a cylinder of seamless steel tubing, a bypass from back to front head, a non-removable electri-



cally welded front head, square coiled spring buffer, adjustable chisel lock, hand hold of the spade handle type, and chisel.

To operate, the throttle handle is moved in a line parallel with the cylinder. Each forward and return stroke of the piston is hand-controlled. About four blows requiring approximately 10 to 15 sec. are required to cut off the head of a ⅞-in. rivet. Two men are required to operate the machine.

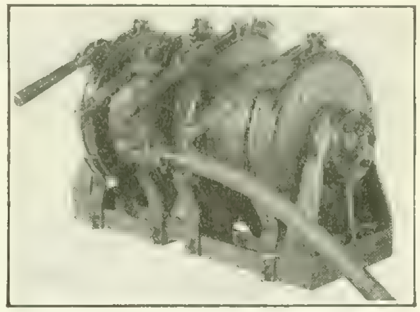
The machine is made in two types, standard and special, the weights (with chisel) being, respectively, 78½ and 86½ lb., and the overall lengths 69$\frac{11}{16}$ and 74$\frac{11}{16}$ in. An air pressure of 100 lb. per square inch is required and for both types the piston diameter is 2 in. and the length of stroke 29½ in.

Light Double-Drum Compressed-Air Hoist

While designed primarily for mining operations, such as hauling ore scrapers or slushing, the 6½-hp. portable, double-drum compressed-air hoist just announced by the Sullivan Machinery Co., Chicago, is adapted to industrial and construction purposes within its capacity. A Turbinair motor supplies power to the two hoisting drums, each 10¾ in. in diameter. A driving pinion at each end of the motor casing engages an internal gear in each drum shell. The two drums are controlled independently by friction clutches and band brakes and may be operated separately or together.

The hoist weighs only 555 lb., or about 85 lb. per hp., is 29 in. long by 15 in. wide and stands 18½ in. high. Each drum holds 225 ft. of $\frac{5}{16}$-in. wire rope. Either drum is capable of lifting 2,000 lb. dead weight vertically with 76 lb. of air pressure at a speed of 110 ft. per minute. Sufficient air can be supplied to the machine through a ¾-in. hose line to develop the machine's rating of 6½ hp.

The manufacturers point out that the hoist may be used on broom derricks where one drum is used for hoisting



the load and the other for operating the broom. The outfit also is useful on scraper loader work, removing such materials as coal, sand, gravel and crushed stone. One of these hoists has been employed for hauling broken stone up an incline to a crusher. The double-drum feature is useful in work of this sort because one drum can be used for hauling the live load and the other for returning the empty scraper to the loading point.

Publications from the Construction Industry

Paving Guard—W. S. Godwin Co., Inc., Baltimore, points out the uses of its steel paving guards in a recently published pamphlet. The guards are in the form of steel edging designed to prevent edge wear along curbs or furnish side support for paving surfaces.

Pressure Filter Specifications—Standard specifications for pressure water filters adopted by the Associated Manufacturers of Water Purifying Equipment on Feb. 7, 1922, are available for distribution in the form of a page reprint from Sweets' Architectural Catalog. Applications should be made to Arthur M. Crane, secretary-treasurer of the association named, Nutley, N. J.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Construction Cost and Volume Compared

Prices Now High and Fairly Steady—This a "Normal" Year; Only Necessary Construction in 1921

During 1921 general construction cost declined steadily from February to October. The decline was abrupt, amounting to 65 points or 28 per cent. Then prices began to stiffen, until the slump in February, since which time the tendency has been upward. The average *E. N.-R.* Construction Cost Index Number for the eleven months of this year is 173.4, while since Oct. 1 the number has been 188.60.

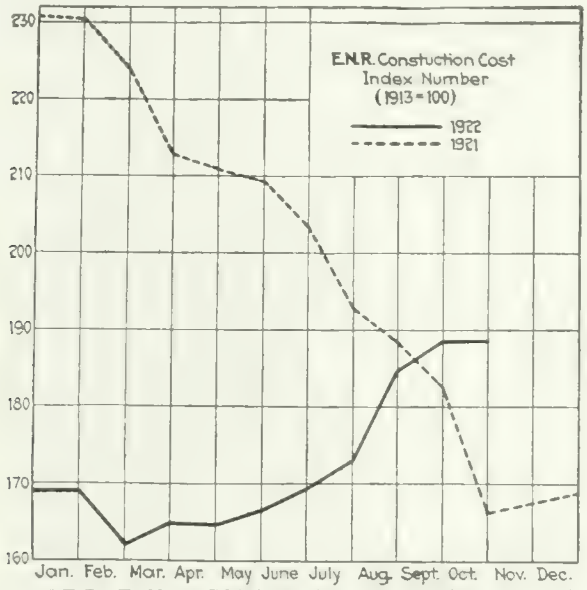


CHART I—*E. N.-R.* COST INDEX COMPARED, 1921-1922

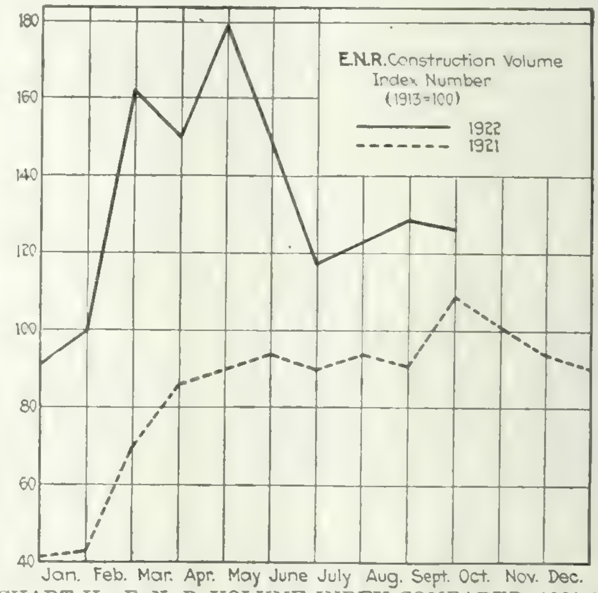


CHART II—*E. N.-R.* VOLUME INDEX COMPARED, 1921-1922

Indications point toward the present price level being maintained for some time to come. With the passing of the peak of car loadings (October) and when a sufficient number of freight cars are available it is quite possible that lumber prices will decline. Steel and cement prices are holding firm. The trend of labor rates is problematical and depends to a large extent upon the correctness of the American Federation of Labor's contention that there is no shortage of labor, either the skilled or unskilled. The United States Bureau of Labor Statistics and other statistical agencies claim that there is a labor shortage. In either event it is unlikely that labor will be further deflated at this time.

With respect to construction volume, the 1921 trend and the 1922 trend of contracts awarded as given by the *E. N.-R.* Construction Volume Index Number, are compared in Chart II. Clearly, this is a much better construction year than last. The 1921 curve is fairly smooth, indicatng that the bulk of the work was of a necessary character. Its appearance is spiritless. This year, on the other hand, there was a very evident and prolonged boom, with sub-booms. The 1922 curve gives an appearance of healthy activity that shows that the construction industry has regained interest in itself. The two curves have totally different characteristics, for the reason that 1922 may be called a "normal" year, whereas last year was one of only necessary construction.

A New Theory of Business Cycles

A unique and rather convincing theory of Business Cycles is brought out in the *Annalist,* November 13, 1922, by Richard H. Tingley in which he analyzes the six cycles with their seven crises or panics which have occurred since the Civil War.

This is done by means of several diagrams on which have been plotted, month by month and year by year, the ratio found to exist between loans and discounts on the one hand, and deposits on the other, in certain important commercial banks.

On one of the diagrams this ratio is shown as made by all of the national banks of the country. On another, the same ratio referring to the banks belonging to the New York Clearing House. In every instance it is clearly shown that the seven crises have been approached by a sharply rising ratio of loans and discounts to deposits—in other words, as the banks have continued to loan more and more money than they have on deposit, a crisis is precipitated and liquidation ensues.

Mr. Tingley suggests that, since his principle has been found to work with unerring accuracy over a period of fifty-seven years which include seven crises, it may be profitable for business men to keep track of this ratio, week by week, as it is easily read in the daily prints, and he introduces a final diagram, which was reproduced in *Engineering News-Record,* Nov. 16, p. 864, showing the progress of this ratio during the present year. The diagram shows that the ratio, having fallen sharply, is now on the rise, throwing out its warning signal as it does so.

In the *News-Record* excerpt it was clear that if it were possible to obtain the total loans and the total deposits of all the banks in the United States at any given minute the result would be very close to 100—or parity. But a large number of these are not commercial banks and Mr. Tingley has confined his analysis to such, only, choosing for his purpose the really crucial banks of that character as representative of the trend of the country's business.

Car Loadings Drop 4 Per Cent and Shortages 2 Per Cent in Week

Loading of revenue freight continues at the present time to be the heaviest in the history of American railroads, according to reports received from the carriers by the American Railway Association.

For the week ending Nov. 11, loadings totaled 953,909 cars, which is an increase of 198,132 compared with the corresponding week last year, and an increase of 26,323 compared with the corresponding week in 1920. The total, however, was a decrease of 40,918 cars compared with the preceding week due to Election Day and the observance of Armistice Day throughout the country, both of which took place during the week of Nov. 11. Coke loadings totaled 12,273 cars, 632 above the week before. Compared with the same week last year, this was an increase of 5,896 cars, but a decrease of 2,837 cars compared with the same week two years ago. Forest products amounted to 60,392 cars, a gain of 379 over the preceding week, and an increase of 9,626 above last year. Compared with the same week in 1920 this also was an increase of 4,136 cars.

Coal loadings for the week ending Nov. 18, reached 238,833 cars, a new record for any single week since the termination of the miners' strike.

Car shortages, on all lines throughout the United States, for the week ending Nov. 8, totaled 174,498 as against 179,239 for the week of Oct. 31; this represents a drop of 2 per cent.

"Fair Minimum American Standard of Living"

Cost of maintaining a "fair minimum American standard of living" (which, however, is not necessarily a measure of the minimum wage) in Lawrence, Mass., the result of a field study of actual conditions prevailing among mill workers' families in June, 1922, at height of textile strike, made by the National Industrial Conference Board,is given in the accompanying table. These figures measure only minimum cost of living and allow nothing for saving.

MINIMUM COSTS IN LAWRENCE, MASS., MILL DISTRICT

	Parents and 1 child		—2 Children—		—3 Children—	
	Year	Week	Year	Week	Year	Week
Clothing	$167 36	$3 22	$197 64	$3 80	$227.92	$4.38
Food	304 20	5 85	384 80	7 40	465.40	8.95
Rent	208 00	4 00	260 00	5.00	260.00	5.00
Fuel and light	79 88	1 54	82 70	1.59	82.70	1.59
Sundries	163 28	3 14	200 20	3 85	237.12	4.56
	$922.72	$17.75	$1,125.34	$21.64	$1,273.14	$24 48

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 279 to 290, are the following:

Railway, from Orchard to Perkins, Idaho, for Oregon Short Line R. R. Co., $3,180,550.

Dormitory, two and three stories, limestone, for Pennsylvania State College, $2,000,000.

Rein.-concrete warehouse for State Board of Harbor Commissioners, San Francisco, Calif., $2,000,000.

Recent Unit-Bids Throughout the Country

Representative unit-bid prices of various materials and operations, applying on several of the more important contracts awarded during the last two months, are shown in the accompanying table.

Cost comparisons, on identical materials or operations in different parts of the country, are depicted in the tabulation. For instance, a rate of 23.4c. per cu.yd. was bid on earth excavation in Waterloo, Ia. as against 40c. in Garden City, Kan.; 70c. in Houston, Tex. and $1 per cu.yd. in Newark, N. J. Structural excavation, however, cost 75c. in Brownsville, Tex. as compared with $1 per cu.yd. in Salt Lake City, Utah. The rate for rock excavation in Utah was $2, with $3 per cu.yd. for the same operation in New Jersey. In wet excavating work, a rate of 25c. per cu.yd was bid on harbor dredging in Providence, R. I.

UNIT-BID PRICES ON IMPORTANT MATERIALS AND OPERATIONS IN RECENT CONTRACTS AWARDED

Where located	Successful Contractor	Date	Nature and Extent of Job	Unit-bid price
Calif., San Diego	California Constr Co.	Nov. 23	2.2 mi concrete paving	23,909.09 per mi.
Calif., San Jose	Raisch Improvement Co., San Francisco	Nov. 2	134,870 sq.ft. 1½ in. asphaltic concrete on 3 in. concrete	0.24 per sq.ft.
			135 sq.ft. concrete gutter	0.24 per sq.ft.
Fla., West Palm Beach	So. Florida Dredging Co., Ft. Lauderdale	Nov. 9	1,430,000 cu.yd. ditching	0.0874 per cu.yd.
Ia., Ft. Madison	Cameron, Joyce & Co., Keokuk	Oct. 26	236,447 cu.yd. clay excavation	0.249 per cu.yd.
Ia., Waterloo	Phelan & Shirley, Omaha, Neb	Nov. 9	137,143 cu.yd. earth excavation	0.234 per cu.yd.
Kan., Garden City	M. R. Ammerman, Wichita	Nov. 16	2,595 cu.yd. earth excavation	0.40 per cu.yd.
			8,350 cu.yd. borrow	0 35 per cu.yd.
			11,746 sq.yd., 2 course concrete	2.57 per sq.yd.
Kan., Mound City	R. S. Morrow, Omaha, Neb	Nov. 2	20,871 cu.yd. earth excavation	0.28 per cu.yd.
			182,423 cu.yd. borrow	0.22 per cu.yd.
			268.1 cu.yd concrete	19.75 per cu.yd.
			17,910 lb. reinforcing steel	0.06 per lb.
Mo., Kansas City	D. T. Brosnahan	Nov. 9	9,129 sq.yd. brick block pavement	3.96 per sq.yd.
			2,462 lin.ft. 6-in. drain tile	0.20 per lin.ft.
Mass., Boston	Lane Construction Co., Meriden, Conn.	Oct. 8	8 mi. bituminous macadam, 16 ft wide	38,426.88 per mi
N. J., Newark	Heyman & Goodman Co., Jersey City	Oct. 19	100 cu.yd. earth excavation in tunnel	20.00 per cu.yd.
			8,400 cu.yd. trap rock excavation in tunnel	21.00 per cu.yd.
			16,400 cu.yd. sandstone excavation in tunnel	18.00 per cu.yd.
			30 M. ft. b.m timber in tunnel	100 00 per M. ft.
			10,900 cu.yd. concrete masonry in tunnel	12.00 per cu.yd.
			13,000 cu.yd. earth excavation in open cut	1.00 per cu.yd.
			11,500 cu.yd. rock excavation in open cut	3.00 per cu.yd.
			750 cu.yd. reinforced concrete	17.00 per cu.yd.
			10 cu.yd. brick masonry	35.00 per cu.yd.
			27,000 bbl. cement	4.00 per bbl.
			48,000 lb. concrete reinforcing steel	0.06 per lb.
			50 cu.yd. sand, gravel and crushed stone	7.00 per cu.yd.
			2,300 lin.ft. vitrified pipe	0.70 per lin.ft.
N. Y., Buffalo	Penn Bridge Co., Beaver Falls, Pa.	Oct. 12	3 dump scows (steel), 400 cu yd capacity	30,706.67 each
N. Y., New York	P. J. Kearns Contg. Co.	Nov. 9	4,000 cu.yd. broken trap rock stone	2.93 per cu.yd.
N. Y., New York	Rosoff Sand & Gravel Corp.	Oct. 26	1,000 cu.yd. course aggregate for concrete, delivered on job	2.90 per cu.yd.
O., Canton	Urvan Bros.	Nov. 2	2 mi. monolithic brick paving, 16 ft. wide	34,380.00 per mi.
R. I., Providence	J. S. Packard Dredging Co.	Nov. 9	41,200 cu.yd. harbor dredging	0.25 per cu.yd.
Tex., Brownsville	F. P. McElwrath, Corsicana	Oct. 9	17,431 cu.yd. earth excavation (roadway)	0.16 per cu.yd.
			577 cu.yd. dry structural excavation	0.75 per cu.yd.
			279.94 cu.yd. class "A" concrete, 1:2:4	24.00 per cu.yd.
			26,790 lb. reinforcing steel	0.055 per lb.
			110,650 sq.yd. two-course concrete pavement	2.83 per sq.yd.
Tex., Ft. Worth	McKinzie Constr. Co., San Antonio	Sept. 26	100,000 cu.yd. earth excavation	0.55 per cu.yd.
			100 cu.yd. class "A" concrete	9.50 per cu.yd.
			10,000 lb. steel reinforcing	0.05 per lb.
			10 tons class "A" c.i pipe	80.00 per ton
Tex., Houston	Smith Bros. Constr. Co., Dallas	Nov. 23	1 mi. bitulithic paving, 40 ft. wide	63,466.00 per mi.
Tex., Marlin	Natl. Cast Iron Pipe & Fdry. Co., Tarrant City, Ala.	Oct. 1	562.5 tons 12-in. c.i. pipe, f.o.b. Marlin	51.00 per ton
Tex., Houston	Smith Bros. Constr. Co., Dallas	Oct. 5	11,000 cu.yd. earth excavation	0.70 per cu.yd.
			32,750 sq.yd. 6-in. concrete base	1 40 per sq.yd.
			13,300 lin.ft. combined curb and gutter	1 00 per lin ft.
			34,250 sq.yd. asphaltic concrete surface	1.60 per sq.yd.
			34,250 sq.yd. 2-in. rock asphalt surface	1.70 per sq.yd.
Utah, Salt Lake City	Moran Paving Co.	Oct. 10	6,500 cu.yd. solid rock excavation	2.00 per cu.yd.
			68,725 sq.yd. plain concrete paving	1.09 per sq.yd.
Utah Salt Lake City	Gibbons & Reed	Oct. 18	4,416 cu yd common excavation	0.80 per cu.yd.
			428 cu.yd. excavation for open drains	0.30 per cu.yd.
			123 cu.yd. structural excavation	1.00 per cu.yd.
			43,238.3 sq.yd. 7½ in. concrete pavement	1.15 per sq.yd.
			31 lin.ft. plain concrete curb and gutter	1.20 per lin.ft.
Wash., Olympic Highway	Ward & Ward, Inc., Tacoma	Oct. 10	138 cu.yd. class "A" concrete	25.00 per cu.yd.
			40,000 lb. reinforcing steel	0.07 per lb.
			353,000 lb. structural steel in place and painted	0.075 per lb.
			4,000 lin.ft. piling	0.50 per lin.ft.
Que., Montreal	Duranceau & Duranceau	Nov. 23	2,000 sq.yd. asphalt paving	5 56 per sq.yd

and 8.74c. for ditching in West Palm Beach, Fla.

Two-course concrete pavement was laid at a cost of $2.57 in Kansas and $2.83 in Texas. Combined curb and gutter bids were accepted at $1 per lin.ft. in Houston, Tex. and $1.20 in Salt Lake City.

Reinforcing steel rates were as follows: 5@5½c. per lb. in Texas; 6c. in Kansas and New Jersey and 7c. in Washington, delivered at site of job.

Open Shop Rule Governs Building for U. S. Commerce Chamber

Contract for the construction of the new $2,500,000 Washington headquarters of the Chamber of Commerce of the United States has been awarded to James Stewart & Co., of New York. The contract cont ins a provision that the builders must observe the principle of the "open shop" in the employment of labor.

This item is provided for by the following clause in the specifications:

"The actual construction of the building is to be upon the 'open shop' basis—that is, that union and non-union men shall be employed without discrimination, it being understood that the building committee of the Chamber of Commerce of the United States shall provide such means as in its best judgment shall be impartial and disinterested for prompt review and decision with respect to the interpretation and application of this clause."

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 279 to 290, are the following large projects:

Hospital at Camp Sherman, Chillicothe, O., to Geo. A. Fuller Co., Cleveland, $1,497,000.

A bakery at Philadelphia, Pa., to J. Griffith Sons Co., Chicago, Ill., $1,000,000.

State highways, 50.12 mi., Duluth, Minn., to Butler Bros., St. Paul, $1,369,-033.

Two schools, Philadelphia, Pa., to Cramp & Co., $428,562 and $444,297, respectively.

A school at Philadelphia, Pa., to McCloskey & Co., $406,666.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 2; the next, on December 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.14	$3.95	$4.40	$3.02½	$3.15	$3.85	+$3.35	$3.80	$3.75
Structural rivets, 100 lb.	3.85	4.60	6.00	3.75	4.00	4.80	+4.75	4.25	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.04	3.85	4.00	2.92½	3.05	3.85	+3.35	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	53.95%	45%	59½%	57–5%	41%	39.2@51.8%	40%	30.00
Cast-iron pipe, 6 in. and over, ton	55.30	+47.50	55.00	51.17	+55.50	63.61	53.00	55.00	55.00
Concreting Material:									
Cement without bags, bbl.	2.60	2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd.	2.00	1.75	2.25	2.25	1.75	1.90	—2.15	1.00	1.50
Sand, cu.yd.	1.00	1.32	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.10	1.65	2.25	2.25	3.50	—2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59.00	—36.00	40.00	51.00	39.75	39.75	35.00	+23.50	50.00
Lime, finishing, hydrated, ton	16.80@17.17	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	+18.00@18.55	11.50	9.90	11.00	18@19	12.00	+15.50	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	.0796	.065	....	.11	.09
Hollow partition tile 4x12x12, per block	.1230	.0776	.115	.0808	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	—.90	.97	1.07	.95	1.00	1.08	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	......	......	....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 10c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and sh vel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par.) Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Although shapes, plates and bars are holding to the $2 level; some mills have shown willingness to cut under this price to the extent of $1@$2 per ton, at mill. Reinforcing bars, however, are quoted at $2.10 per 100 lb., f.o.b. Pittsburgh, for delivering in first quarter of 1923.

San Francisco warehouses advanced shapes and bars to $3.35 per 100 lb., from $3.30, during the week. Rivets are also quoted 25c. per 100 lb., higher. Warehouse prices in other cities continue to show firmness.

Easing of the car situation has caused a reduction of 10c. per cu.yd. in gravel and crushed stone in San Francisco. Prices unchanged in other cities.

Pine lumber dropped $2 per M ft. in Atlanta, during week, while Douglas fir rose $1.50 in Seattle. The chief difficulty in the yellow pine market is shipments of old orders; the car situation being still badly out of line. Slight improvement, however, is reported in some sections.

Common brick quoted at $15@$15.50, alongside dock New York, an advance of 50c.; San Francisco reports $15.50 as compared with $15 per M.

New York quotes raw linseed oil at 90c. per gal. (5 bbl. lots) as against 93c., last week; prices stable elsewhere.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

Volume 89 NEW YORK, DECEMBER 7, 1922 Number 23

A Ray of Hope

ENCOURAGEMENT is to be derived from the announcement by President Butler of Columbia University that in the budget of 1922 the committee on education had recommended to the trustees the creation of ten professorial positions each to pay $10,000 a year and twenty-five such positions each to pay $7,500. Meagre salaries for college and university faculties have come almost to be accepted as an inevitable feature of educational practice, and it is stimulating to see a professorship listed with a $10,000 salary even prospectively. While this announcement deals only with the higher grades in the ranks of the teachers, it sets up a standard that sooner or later must exert a beneficial influence upon salaries all the way down the line.

An Interstate Pact

NO NATURAL problem in the United States today is as far-reaching or so varied in its implications as the control and development of the Colorado River. Every one of the seven states through which it flows wants its water for power and irrigation and those lying in its lower alluvial plane must in addition have protection against its overflowing banks in time of flood. Beside this the federal government has concern with its potential navigability and its relation to the foreign country through which it passes to the sea. Millions must be spent on the Colorado in this generation but hardly a cent can be spent until some amicable agreement is reached between the bordering states as to their respective rights and privileges. Such an agreement has just been signed by the states' representatives but will not be effective until ratified by the legislatures which will meet within the year. The compact signed at Sante Fe is obviously a compromise but it is a fair compromise upon which a start toward construction can be made, especially by the federal government which must initiate, at least, the great work on the river. Obstruction on the part of any one state now can only hold back progress to the detriment of that state as well as its neighbors.

Typhoid from a Cross-Connection Again

ANOTHER addition has been made to the list of typhoid outbreaks due to a cross-connection between a municipal and an industrial water supply, this time in New Jersey. The Franklin Furnace outbreak, noted in our News of the Week section, is unusual in that both the industrial and municipal supplies are owned by the same company and in that no charge is made for water supplied for domestic use. It seems to be a case of cross-connection unknown to the operating officials, protected by a single check valve that, as so often happens, didn't protect. The check valve, it seems, has gone untested because its existence was unknown. How to ferret out these forgotten or neglected cross-connections is a question for water-works and health board men. The fact that this particular cross-connection and valve probably admitted polluted water to the municipal system during an underwriters' fire test suggests that whenever such tests are made on fire-protection supplies known to be or suspected of being cross-connected with domestic supplies, some one of the highly colored chemicals available for the purpose be introduced in the fire-protection supply and looked for at taps connected with the domestic supply.

What is Sand?

SOME months ago in discussing in these columns the difficulties of technical nomenclature, mention was made of the ambiguities lurking in the definition of so simple a material as sand. In Washington just now this has official exemplification in a case before the Treasury Department. In the new tariff law "sand, crude or manufactured" is on the free list and "silica, crude" is taxed $4 per ton. "When is silica sand," and vice-versa, are questions now being asked the Customs Division. An accepted authoritative definition of sand would no doubt help the government in its ruling. The obligation resting collectively on engineers to establish precise nomenclature extends far beyond the immediate needs of the profession.

Building Piers to Order

MUCH mystery surrounds the exact status of the great shipping-pier group which the city of New York has built at Stapleton, on the harbor side of Staten Island, but it is evident that the lessees are anything but happy in their possession of the piers and are trying to get out of such contracts as they may have made. Such a situation is a condemnation of the city's theory of pier layout, which has been repeatedly criticized on other grounds. The city, it will be remembered, holds that piers are intended to accommodate the steamship companies who lease them and that the lessee's wishes as to design are governing. On that basis the Stapleton piers were designed, with resulting details far from those approved by the consensus of expert engineering opinion. These details, it was answered, suit the lessees. They are paying for them; the city gets a fair return on its investment. What more could one ask? The answer has now come. The lessees, at least some of them, do not want the piers and there is a fair chance that they cannot be made to keep them, so the city is left with some special made-to-order goods and the job of finding someone they will fit. How much better it would have been to make standard goods and then try to market them.

Adding to Knowledge

IT HAS already been suggested in these columns that the construction of every engineering work gives occasion for researches which will improve the work itself and in addition will add to the general knowledge of the profession. The column tests for the Philadelphia-Camden suspension bridge, outlined in this issue, afford an

instance of such researches. Though a committee had been occupied with column testing for nearly ten years, rather recently, many important detail questions remained untouched, among them that of web strength. Hence the present tests. Unless we mistake the attitude of the engineers of this great work, the tests described will not be all or even the largest part of the research work likely to be carried out in connection with the bridge, but every major point in which doubt as to most economical or safest proportioning appears will be studied both by analytical calculation and by practical test. The undertaking thus will be utilized to the full for adding to the stock of engineering knowledge. We assume that the same spirit will prevail in dealing with the details of the tests, so that, for example, the results will be studied not only for the conclusions of immediate importance to the tower design but for all the facts and conclusions contained in the test data. There is room, as every one knows, for more knowledge in the delicate and always interesting field of column design. Similarly, there is room in many other departments of engineering for fuller and more precise knowledge. Every investigation that is made to help in the construction of an engineering work can be made to contribute some of the missing knowledge and advance the efficiency of the engineer's art.

Departmental Reorganization

PERSISTENT rumors come from Washington that the long sought reorganization of the government departments will be presented to Congress at this session. Let us hope that it will. There has been altogether too much pussyfooting and inside maneuvering in the two years since the Brown commission started its study of the departments. It is time that some tangible scheme be brought onto the floor of Congress and its merits and its defects exposed in the ensuing committee hearing. The economies which will result from a proper rearrangement of the federal bureaus are just as self-evident as are certain the struggles with which most of those bureaus will resist such rearrangement. Let us get the discussion out into the light where everyone can see wherein lies the opposition and can evaluate it.

Aerial Photographs by the Engineer

ANY reasonably good amateur photographer using an ordinary camera can take photographs from an airplane that are of value in engineering work. Suggestions for work of this sort are presented in the article by F. H. Tibbetts in this issue, in which he makes clear the distinction between accurate vertical aerial photos for mapping and oblique aerial photographs taken to give perspectives and to serve general utility purposes. Accurate aerial maps call for trained operators and special photographic apparatus not commercially available. Perspective or bird's-eye views, on the other hand, such as can readily be made by the amateur with equipment to which he is accustomed, have proved so useful in engineering work done by Mr. Tibbetts that he urges other engineers to consider their use. Instead of thinking of aerial photographs as something entirely out of reach, or at best to be contracted for with an aerial photographer, it is urged that an airplane and pilot, now available for commercial work in all parts of the country, be employed by the engineer and that he make the flight himself, taking such pictures as will be useful and at the same time gaining the advantage of an aerial reconnoissance.

An engineer's duty is ordinarily but half done when he has obtained a correct solution of the technical problem presented. He must convince non-technical but vitally interested citizens, voters, directors and executives of the merits of the work which he recommends and must keep the general public informed concerning the progress of construction work in which it should have an interest. Aerial photography furnishes one of the most promising fields for informing, educating and interesting the public in great public enterprises. Looking at the matter from a broader viewpoint, it should be remembered that although the conquest of the air has been a peculiarly American achievement, future air supremacy, a matter of overwhelming military importance, will depend in large degree upon the maintenance of a trained aviation personnel in peace times. Pride in a great American invention, far-seeing patriotism and scientific interest, as well as practical results on the particular piece of work in hand, should all combine in enlisting the support of the practising engineer in the more extended and more general use of the airplane and aerial photography.

Credit to the Old

IN THIS era of ultra-heavy railroad standards and daily retirement of old track and structures for heavier ones, it is refreshing to learn that a bridge built in the days of wrought iron and light loads has done its work regularly for nearly thirty-five years and is unimpaired. Many features of the arrangement and construction of this bridge might be called into question, in spite of the fact that it was designed by one of the masters of the bridge engineering art of a former generation, Theodore Cooper; but its service record silences these questions and vindicates Cooper's judgment and skill. The case is a timely reminder of the truth that the engineering of the past will bear comparison with that of the present. Although each year fewer of the old-time works survive the demands of modernization, most strikingly so in the field of iron bridges, we may still learn from what our predecessors did, whether we see it in its surviving form or must take it from printed records. The new generations can learn from the past.

Every art as it becomes more fully developed tends to follow fashions—it becomes conventionalized in a way, or, as we like to say nowadays, standardized. However excellent the elements of the preferred, selected practice, the engineer who uses them will nevertheless miss something if he does not retain part of the versatility and greater freedom of thought that characterizes earlier stages of development. In bridge practice this is particularly true. The stimulus or even inspiration flowing from the works of earlier masters is vital to the power of bridge engineering thought. Herein lies the distinguishing value of the study of an old-time structure, even when of such plain and apparently routine type as the old Newburyport bridge.

Much more valuable, however, than the historical feature of the case is the remarkable instance which it presents of continuing old material in full-efficiency service in spite of the handicap of different inherent strengths of the original and the added metal. The reconstruction shows the faith which the engineer may properly place in an old structure on careful scrutiny

of its service record and its condition. The engineers of the Boston & Maine are entitled to all possible credit for having the courage to use the old on the same rating as though it were new. Further, the method by which the steel and the wrought iron are combined and each is given its appropriate stress affords an instructive model. The part played by the transverse members in distributing the load by making the structure integral as regards deflection is exactly the same as that played by the floorbeams in the latest reconstruction of the Poughkeepsie cantilever bridge, where the old three-truss structure formerly proportioned for double-track loading now carries a single track.

After noting the various interesting details of the reinforcement method, the reflections of the engineer who reads of the work are likely to turn back again to a fundamental question at issue in its planning: whether a wholly new bridge should be built or the old one brought up to full strength by reinforcement. A difference in cost was involved in this decision, and also the somewhat less tangible question of the desirability of a reinforced bridge. On the latter point different engineers entertain sharply different views. Many are inclined to favor new construction and—unjustly, we think—to place a low valuation on a reinforced structure, as being a piece of patchwork. The decision reached on the Boston & Maine tends to oppose this latter attitude, and to strengthen regard for old material and old structures by showing in a practical way how they can be applied at full value to the service of today.

Common Sense Garbage Disposal

EVERY city that is contemplating heavy capital outlay and uncertain, but surely considerable, operating expense for garbage disposal, or that feels itself burdened with expense and other troubles incident to existing means of disposal, should weigh carefully the experience of Seattle, Wash., reviewed at length on p. 876 of our issue of Nov. 23. In a sentence, Seattle scrapped three refuse incinerators of the British type after three years of use and for seven years past has got rid of its garbage at relatively low cost by the "sanitary fill" method of disposal—dumping garbage, ashes and other refuse in low places and keeping the dump surface and slope covered with earth or ashes.

From the Seattle experience it does not follow that every other city should abandon incinerators or reduction works or hog feeding if any one of these means of garbage disposal is in use, or should pass by all these methods for the sanitary fill in case the problem is being faced for the first time. The two first principles to be observed here as in any other field of engineering are (1) that each well tried method available for solving the problem in hand should be considered in view of all local governing conditions and (2) that the experience of other cities with all these methods should be studied and each given its proper weight, again in the light of the local conditions of the city immediately concerned.

A strong reason for close study elsewhere of the Seattle experience before adopting plans for garbage disposal is that incineration, particularly in high-temperature destructors, was strongly advocated in many quarters for two decades as by far the best method of garbage disposal for American cities. Disposal by reduction was often and unwisely scored as necessarily unsanitary. If hog feeding was mentioned it was only to be condemned. Disposal by dumping was also scored, usually without recognition of the fact that a light covering of dirt or ashes, as is practiced at Seattle and has been practiced at smaller places under intelligent direction, would convert an objectionable dump into a sanitary fill. And beyond all this, it was urged that garbage disposal is a vital public health matter and that fire is the only safe means of disposal.

What every city needs to know and act upon today is that fundamentally garbage disposal is a matter of city cleansing rather than of public health, and that the main object in choosing a method of disposal and operating a disposal plant is to get rid of the garbage at the lowest possible cost consistent with the production of a reasonable minimum of offense to sight and smell. In addition, every city needs to know that the country is dotted with abandoned garbage disposal plants, of all types; due partly to unwise original choice of method to suit the local conditions, partly to poor design by inexperienced engineers and promoters, but most of all to failure of the appropriating and administrative authorities of our cities to recognize that garbage and refuse disposal is an engineering problem, as regards both the design and *operation* of plants.

Unfortunately most of the engineers of the country, even those in the municipal service, know little about garbage disposal. For a hundred engineers who have specialized in water or sewage treatment we have only one or two who have mastered garbage disposal. Consequently in the all-too-rare cases where a city council or board calls on some member of the city engineering staff for advice, the chief gain is not in having the advice of an experienced specialist, but in getting an engineering view of the problem. That is an unquestioned gain in all cases and a great gain in some, but it does not take the place of advice from a specialist, and but few of our cities have engineering staffs from which a competent man can be detached and given time to inform himself as to garbage disposal.

Until conditions in garbage disposal as a part of the general city administration and also as a branch of municipal engineering are improved, it would be a wise course for every city to go slowly in choosing or changing a method of garbage disposal. This is particularly true just now in view of the present high costs of construction and operation of garbage disposal plants and of the low revenues from such methods of disposal as produce a return that helps reduce cost.

For some cities the sanitary-fill method practiced at Seattle would serve at relatively small cost for at least a few years, while for other cities, mostly smaller ones, burial in shallow trenches would be cheap and satisfactory. Hog feeding, under intelligent supervision—but no more intelligent than is needed to operate a destructor or reduction plant—deserves continued trial. As for either incineration or reduction, let every city beware until one or the other has been advised by a competent garbage specialist, after as long and detailed an investigation of local conditions as may be necessary, with particular attention to the relation between collection and final disposal. And even if the specialist advises incineration or reduction, let every city government shun either unless there is assurance of placing and keeping the plant in the hands of a competent chief operator, keeping the operating staff out of politics and, last but not least, unless there is a fair chance that following city administrations will not refuse appropriations essential to proper plant operation and upkeep.

Construction Methods and Plant on the Marseilles Lock

River Between Mixer and Lock Crossed by Cableway, Movable Bridge and Ferry Boats — Excavation Kept Just Ahead of Concrete to Avoid Disintegration of Shale Foundation

METHODS of transporting materials to the site were the controlling construction problems in building the Marseilles lock of the new Illinois waterway near Lockport, Ill., particularly as the Illinois River is between the lock and the nearest railway. At the lock site the width of the river in round figures is about 700 ft. Flood water and ice in large volume in spring and fall characterize the stream and any means of across-river carriage had to take these conditions into account. A secondary controlling factor was the blue shale rock of the lock foundations. This shale disintegrates rapidly into clay and excavation was controlled by the progress which could be made in concrete construction since the foundation bed could not be left long uncovered. Altogether the excavation amounted to 243,000 cu.yd. and the concrete to 60,000 cu.yd., with 89,000 lb. of reinforcing metal.

Marseilles lock as described in *Engineering News-Record*, Dec. 2, 1920, p. 1095, is one of a series of locks on the new waterway, a planned improvement to make the Desplaines and Illinois rivers navigable for 6-ft. barge transportation between Lockport and Utica, Ill. It is a concrete structure about 938 ft. long overall with a lock chamber width of 110 ft. The concrete is contained chiefly in the side walls, which are gravity walls, with filling and discharge culverts in their lower sections. The site is on dry land away from the river with which connection will be made by future canals. Water has caused no serious trouble. Indeed, except for the river intervening between lock site and railway and for the poor rock bed, practically no natural conditions entered to complicate the construction problem.

From the construction viewpoint the outstanding operations were: Plant layout, excavation, and concrete work. It should be noted also that a form of contract was employed which put the burden of risk for fluctuating prices and wages largely on the owner. Each of these factors of the work is considered by itself.

Plant Layout—An electric railway parallels the right or north bank of the river across from the lock. There are also highways on both sides of the river. The electric railway was selected as the main route for delivering material and a spur was swung south and forked into yard tracks as shown by Fig. 1. By this arrangement all materials were brought in car loads to the yards where a locomotive crane did the switching and unloading. Prior to the construction of the yard tracks some hauling to the lock site was done by trucks from Marseilles over the road on the south bank.

With the completion of the yard tracks means of transportation across the river were undertaken. At first a ferry was established to haul supplies. Above the ferry a stationary cableway of about eight tons capacity and a span of 1,300 ft. was erected on 100-ft. towers. This cableway handled materials and served also the secondary purpose of installing and dismantling the movable wooden bridge located directly underneath.

Concrete materials formed the bulk of the freight brought into the yard and as they had to be unloaded here it seemed logical instead of trans-shipping them across the river to do the mixing at the yards and haul the mixed concrete across the river. Truck haulage

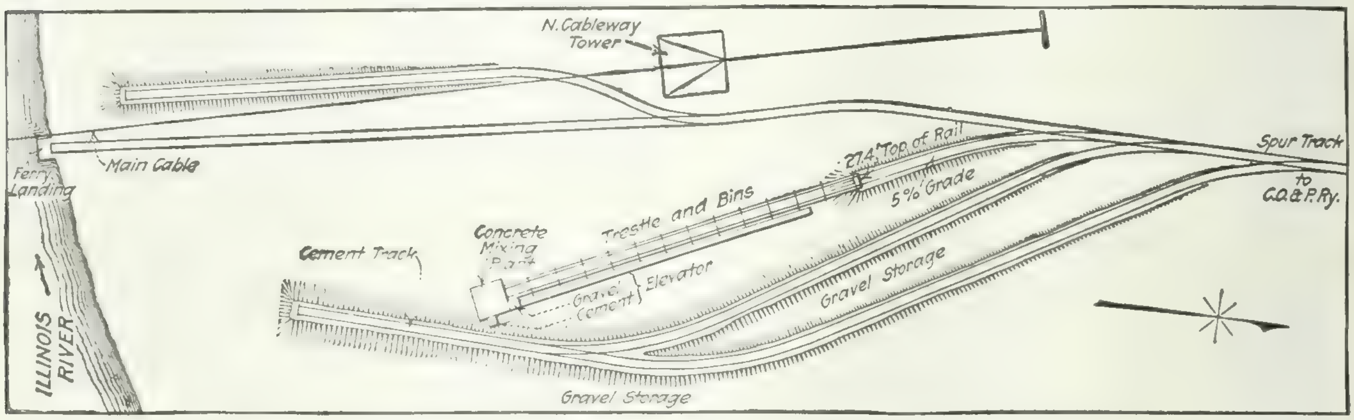


FIG. 1—CONTRACTOR'S YARD LAYOUT ACROSS RIVER FROM MARSEILLES LOCK

was decided on and the bridge mentioned provided the roadway across the river. It was designed to be removable because a fixed bridge, which would withstand the high water and ice, could not be installed at a reasonable price. A permanent bridge which would meet the requirements for navigable river crossings was not warranted by any future use to which it could be put. The removable bridge then was the distinctively novel feature of the construction plant.

A bridge 700 ft. long of the design shown by Fig. 2 was constructed so that it could be disconnected and removed or set up in units as indicated by Fig. 3. Dowel pins in the bottoms of the posts were sufficient to anchor the bents to the soft shale of the river bottom when the water was 8 ft. deep and had a current of 3½ miles. Normally the water was only 4 ft. deep. About 75 M. ft. b.m. of lumber were required. Each bent was designed for a load of two trucks carrying a cubic yard of concrete each. The bridge has been removed and installed every fall and spring and in emergency has been dismantled in a few hours.

The structures described, with the storage and mixing units, which are described farther on, and with shops, offices and a camp for the workmen, completed the plant. The work of installation was begun Nov. 6, 1920, and continued during the fall and winter.

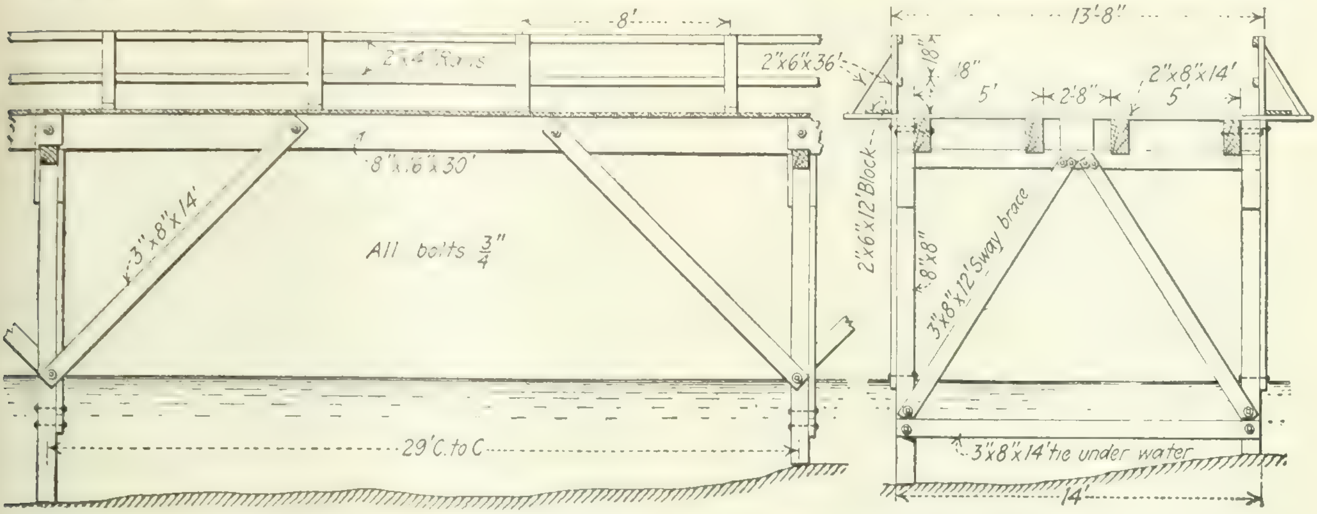


FIG. 2—REMOVABLE BRIDGE FOR TRUCKS HANDLING WET BATCHES

Excavation—There were about 116,000 cu.yd. of earth and 127,000 cu.yd. of rock to be removed for the lock emplacement. Some 40,000 cu.yd. of the earth were taken out with teams and graders and the remainder with a small steam shovel loading into wagons. The rock was a blue shale which had to be blasted but broke very easily and disintegrated quickly when exposed. Well drills put down 20 and 30-ft. holes for the main cut and jackhamers were used for trimming blasts and breaking large blocks. The material was excavated and loaded into 9-cu.yd. 30-in.-gage dump cars by a railroad-type steam shovel. Three-car trains hauled by dinkies took the spoil to dumps on both sides of the lock. Here on the shallow dumps good service was given, pulling down the dumped spoil by a portable backfiller for trenches. This device, it was estimated, saved 20 to 30 men which otherwise would have been needed to keep the fill pulled down so as to give the cars a clear way for dumping.

In the final cut which shaped the rock for the concrete, very slow progress was made purposely. The shale could not be left long uncovered without going to pieces and so the work was done no faster than space was needed for placing concrete. In these circumstances efficiency and output records signify nothing important. In fact this statement is true of the whole lock construction. At any reasonable rate of progress the lock would be completed long before it could be of any possible use and so the contractor was not held to specified progress and found it preferable not to hurry.

Concrete Construction — All concrete (about 60,000 cu.yd.) is mixed on the north bank and hauled in wet batches to the lock. It is proportioned 1.3 bbl. cement to 1 cu.yd. of bank-run gravel, to make 1 cu.yd. in place. Fig. 1 shows the location of the mixing plant at the end of one of the yard tracks and in relation to the other plant units and the stockpiles. An inclined trestle about 200 ft. long carries the track approaching the mixing plant and is arranged as shown by the section, Fig. 4, to form a bin for the gravel which is brought in hopper-bottom cars. A 24-in. belt conveyor 175 ft. long, with a capacity of 50 cu.yd. per hour, takes the gravel through traps in the bin floor and delivers it to the boot of a bucket elevator delivering into a bin above the mixers. The trestle storage provides for two or three days' supply and adjacent stockpiles provide for emergencies.

Cement is received in bulk and the cars are unloaded

FIG. 3—CABLEWAY ERECTING REMOVABLE BRIDGE
View shows mixing plant and head-tower of cableway at the contractor's yard. The lock is on the side from which the view is taken.

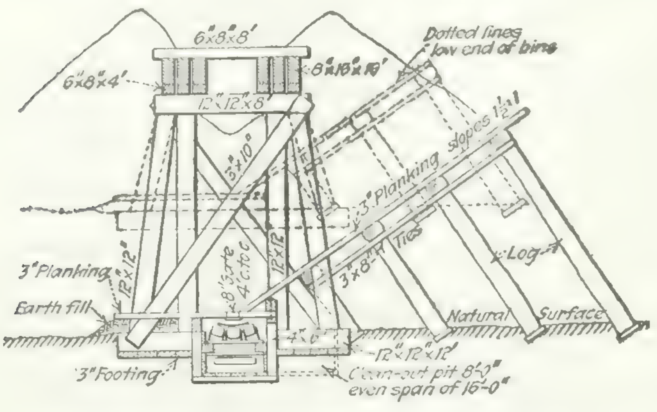


FIG. 4—SECTION OF GRAVEL STOCKPILE TRESTLE

by an automatic power unloader into the boot of a bucket elevator delivering to a bin above the mixers.

Three or four carloads can be handled in a day. The cement bin holds about 500 bbl. and there is a house for an emergency stock in bags. The contractors have found bulk cement to be more economical to handle than cement in bags.

The mixing plant, as shown by Fig. 5, is a notably compact structure with a duplicate mixer installation. Separate power units, measuring devices and bin gates make the operation of each mixer absolutely independent. Each mixer is 1-cu.yd. wet-batch capacity. Two 50-hp. upright boilers supply steam for the mixer engines, two engines for the elevators, one engine for the car hoist in the trestle and a surplus for heating the gravel in the mixer bins by means of jet pipes.

As shown, the mixers are mounted just high enough to discharge into trucks which carry 1-cu.yd. self-dumping bodies. Twelve are employed. They cross the bridge onto plank runways which end at the lock in the platform and hopper shown by Fig. 1. Chutes lead from the hopper to the place where concrete is being deposited, their lower ends being carried by small portable hand derricks.

Wood forms are used in all places except for the wall culverts which are molded by steel forms. For the uniform sections of the walls the forms are mounted on car trucks for shifting and when in use are blocked up and braced. The steel forms for the culverts consist of separate upper and lower sections as half of the culvert is molded with the footing and half with the lower section of the wall.

Records of concrete placing signify little for the reasons stated in discussing excavation. At no time has the capacity of the plant been reached and at times 600 cu.yd. of concrete have been placed in a day.

Contract Practice—As the contract was let in October, 1920, when wage scales were still unsettled and prices and freight rates were uncertain, a special form of contract was drafted by which the state assumed the major part of the risk due to possible increase. Briefly, a schedule of wages and prices was agreed upon. It was then provided that if any increase occurred in either, the state should absorb 80 per cent and the contractor 20 per cent. Any increase in freight rates was to be absorbed wholly by the state.

While this contract met the 1920 situation and got reasonable bids and, indeed, has worked well enough, it would probably not be considered for use again under present conditions. One principal fact brought out was that the ratio of price or wage increase or decrease to be absorbed by the contractor is too small. His gain is so

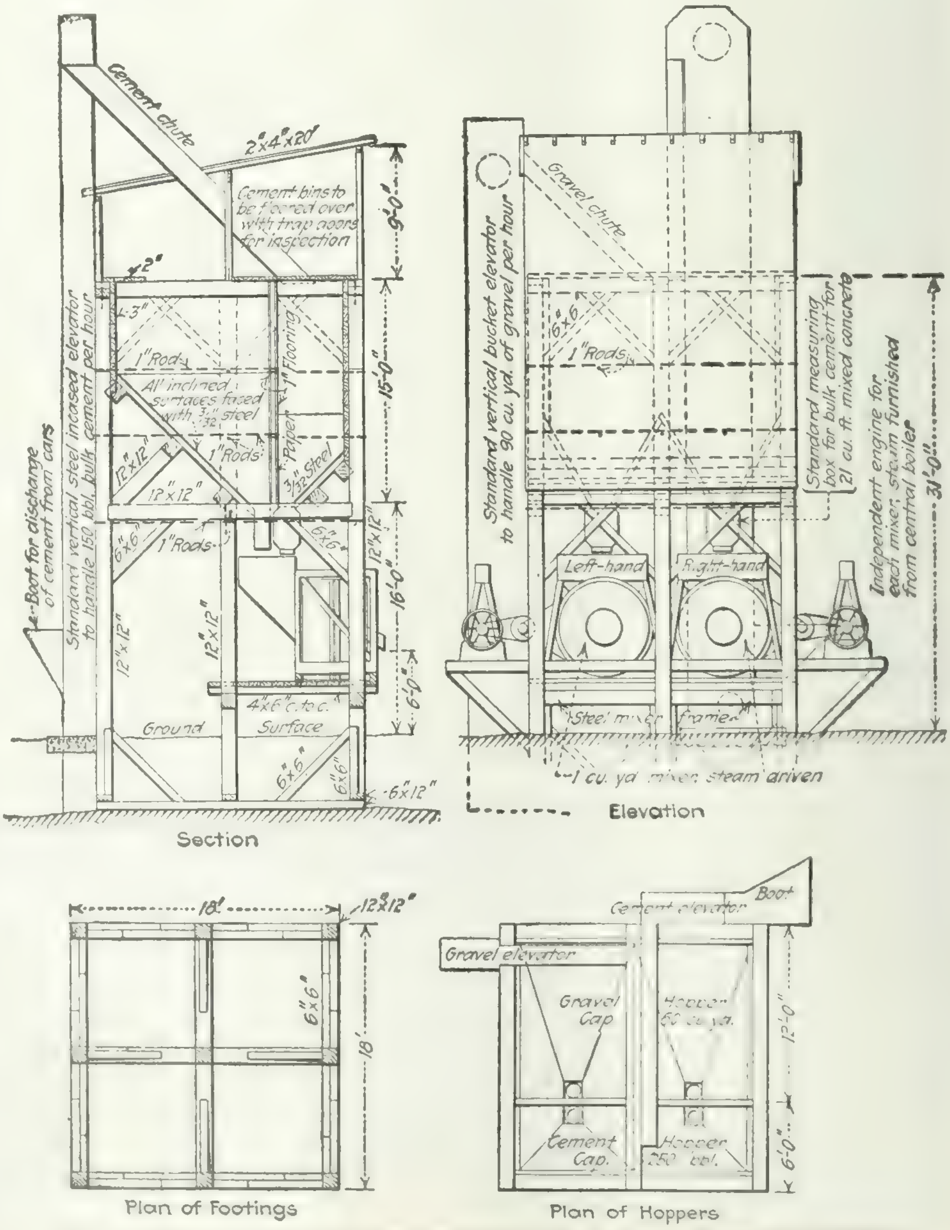


FIG. 5—DETAILS OF MIXING PLANT WITH DUPLICATE MIXER EQUIPMENT

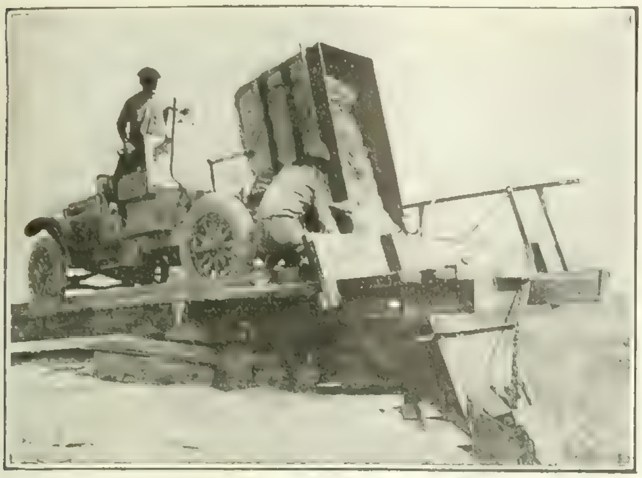


FIG. 6—DUMP-BODY TRUCK HAULS WET BATCHES
Receiving their loads at the mixing plant these trucks crossed the removable bridge onto plank runways ending at the lock in the dumping platform shown.

little from a reduction that he will not make great effort to force wages down if there seems to be a prospect that by so doing trouble may be had with the men. As an emergency resort the special contract proved valuable but it will not be employed in future work for the waterway.

Outstanding Features—Reviewing the lock construction operation the things which stand out prominently are:

1. Placing concrete by a procession of small handling units any of which can be dropped out without affecting the efficiency of the others is believed to be more flexible and to give greater assurance of continuous output than large capacity single-unit concrete transporting devices.
2. Wet batches hauled up to 2,000 ft. suffered no deterioration that called for remonstrance by inspectors. Seldom more than 10 minutes elapsed from the time the mixer was discharged until the concrete was deposited in the forms.
3. By wet-batch haulage in trucks an opportunity is afforded of choosing a location for mixing plant and stockpiles far enough away from the structure to get advantages of space not possible near it.

The Men in Charge—The Illinois Waterway Project was planned and construction started under the direction of the Waterways Division of the Illinois State Department of Public Works. M. G. Barnes is chief engineer of the Waterways Division and L. D. Cornish is assistant chief engineer. Roy Shackleton is superintendent and Ralph A. Bonnell is engineer for Green & Sons Co., the contractors. The state is represented by J. Bassett, division engineer at Ottowa, and Ralph S. Heath, resident engineer on the work.

French Hydro-Electric Developments

Of a total of 2,100,000 hp. of electrical energy at present in use in France, 650,000 hp. is for lighting, heating, and minor power; 1,300,000 hp. for industrial use; 50,000 for traction purposes; and 100,000 for agricultural and other miscellaneous uses. French industries are being educated to the substitution of electricity for steam power wherever electrical energy can be made available, and although the market in France for American machinery and equipment is hampered at present by the depreciation of French exchange, a much greater demand for American goods of this nature will most certainly accompany the return to more normal conditions.

Small Iron Removal Plant for the Water-Works of Leroy, Ohio

Aerator, Roughing Filter and Rapid Sand Filter Treat Well Water for Town Built by Ohio Farmers Insurance Co.

By A. Elliott Kimberly
Consulting Engineer, Columbus, Ohio

IN JANUARY, 1922, the Ohio Farmers Insurance Co., of Leroy, Ohio, placed in service a small water-works comprising a flowing well, low-service pumping station, iron removal plant, high-service pumping station, a 50,000-gal. elevated tank and about 1.37 miles of 6-in. cast-iron pipe. Leroy is in the southwestern portion of Medina County and has a population of about 300. The town was virtually created by the insurance company to provide for its home offices and to house its officers and other employees, who comprise practically the entire population. The rock waters of Medina County are hard and high in iron, and in two other instances, namely at Wadsworth and Lodi, plants have been provided for the removal of iron. Since the design of the Leroy plant has one or two interesting features, a description of it with some analytical data may be of interest to those concerned in iron removal from other chalybeate waters of this type.

Source of Supply—The flowing well at Leroy, originally drilled for gas, is located about 0.9 mile west of the center of the village. In drilling, a large vein of water was struck about 75 ft. beneath the surface and about 38 ft. in the Cuyahoga shale. When gas operations were abandoned, an 8-in. capped casing was left in the upper part of the hole. The water is under artesian pressure and in the summer of 1921 gave a measured flow of approximately 0.15 m.g.d. The water flows into a pump well, whence it is forced to the iron removal plant about 1,600 ft. distant.

In developing its properties, and in providing for the housing of its employees, the Ohio Farmers Insurance Co. has made Leroy a very picturesque village under the guidance of experienced landscape engineers. On this account it was necessary to locate the water plant away from the center of the village and to make it as inconspicuous as possible. Particular attention was paid to the architectural features of the building so that the plant would harmonize with the type of structures already built at Leroy. These considerations controlled the design of the plant which provides separate pumping stations for low and high service with the arrangements for iron removal installed within the high-service pumping station building.

Iron Removal Plant—The iron removal plant comprises an aerator, roughing filter, rapid sand filter and clear well, housed in a 31 x 36-ft. brick structure. The water from the low-service pump enters the aerator and then flows successively to the roughing filter, sand filter and clear well. The plant was designed for a capacity of 150,000 g.p.d., and provision is made for a second filter unit.

Aerator—Under a residual pressure of from 8 to 10 lb., the raw water enters a pipe reservoir, located on the roof of the pumping station building, and constructed of 8-in. cast-iron pipe, supported in a concrete basin 10 x 22 ft. in plan, covered to a depth of 12 in. with 1 to 3-in. limestone. At either end of the pipe reservoir are five No. 4 1½-in. Binks spray nozzles, $\frac{5}{8}$-in. orifice, each

with a capacity of about 11.2 g.p.m. at 10 lb. pressure. The aerator is completely surrounded with a wooden louver 10 ft. high.

Roughing Filter—The aerated water flows into a perforated grid supported above the roughing filter. The latter is a concrete tank 10 x 6⅝ ft. in plan containing 6 ft. of ⅜ to 1½-in. limestone. The roughing filter is provided with valves for backflushing and is so designed that when idle, free passage of air takes place within the limestone "contact" material.

Sand Filter—The main or sand filter, which contains no features differing essentially from standard practice, consists of a concrete box having an area of 65 sq.ft. and containing 23 in. of Ottawa sand with an effective size of 0.40 mm. and a uniformity coefficient of 1.5, supported by a 4-in. layer of coarse (torpedo) sand, this in turn resting upon 17 in. of graded gravel. The underdrains comprise a manifold of 8-in. cast-iron pipe tapped with lines of 2-in. galvanized-iron pipe provided with ¼-in. holes on the lower side. Wash water is applied at a rate of 20 in. vertical rise per minute from a 5,400-gal. tank. The filter is provided with five hand-operated valves and the rate of filtration is controlled by a float valve and orifice. The filtered water enters a 25,000-gal. circular, covered concrete clear well located outside of the pumping station.

Basis of Design—An analysis of the flowing well water made in June, 1921, showed 8 p.p.m. of iron, 45 parts of free carbonic acid and practically no dissolved oxygen; total hardness, 563; alkalinity, 397; incrustants, 166; sulphates, 439.

Evidences of rapid oxidation of the iron following the escape of the carbonic acid were noted around the well,

ANALYSES OF RAW AND TREATED WATER AT LEROY, OHIO, AUG. 29, 1922

Source	Temperature Deg. F	Iron (Fe) P.P.M.	Free CO_2 P.P.M.	Dissolved Oxygen P.P.M.	Dissolved Oxygen Per Cent Saturation
Flowing Well....................	54	2.0	64	0.0	0.0
Aerator	63	0.0	20	9.6	98.4
Roughing filter..................	62	0.0	19	8.6	87.3
Sand filter	61	0.0	23	6.8	68.4
Tap at hotel	69	0.0	23	3.2	35.2

suggesting that aeration would be very effective as the initial treatment. A number of iron removal plants provide settling basins following aeration, but from analytical data made available to the writer through the courtesy of the Engineering Division of the Ohio State Department of Health, it appears that but little iron is removed by plain sedimentation; that is, in the Ohio plants studied, the filters carry practically the entire burden. With the thought of finding a method of relieving the work of the filters, careful inquiry was made regarding American and foreign iron removal practice. In his work on iron removal ("Enteisenung von Grundwasser"; Leipsic, 1905), Darapsky expresses the law of ground-water deferrization, which, freely translated, is as follows:

> The removal of iron from water requires the very intimate admixture of an excess of air (oxygen), following which, to secure coagulation, the aerated water must be subjected to the catalytic action of previously precipitated iron sludge. The required time of contact is inversely proportional to the relative quantity of oxygen introduced.

It thus appears that the successful removal of iron from water is a two-stage proposition: (1) Removal of the free carbonic acid by very thorough aeration and oxidation of the ferrous iron by the oxygen thus absorbed and (2) the coagulation of the colloidal iron. The second stage is, of course, accomplished in sand filters at the expense of wash water, but is also effected by contact of the oxidized semi-colloidal ferric iron with previously precipitated iron sludge in basins or towers containing coarse, rough material. Such devices are illustrated by the towers and roughing filters containing coke, brick, wood, gravel, stone and slag provided at many plants.

In applying these principles to the plant at Leroy, it was decided to provide nozzle aeration producing a very fine spray and to cause the spray to fall 6 to 8 ft. into a collecting tray or shallow reservoir containing 12 in. of very coarse limestone. Built upon the roof of the building with louver protection, and with free circulation of air at all times, considerable removal of carbonic acid and excellent aeration were anticipated.

As a second step, preparatory to final filtration through sand, a roughing filter was provided to effect the coagulation of the oxidized iron. The rate of superficial filtration is approximately 97 m.g.d. per acre or 1.543 gal. per square foot per minute. It may be said in passing that the efficiency of the roughing filter appears to be related to the time of contact with the filtering material so that the superficial area is not so much a criterion as is the volume and the actual surface area of the filtering material from top to bottom. It is therefore essential to use fairly coarse, rough, hard material. According to Piefke ("Handbuch d. Hygiene," Rubner, v. Gruber, Ficker, II Band, 2 Abt. s. 95), coke is not suitable for hard water. He recommends broken brick, broken tile or waste blocks of wood.

To permit the free passage of air through the roughing filter, the water is applied to the surface of the filter through a perforated grid system and further the elevation of the high-water line in the final sand filter is below the bottom of the roughing filter. The roughing filter is cleaned by backflushing to the surface of the filtering material and the sudden opening of a drain valve. It is, of course, not advisable to remove the ferric iron completely but merely to restore the clogged filter to normal quantitative performance. The sand filter is designed on the basis of a rate of filtration of about 100 m.g.d. per acre or 1.603 gal. per square foot per minute. The upper sand is slightly coarser than often required in mechanical filtration practice.

Operating Results—In August, 1922, after about seven months' operation, tests were made to determine the efficiency of the plant in the removal of the iron and the carbonic acid. The tests included the collection of samples of the raw water, the effluents from the aerator, roughing filter, sand filter and the tap water in the center of the village. Based upon the operating records of the plant, it appears that the daily consumption averages about 20,000 gal., with a maximum of 40,500 gal. and a minimum of 11,000 gal. The maximum demand is incident to lawn sprinkling during the hot, dry summer months.

From the analytical data shown in the accompanying table, it appears that the iron is entirely removed by the 12 in. of coarse stone in the aerator. Note also the large volume of oxygen introduced by the sprays and the corresponding decrease in the quantity of carbonic acid. So complete is the removal of the iron by the aerator and roughing filter that the sand filter is washed on an average of only once in eight days. It is obvious that

the roughing filter is a most effective substitute for the usual settling basin, not only accomplishing a complete removal of iron, but also reducing in a marked degree the volume of wash water required in the operation of the plant. These results strikingly support the evidence obtained in other plants in Ohio to the effect that the passage of the aerated water through some type of roughing filter or tower is much to be preferred to sedimentation as a preparation for final sand filtration.

The Leroy water-works and other improvements (which included sewers and sewage-works) were constructed on force account under the direction of Carl R. Frye of Elwood & Frye, landscape architects and engineers, Columbus, Ohio, as contractors. H. G. Noble was resident engineer for the contractors. Robert R. Reeves, Miller & Reeves, architects, Columbus, Ohio, designed the architectural features of the iron removal plant building. The improvements were designed by the writer and the construction work was supervised by him. The approximate cost of the water-works was $45,000.

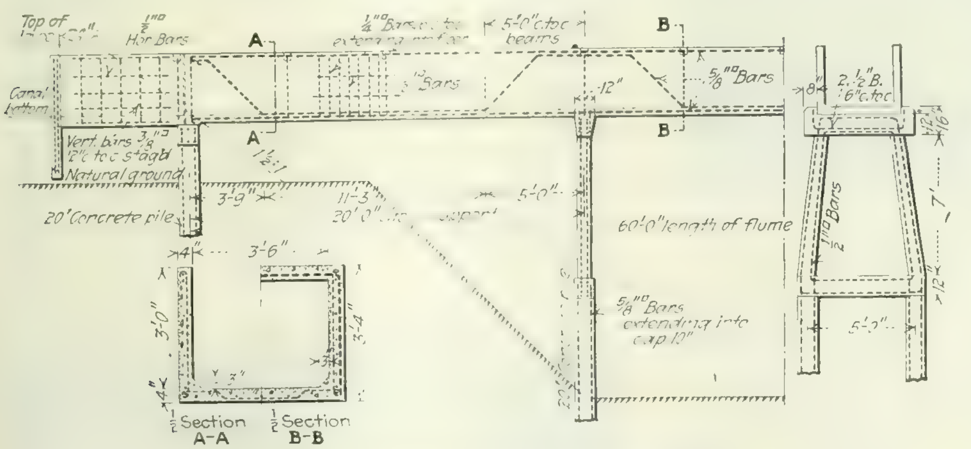
Culvert Failure and Replacement for Drainage District

Old Drainage Pipes in Quicksand Rust and Crush, Causing Failure of Irrigation Laterals

By W. F. Heath

Assistant Engineer, Cameron County Water Improvement District No. 2, San Benito, Texas

WHEN Cameron County Drainage District Number Three started construction work in 1914, it became necessary, in crossing the canals of the San Benito Land & Water Co., to install either culverts in the drains or else carry the canals over the drainage ditches by means of flumes. The former method was chosen and a number of corrugated galvanized pipes in sizes ranging from 24 to 48 in. were installed. Some of these were built with brick headwalls; some had no headwalls of any kind.



DETAILS OF IRRIGATION FLUME OVER DRAIN

As early as the summer of 1919 some of these pipes had become so badly choked with sediment as to prevent the passage of drainage water. In some instances the water was held at such a level as to endanger the surrounding land, raising the water table and causing the land to become alkaline in places. In the spring of 1921 the drainage district started an intensive ditch-cleaning campaign, taking out the silt in the main drains down to the original grade. Several months after this work was completed Cameron County Water Improvement District Number Two (successors to the San Benito Land & Water Co.) woke up one morning and found that one of its main distribution laterals had caved in over one of the old corrugated iron culverts, putting the irrigation lateral out of service. A temporary wooden flume was built to carry the irrigation water. As the irrigation system was built before the drainage ditch the culvert naturally had to be replaced by the drainage district.

CONCRETE FLUME CARRYING IRRIGATION LATERAL OVER WRECKED DRAINAGE CULVERT

After a joint meeting of the drainage district commissioners and the engineering department of the irrigation company it was decided to carry the irrigation lateral over the drainage ditch by means of a concrete flume, thus giving a free passage for the drain water and insuring a permanent structure. This flume is 3 ft. high by 3½ ft. wide and carries 18 sec.-ft. of water with a freeboard of 8 in. and a total loss of head of about 0.1 ft. It has three 20-ft. spans in the barrel and a flaring intake and outlet, each 7 ft. long. The flume side walls were used as beams to carry the load.

The cost of the flumes was $1,250 (contract price); an amount not much in excess of that required to replace the culvert as it was before failure, since much of the excavation would have been in quicksand and shoring would have been necessary.

Since the first pipe failed, another has caved in and been replaced, and there are several more that are in a precarious condition. All of these failures are in the drains that have been recently cleaned out (the cleanout work instituted in 1921 was the first done since the drain ditches were built) and the cleaning evidently had something to do with the failure. There have been many theories advanced as to just what caused the failure, but the most logical explanation is that the dredging extended down into the quicksand and the flow of water around the pipe carried the quicksand from around and under the pipe. As the pipe had rusted badly the weight from above caused it to settle and break.

Protecting Steel Bridges from Locomotive Blast

Examination of Gunite and Reinforced-Concrete Casing of Floor System of Railway and Street Bridges in Chicago

HOW to protect the underside of steel bridges exposed to blast, smoke and gases from locomotives is an important and often troublesome problem in large cities where numerous bridges have a limited headroom over tracks carrying heavy traffic. The resistance of different methods of protection applied to some Chicago bridges is shown in the accompanying views. The results are comparable, as the clearance in all cases is about 17 ft. from the top of rail to underside of bridge.

In Fig. 1 is shown part of the underside of the bridge carrying the Chicago, Rock Island & Pacific Ry. over

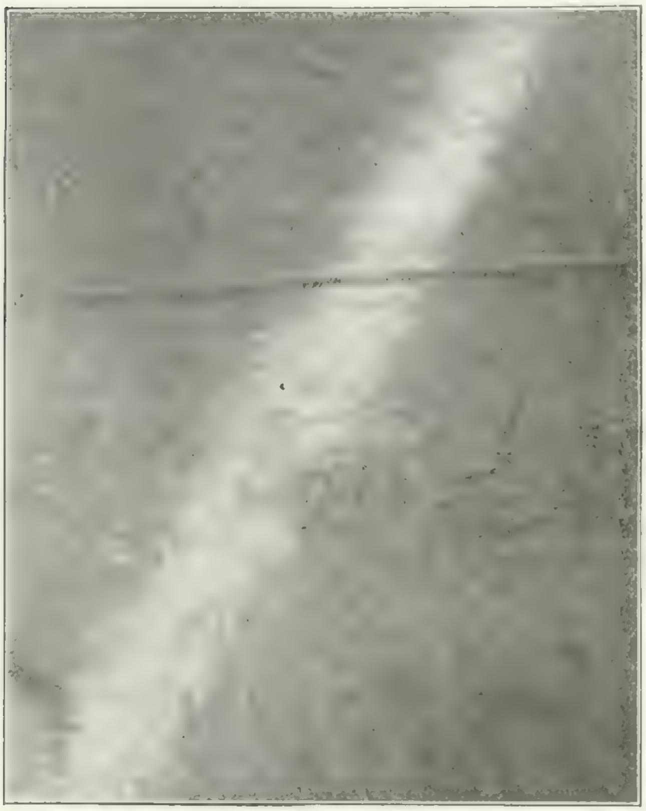


FIG. 1—GUNITE CEILING OF 79TH ST. BRIDGE

Surface uninjured after nine years' exposure to locomotive blast

the Chicago & Eastern Illinois R.R. at 79th St. This is a gunite ceiling placed in 1914 by the Cement-Gun Construction Co., Chicago, under the direction of R. H. Ford, track elevation engineer (and now assistant chief engineer) of the former road. This view shows a portion of an expansion joint at a point where the engine blast is continuous and heavy. The white streak indicates where the blast has blown the surface clean of soot, but it will be noticed that the original pebbled surface is still intact and that even the corners of the expansion joint have not been rounded off in nine years of service.

Bridges over the tracks approaching the Chicago union station from both north and south afford examples of the service of various forms of steel protection under conditions of minimum headroom and heavy blast. Fig. 4 shows the girders and floorbeams of the

FIG. 2—EFFECT OF BLAST ON CONCRETE CASING

Condition after one year's exposure, with track center off center of blast plates, causing wear shown. Taylor St. bridge.

Lake St. bridge, which were encased in concrete poured at the same time as the floor. This work was done in 1915 and so the concrete has been subjected to about eight years of service. The 3-in. concrete under the main girders has been worn away, exposing the steel, and at the right of this a hole has been worn through the 3-in. ceiling. The ends of the broken steel reinforcement are shown, and at the extreme right is an exposed reinforcing rod. The sidewalk slab at the left is badly cut, and beyond the part shown in the view some of the bars are exposed.

The underside of the Taylor St. bridge, built in 1920-1921, is shown in Fig. 2. Poured concrete was used for the steel encasement, with cast-iron blast plates over the tracks. At the time the photograph was taken the track had not been placed in final position, with its center line directly under the iron plates, so that part of the blast has been received by the concrete. In one year of service the concrete, both where subjected to the center of the blast and at the sides of the cast-iron blast plates which were not struck centrally, has been cut away so as to expose the reinforcing mesh. Fig. 3 shows the same bridge where the floor structure

FIG. 3—BLAST WEAR ON CONCRETE UNDER SLAB

Cast-iron plates are on underside of beams. Taylor St. bridge.

is of a different type and where blast plates were placed on the concrete encasement of beams. Here also the concrete shows evidence of disintegration on the bottoms and sides of beams and the bottom of the floor slab.

At the Harrison St. bridge, two blocks north of the Taylor St. bridge and built at the same time, the main girders and beams were encased in gunite, while some of the smaller floor beams were encased in ordinary concrete, poured at the same time as the slab. Blast plates were embedded in the gunite on the underside of the main beams and girders. This gunite casing shows no signs of deterioration, but is in the same condition as that on the 79th St. bridge shown in Fig. 1. Poured concrete casing of the floor beams and the concrete slab, although at a higher elevation above the track, are showing evidence of pitting and deterioration.

Although gunite for the protection of steel is approved by engineers of the lines described, some conditions are noted as necessary to successful results. Surfaces to be covered must be clean and free from grease and dirt, the sand must be clean and suitable for cement-gun work, and the staging and apparatus must permit ready access to all parts and application of the gunite perpendicularly to the surface. Fresh surfaces must be disturbed as little as possible, the entire coating being applied as nearly as possible monolithic. The final surface must be left with proper finish, surfaces flat, edges straight and corners well formed. In order to accomplish this and to get maximum density and hardness, with absence of sand pockets, it is necessary to have the work done by experienced operators and foremen.

In some recent work where a concrete floor slab is used this slab encases the tops of the beams, the lower parts being then covered with gunite. It is considered questionable whether iron blast plates are necessary or desirable with gunite. The attachment of the plates to insure that their supports will not be destroyed introduces difficulties and the results at the 79th St. bridge seem to indicate that gunite alone is sufficient.

Experience with the Chicago bridges points to the following conclusions: (1) that with a headroom of 17 ft. from the track a gunite casing properly applied will resist locomotive blast for at least nine years without injury; (2) that blast plates may not be necessary if gunite casing is used; (3) that plain concrete in such positions and with limited head room is not likely to form durable protection. The photographs were furnished by the Cement-Gun Construction Co., Chicago.

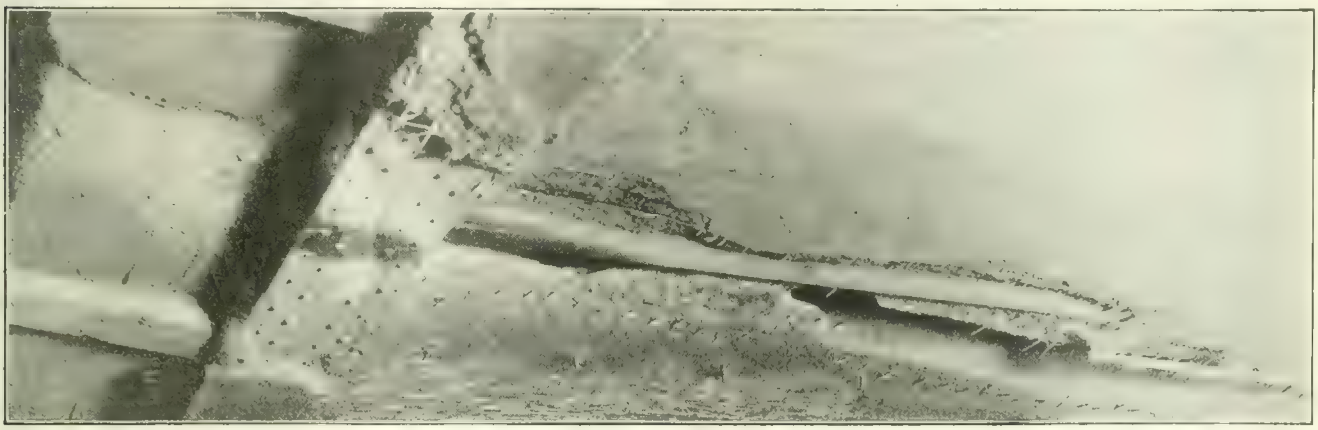


FIG. 4—CONCRETE CASING UNDER LAKE ST. BRIDGE
Condition after six years' exposure.

Company Versus State Management for Indian Railways

RAILWAY management by companies or by the state is a question of growing importance in India, as the contracts under which some of the large systems are operated by private companies expire in a few years.

Practically all of the railways are owned by the state but are operated under contract, the government guaranteeing the companies a low rate of interest but exercising very strict control and regulation. It was expected that the guarantee system would encourage private initiative, but this has not been the result, owing to the government's financial methods. On one hand the government has opposed the raising of capital by the companies and on the other hand it has failed to supply them with the funds necessary for development. In consequence the extension, improvement and equipment of the railway system is far behind actual needs.

A commission appointed recently to consider the situation failed to arrive at a definite conclusion, half the members favoring state management and the other half favoring company management. Inquiries are now being made of local chambers of commerce and the results indicate a strong disapproval of state management. This disapproval is based on the unsatisfactory results of the system in India after many years' experience and on similar unfavorable results in Europe.

Under the company system as now proposed the companies would be free to raise capital as required, up to a limit prescribed by the government. In the reply of the Bengal Chamber of Commerce the report of the above commission is quoted to the effect that "as railways are primarily commercial undertakings they should be managed on a commercial basis so as to secure economy and efficiency; that is to say, by a company with a board of directors."

Some defects of state management are said to be:

(1) Constant transfers of senior officials.

(2) A tendency to promotion by seniority.

(3) Disregard for public opinion.

(4) Lack of initiative and flexibility.

In support of these views it is pointed out that the chamber speaks from experience with both state and company management and has arrived at the conclusion that the public was better served by the company-managed lines than by the state lines.

Safe Yields of Drainage Areas In Years of Minimum Rainfall

Presentation and Discussion of Minimum Runoffs in Northeastern United States—Mass Curves To Show Safe Yields

By Alfred S. Burgess

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IN ESTIMATING the safe yield it is quite common practice to base it at least largely, if not entirely, on the stream flow which has actually taken place during the period of observation and measurement. This procedure would entail no material error provided that the period of observation and measurement happened to include years of low rainfall as near the minimum as could reasonably be expected from observations and records on other similarly situated drainage areas during a long period of years. While severe droughts have occurred from time to time on every drainage area, and will occur again in the future, the chances of a really severe one being included in a period of observation of say ten or fifteen years in a relatively small area is quite remote.

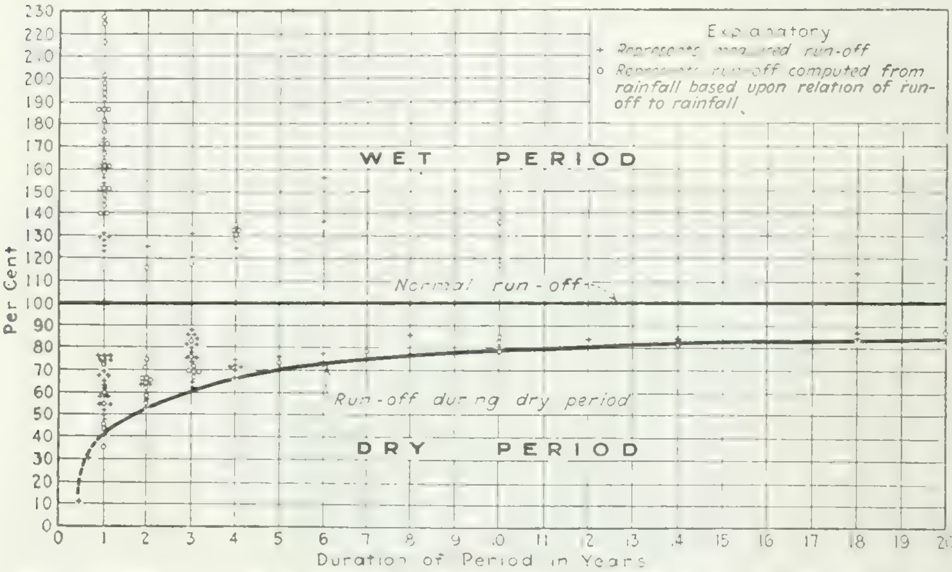


FIG. 1—ANNUAL MASS CURVES OF STREAMS IN NORTHEASTERN UNITED STATES

The accompanying diagram (Fig. 1) shows the stream flows that actually occurred during the most severe droughts on record in the northeasterly United States. It gives the relation, in percentages, between the normal yearly runoff, which is represented by 100 per cent, and the runoff that has actually occurred during continuous periods of low rainfall, varying in duration from 1 to 20 consecutive years.

A study of the runoff records for periods less than one year discloses the fact that during two or three consecutive months the runoff may be reduced in dry years to 10 per cent or less of the average annual rate for a normal year. If the drainage area contains large lakes or storage reservoirs we may expect, in like periods, occasional negative runoffs due to the evaporation from the water surfaces being greater than the stream flow.

The accompanying table gives the yearly fractional runoffs or percentages corresponding to the curve of low rainfall years shown in Fig. 1.

The periods of low runoff upon which Fig. 1 are based were the driest on record in the northeastern United States. The table giving the probable minimum stream flow shows that for a period of one very dry year the runoff may not exceed 40 per cent of normal. For two consecutive dry years it may amount to only about 52½ per cent of the runoff for two normal years.

If this two-year dry period includes one year with a runoff of only 40 per cent the runoff for the other year must necessarily be 65 per cent of the normal. On this supposition we may compute the third year as 78 per cent normal, fourth year as 81 per cent normal, fifth year 86 per cent normal, etc. It was found by several trials that the most critical conditions, except where the amount of water in storage is very large, are usually included in the three or four driest years. Hence, if we construct mass curves of 40, 65, 78 and 81 per cent normal yield, respectively, we may by placing these mass curves together in such order as to give the maximum depletion, ascertain the safe yield based upon the conditions given in the table of probable minimum stream flow. The method of constructing the mass curves and applying them to problems of this nature are clearly explained under Computation of Storage in "Public Water Supplies" by Turaure and Russell and under Storage of Water in "The American Civil Engineers Pocket Book."

In the application of this method of estimating the probable minimum yield and the supply that may be collected and stored, attention is called to the general features of the mass curves shown by Fig. 2. It will be noted that the curves indicate that runoff amounting to 25 per cent of the yearly total may be expected during the months of March and April and that at times the runoff during these two months may amount to one-half of that for the entire year.

Owing to this great variation and inequality in the monthly flows it can be readily appreciated that a considerable amount of the flow may be wasted even during dry periods, especially if the reservoirs are small in respect to the requirements of the watershed. The portion of the supply that can be utilized depends in a great measure upon the consumption and distribution of the flow during the year and also upon the distribution of the driest years in respect to the dry period. In order to arrive at a reasonable and reliable conclu-

PROBABLE MINIMUM STREAM FLOW DURING VERY DRY PERIODS

Continuous Periods, Years	Per Cent of Total Runoff for Equal Number of Normal Years	Continuous Periods, Years	Per Cent of Total Runoff for Equal Number of Normal Years
1	40	11	80
2	52½	12	81
3	61	13	81½
4	66	14	82½
5	70	15	82½
6	72½	16	83
7	75	17	83.5
8	76½	18	83.5
9	78	19	84
10	79	20	84

sion, it is essential that we thoroughly study the conditions in respect to low runoff which will be brought about by the reason of the dry period. This study should not only be made of the yield but also of the amount of water that will remain in the storage reservoirs at different times throughout the drought period. Such a study is most readily made by arranging the

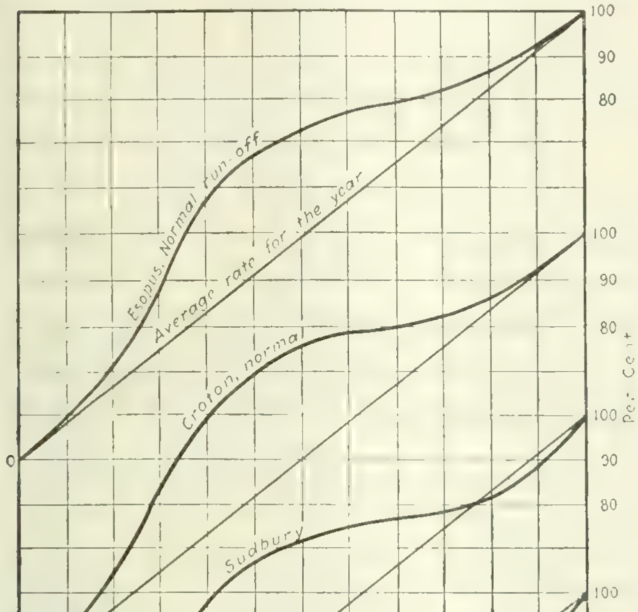


FIG. 2—RELATION OF MINIMUM TO NORMAL RUNOFF

previously mentioned 40 to 81 per cent yearly mass curves of the stream under consideration in such relation that the maximum depletion during the dry period, and hence the safe supply, can be determined.

Objection will no doubt be raised to this method as being ultra conservative. It is true that yields as low as this method indicate are brought about usually by a combination of unfavorable conditions and will occur on a given watershed only at long intervals. On the other hand, we can never be sure just when these unfavorable conditions may arise and it is probable that the future has in store even drier periods than the ones recorded and upon which the diagram is based.

Locating and Mapping Highways in North Carolina

Standardized Methods and Centralized Control Have Increased Results and Reduced Costs—Railway Practice Copied

By George F. Syme
Senior Highway Engineer, North Carolina State Highway Commission, Raleigh, N. C.

HIGHWAY location is costing less than a hundred dollars a mile in North Carolina. Including plans for construction the average cost is $117 a mile. These low costs are due to a very painstaking effort to standardize practice and to centralize control. The new methods have been employed only since the first of 1922, but they are the outgrowth of six years of study and experimentation.

Originally all surveys in a given district were conducted under the direct supervision of the district engineer, and the plans and preliminary estimates were prepared in the district offices. It appeared on study that plans could be more economically prepared at the main office in Raleigh; a large overhead expense was saved, and forces of draftsmen in the nine district offices were eliminated. A drafting force was therefore, assembled, at headquarters, under a chief draftsman, and divided into several squads of five men each,—one man in each squad serving as squad leader. It handled the field survey notes from all the districts and prepared plans, profiles and estimates.

It was next found necessary to standardize the methods of keeping field notes and other records. A notable reduction in the cost of preparing plans was at once observed.

When a survey of a given project was completed the locating party often was assigned to the construction. This was due largely to the urgent and immediate need for construction men. The important thing was, however, that when a new survey was ordered a new locating party had to be organized and put in the field. No experienced locating engineers were being developed.

Sectional Surveys—Based on its success in centralizing the drafting work, the commission finally concluded to reorganize its location forces with a view first to developing skilled locators, thus obtaining better locations and reductions in the construction and operating costs, and second, to reduce the cost per mile of making the surveys. A department of location was created and a principal locating engineer was appointed with headquarters at Raleigh. This department took over all location parties then in the field—about 26 in number. These parties were reorganized, so as to consist of a chief of party, transitman, levelman, front rodman, level rodman, chainman, stakeman, and axemen as needed. The front rodman serves as chainman, making seven men to the party, plus the axemen necessary.

The state was divided into three survey sections, i.e., Coastal, Piedmont and Mountain, and each section was placed in charge of an experienced locating engineer, reporting directly to the principal locating engineer at Raleigh. All of the party chiefs in a given section report to the locating engineer in charge of that section.

By these various changes the efficiency of the parties has been so increased that it has been possible to reduce their number from 26 to 14 and a further reduction to

12 parties is anticipated. This large reduction, however, was not wholly due to increased efficiency, but was partly owing to the fact that the reorganization disclosed that more men were in the field than were needed.

Before the organization of locating department the average mileage of completed location per month, per party, was 6.7 miles and the average cost of making it including all necessary preliminary surveys, subsistence, transportation, etc., was $110 per mile.

Under the present organization the average number of miles finally located per party per month is 9.7 miles, and the average cost, including all necessary preliminary surveys and all other expenses is $92 per mile, and further improvement is anticipated.

Gratifying as are the numerical results, they pale into insignificance when one attempts to compare the results, in the larger aspects, of locations made by untrained men, with those made by locating parties who devote their whole time and thought to location and who become specialists in that class of work. Large reductions in the first cost of construction have been obtained, and better alignment, grades, and drainage have been secured. In the final analysis savings in maintenance and operating costs may well be anticipated from a scientific, economic location.

Location Procedure—The procedure in making surveys is similar to that in railway location—first the reconnaissance, followed by one or more preliminary lines with topography, and contours when necessary; then the projection or paper location, and lastly the final location. All P.C.'s and P.T.'s are carefully referenced by the locating parties, and all field notes are required to be kept in strict accordance with prescribed forms. Careful preliminary cross-sections are taken over the located line at every station and at every important break in the ground. These are merely transverse profiles and are taken by recording the vertical height of each break in the ground at right angles to the center line above or below the ground at the center stake, and the horizontal distance therefrom.

When the survey is finally completed the chief of party plats the profile in pencil on standard sheets 36 x 23 in. to a horizontal scale of one inch to one hundred feet and a vertical scale of one inch to ten feet. On this he lays tentative grade lines representing the subgrade, and he also shows the classification of the materials encountered.

The note books show the suggested size and type of drainage openings required, as determined by special surveys, and other complete information necessary for the proper preparation of plans and estimates. The profile and all of the note books are then sent to the principal locating engineer at Raleigh where they are carefully inspected and then turned over to the drafting department where the final plans are prepared. The alignment, topography, and all other features are platted above the profile to a scale of 100 ft. to the inch.

The preliminary cross-sections are platted on standard-size (36 x 23 in.) sheets and the quantities are computed from planimetered areas of the same. The quantities are then properly balanced by the readjustment of the tentative grade lines. Prints are then made of the project and sent to the District Engineer, who walks over the line, plans in hand, and carefully studies the grades, drainage openings and other features of the survey. He makes such corrections or changes as may seem proper and returns the prints with his approval. The plans and estimate are then completed, the necessary number of blue prints made, and the project is ready to advertise for construction.

A set of prints of a given project consists first of a title sheet, showing the title; index of sheets; a small map of the entire project on a scale of one inch to 1,000 ft.; a small inset map of North Carolina showing the general position of the project with reference to the State as a whole, and a small inset map showing the position of the project with reference to the county and to existing railway and other shipping points.

The next sheet shows the typical cross-section of the roadway, the design of the pavement or surface, ditches, etc.

Then follow the plan-profile sheets showing alignment, grades, clearing, drainage structures, balance points, summary of quantities and other information of interest to a contractor. Next come the cross-section sheets, showing accurate areas and yardages. Then comes a sheet showing the type and design of headwalls, retaining walls or special drawings, and finally come the sheets showing designs in detail of all bridges and culverts, which are prepared in the office of the bridge engineer from special surveys made under his direction. A complete set of plans consists of from 25 to 200 prints bound together.

Costs—The total average cost per mile for making a finished location, as before mentioned, is $92 and the average cost of preparing completed plans and estimates, exclusive of bridge and culvert designs is $25.53 per mile, making a total average cost per mile of completed location, plans and estimates of $117.53 for the entire State. These figures are remarkably low considering the large amount of work involved and the care with which it is performed.

It should be borne in mind that western North Carolina has some of the most rugged mountain country east of the Mississippi and that the eastern section contains many large rivers and almost impenetrable swamps which naturally make for difficult and costly location.

The writer feels that the satisfactory results now being obtained with regard to highway location are due entirely to the highly organized and centralized departments of the State Highway Commission and that without such centralized organization the task of locating and building 5,000 miles of new highways would be many times more difficult and costly.

Cheaper Helium To Help Air Navigation

Lighter-than-air craft have a bright future, in the opinion of Dr. R. B. Moore, chief chemist of the Bureau of Mines, who is in charge of the research work on helium being done jointly by the War and Navy Departments and the Bureau of Mines. The results of experiments in the cryogenic laboratory of the Bureau of Mines lead Dr. Moore to believe that within the next decade 99.9 per cent helium will be produced at a cost as low as $20 per one thousand feet. It is now said that thanks to the perserverance and unselfishness of the Linde company and certain scientists, the problems of helium production have been solved, so that it only remains to reduce the costs of production. Dr. Moore believes that the production cost will be reduced rapidly. Once helium is produced at a moderate cost, he expects to see the lighter-than-air ship take its place as one of the permanent agents of transportation.

Steel and Wrought-Iron Trusses Efficiently Combined in Railway Bridge Reconstruction

Newburyport Bridge in Excellent Condition After 34 Years' Service Increased From E20 to E55 Capacity by Adding Two Steel Trusses in Such Manner as to Develop Full Strength of Both Materials

IN a difficult undertaking of bridge reinforcement, just completed, by which a 34-year-old bridge was strengthened from E20 to about E55 capacity, the engineers of the Boston & Maine R.R. have accomplished the noteworthy result of retaining the old wrought-iron trusses in service and utilizing their full strength in combination with new steel trusses. The ingenious methods by which this result was attained were applied in such manner as to permit of the work being carried on while traffic over the bridge was maintained. Fully as interesting as the reconstruction work, however, is the condition which made it possible, namely that the old structure had remained in almost perfect condition and shows substantially no deterioration through rusting or wear, in spite of the fact that it has for many years been loaded to double its originally intended capacity and, being of pin-connected type, is subject to joint wear.

The old bridge is distinguished by a number of individual features: it is a three-truss structure, with the three trusses built with equal cross-section, though the middle truss received about 50 per cent more load than either outside truss; it is on a skew throughout, from bridge seat to cross-ties, including the swing span; its superstructure was designed by Theodore Cooper in 1887, but the masonry piers date from about 1870, and, though they were thrown out of line in their early years by settlement of the pile substructure under the then single-track pier shafts, they are still good enough to carry the new bridge. For these several reasons the present reconstruction invites careful study.

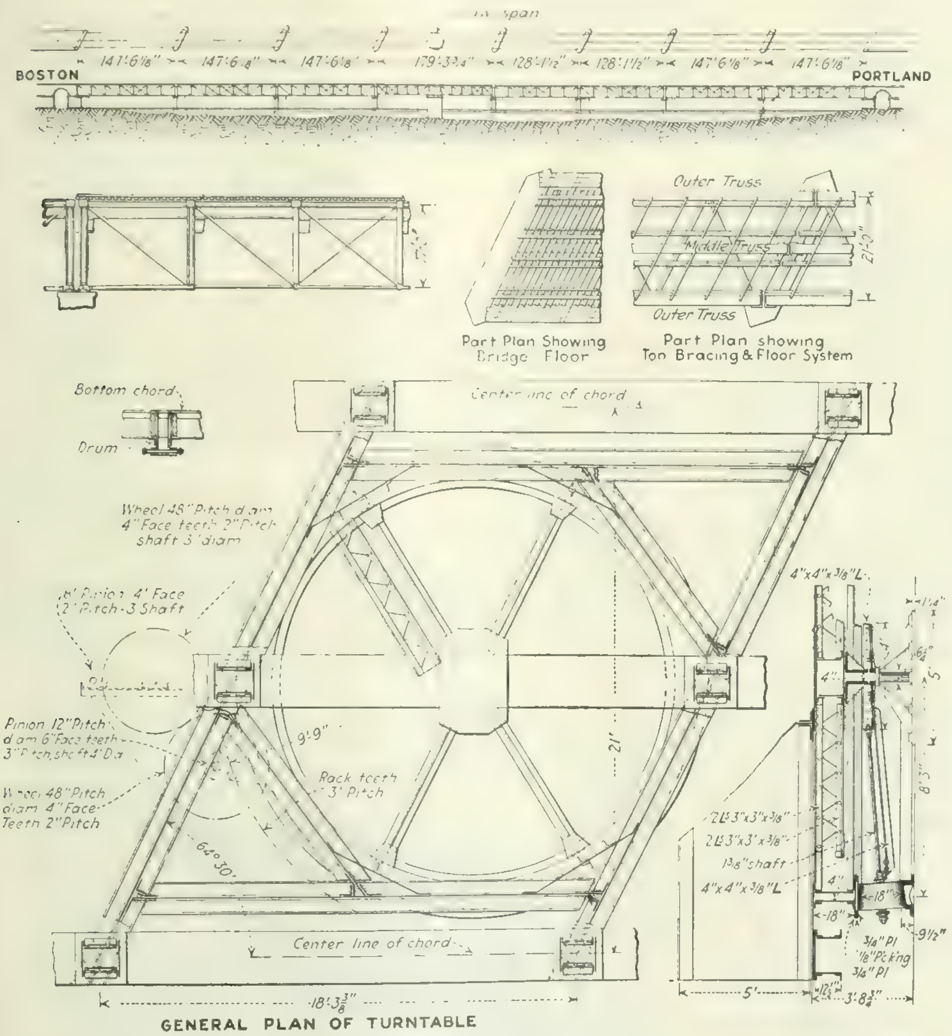


FIG. 1—OLD NEWBURYPORT BRIDGE, RECONSTRUCTED AFTER 34 YEARS' USE

Shown above as it was designed by Theodore Cooper in 1887 and as it was built and was in service until last spring. A peculiar feature of the structure is that the skew extends even to the ties and the draw-supporting girders. The old bridge suffered no measurable deterioration, and in the reconstructed bridge the old metal is being used at full stress value as though new.

The bridge crosses the Merrimac River just north of Newburyport station, 37 miles from Boston. The river is about 1,200 ft. wide and 10 to 20 ft. deep at this point and has a tidal range of 8 to 10 ft. Shipping is accommodated by a swing span at the middle of the crossing and (for smaller vessels) by the clearance under the steelwork, 12½ ft. at mean high water. The latter condition led the War Department to require the same clearance under the swing span for the reconstructed bridge, although a slight decrease of clearance was allowed in the fixed spans.

Reference to the drawing Fig. 1, reproduced from the original design sheets, will show the general character of the old structure and its principal dimensions. Five of the seven fixed spans are 147 ft. 6⅞ in. long, the other two 128 ft. 1½ in., and the draw span 179 ft. 3¾ in. A sketch of the draw-span turntable is included. In the fixed spans, as will be seen from the drawing, the top lateral system extended between outside trusses only, there was no stringer bracing, and the three top chords and four lines of stringers were tied together by single-angle transverse struts spaced about 7 ft. apart. In the draw span the supporting girder system comprised two main

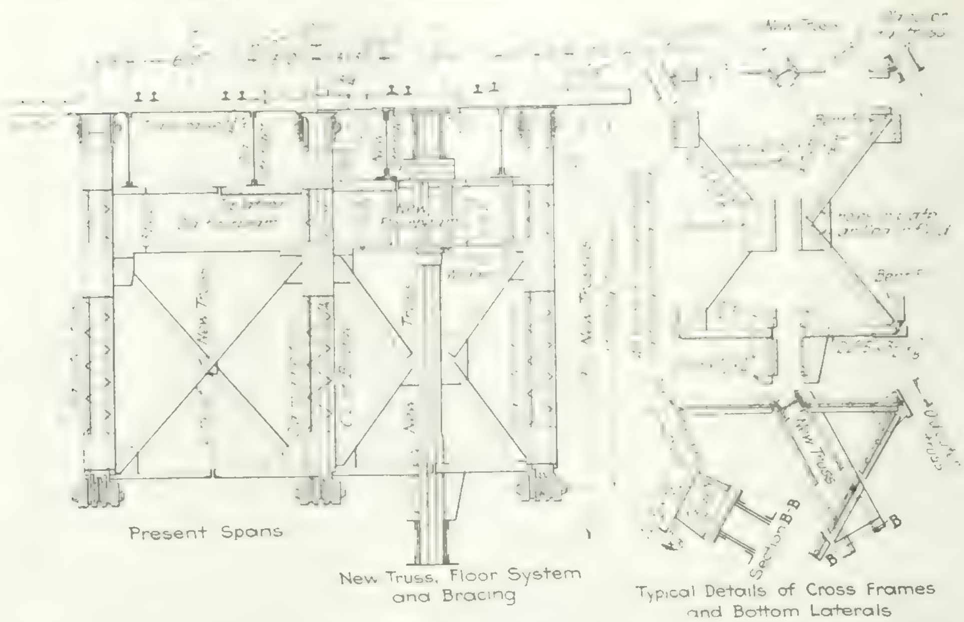


FIG. 2—TWO NEW STEEL TRUSSES ADDED TO THREE OLD WROUGHT-IRON TRUSSES
Floor system and bracing renewed. New trusses made 2 ft. deeper than old, to take greater stress at equal deflection.

transverse girders on the same skew as the other parts of the bridge, and two longitudinal distributing girders, which, together with two short diagonal girders in the sharp angles of the resulting parallelogram, brought the load of the span to bear on the drum at six points. The main transverse girders, however, were thus supported eccentrically and tended to deflect unequally with a resulting tendency for the girder parallelogram to droop at the ends of its long axis and twist the connections of the girder system. While this condition had not given rise to noticeable difficulty in the operation of the old bridge, it required to be dealt with in the design of the reinforcing work in order to secure reasonably uniform distribution of the greatly increased load.

In the detail of the turntable it may be noticed also that the drum was very shallow and that the tread by which the drum rested on the wheels was carried by a pair of wide plates separated ⅛ in. by packing along the edges. This construction apparently had the object of producing a cushioned support for the tread, and as the drum and wheels withstood their long service without damage it was evidently effective. The bottom chord of the middle truss cut through the drum girder, but the latter was spliced across the chord by reinforcement material and top-flange cover plates. Of the whole turntable structure, no part suffered any material damage or gave rise to trouble in the history of the bridge, except that the circular track did not bear evenly or maintain good surface. It should be remarked further that the entire draw span was several inches off line and slightly out of level during the larger part of its existence as the result of settlement of one side of the pier. The pile substructure was constructed for the double-track width at the very start, about 1870, but the pier masonry above low water was carried up only as single-track shafts; when the original wooden single-track superstructure was replaced by the wrought-iron Cooper bridge in 1888, the remainder of piers was built up, but even long after this time the actual traffic over the bridge was single-track, as the connections for the second track were not completed. Tilting of the piers upstream and lateral shift of the draw pier developed at an early stage, the movement being in the direction of the first track. The maximum difference of settlement between one side and the other was about 1½ in.

Reinforcement or Replacement—Computed with proper allowance for impact, the old structure had a carrying capacity equivalent to about E20 to E22, more accurately E20 to E22 for the center truss and E28 to E30 for the outer truss and the floor. Traffic over the line has for years had a maximum load equivalent of E40 to E45, but for some time past trains have not been allowed to meet on the bridge on account of the lightness of the middle truss. The bridge thus was overloaded and developed considerable vibration. Accordingly, it was kept under very careful observation, without, however, showing any local weaknesses.

Replacement or reinforcement has been in contemplation for four or five years, but because of financial and other conditions the work could not be taken in hand until last year. At that time, on full study of the various conditions governing the work, it was decided to reinforce the old bridge rather than to build a new bridge.

Preliminary to this decision, careful review of the condition of the old masonry led to the conclusion that it is adequate for the necessary increased superstructure weight and present traffic load for some time to come. The limited width of the piers would not, however, permit of supporting new trusses outside the old ones, unless distributing girders were put in on

FIG. 3—FIVE TRUSSES OF RECONSTRUCTED BRIDGE
The two intermediate trusses are steel, the original ones wrought iron.

the piers, and these, under the circumstances, would be so costly and difficult to install as to put them out of consideration.

The number of piles in the pier footings could be determined approximately, and on the basis of the resulting estimate of their carrying capacity, taken in connection with the fact that the piers had become stabilized and under double-track operation, they were considered ample for present loads. Therefore, nothing more was done than to point and grout the masonry thoroughly. In the reconstructed bridge the load will be distributed over the piers more uniformly than in the old bridge, especially with one track loaded, which is a favoring factor. However, if later on the piers should develop weakness under increased loading they can be strengthened or rebuilt, as required, fully as cheaply as (under traffic) at present.

Study of the factors affecting the superstructure included the following points: The wrought iron of the old bridge was in excellent condition, showing no rust deterioration (the bridge had been kept well painted) and no pin wear; the bridge would have to be kept open for traffic during reconstruction, as a run-around line was not practicable; no additional dead-load could be put upon the old bridge while it was carrying live-load, in view of the existing high over-stress; building a new structure around the old one involved serious complications and high cost in view of the need for pier girders to carry it safely on the old masonry; falsework construction would be costly, and in the draw span would not be practicable in any event. New spans might be floated in; but regardless of questions of cost and difficulty it was apparent that new superstructure would require additional metal over a reinforcement scheme, corresponding to the value of the old metal utilized in the latter. Because of these several conditions, when a satisfactory reinforcement scheme had been evolved, it was preferred in every point to the most attractive replacement scheme. At least $100,000 or about 25 per cent of the cost of a new structure was saved by reinforcement.

Reinforcement Scheme—The cross-section in Fig. 2 most simply explains the method of reinforcement. The half width of the old bridge is shown at the left and the half width of the reinforced bridge at the right. It will be seen that two new trusses are added, one between either outside truss and the center truss, together with new stringers, floorbeams and bracing. In the fixed spans the new trusses are 19 ft. deep between chord centers, as compared with 17 ft. for the old trusses.

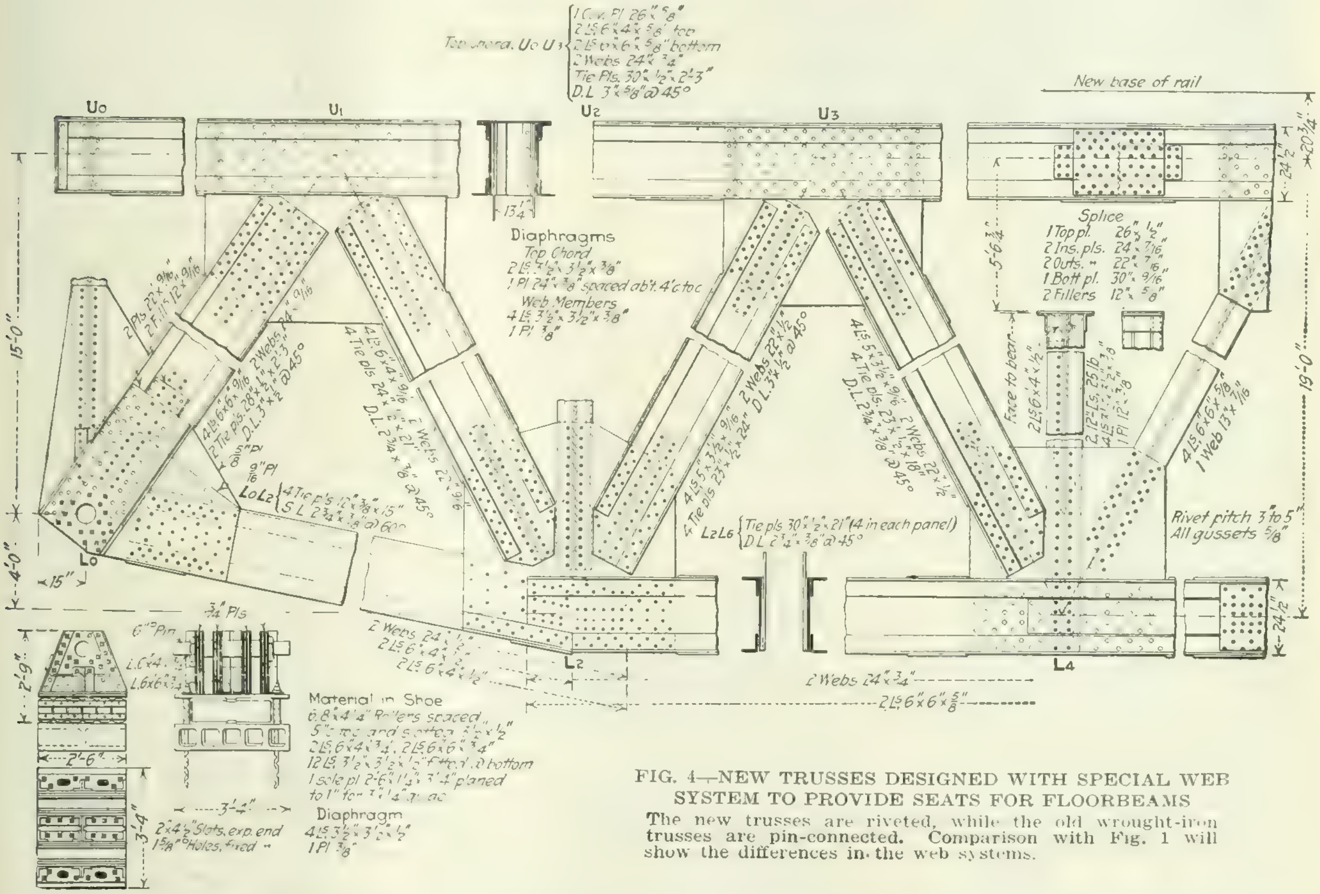


FIG. 4—NEW TRUSSES DESIGNED WITH SPECIAL WEB SYSTEM TO PROVIDE SEATS FOR FLOORBEAMS

The new trusses are riveted, while the old wrought-iron trusses are pin-connected. Comparison with Fig. 1 will show the differences in the web systems.

The basic principle of the reinforcement scheme is that the deep floorbeam connections and rigid cross-frames, whose details are shown at the right in Fig. 2, make the entire assemblage of five trusses a unit as regards deflection, so that any load will develop stresses in the different trusses proportionate to their depth. The chords of the old trusses, therefore, will be stressed about 10 per cent less than the new trusses, which difference was considered to correspond roughly to the difference in allowable working stress between steel and wrought iron. It followed that the total strength to be provided in the new trusses was the difference between the total load and the amount of load which would be carried by the three old trusses at a unit stress of 13,500 lb. per square inch, this remaining load being assigned to the two new trusses at a unit stress of 15,000 lb. per square inch. The same relation

between stresses in the two metals was maintained throughout, compressive stresses being suitably reduced for column effect.

In this scheme it was necessary to discard the floor members and the bracing, partly because these had to be remodeled in any event to admit the new steel and partly because the floor members were inadequate for present-day loads in spite of the fact that they had been strengthened some years ago by fitting stiffeners to the floorbeam webs and repairing the top flange angles under the stringers, where the riveting had been injured and the flange angles broken by the concentrated loads from the stringers. Thus the bridge retains the three old trusses and the single-angle stringer braces, discarding all other parts of the superstructure.

As the action of the reinforced structure depends essentially on the stiffness of the transverse connections, it is of value to record that when the reinforcement had been completed for one-half of the bridge, but no work done on the other half, producing a condition corresponding to that shown in the cross-section in Fig. 2, the bridge was free from vibration when a train moved over the track on the unreconstructed side, and no difference of deflection of the four trusses could be noticed, indicating that even the half-completed work was able to assure equal deflection and proper load distribution.

The entire reconstruction carried out according to this scheme involved a weight of new steel amounting to 4,758,000 lb. The character of the new portions of the bridge is indicated by Fig. 4, a drawing of one of the 147-ft. 6½-in. fixed spans. The truss work of the draw span is generally similar, but the new trusses (see Fig. 5) had to be kept down to the same depth as the old, 15 ft. in this span, and in addition the depth over the turntable had to be contracted to about 12 ft. by carrying the bottom chord upward, so that it could pass over the drum and continue through the web of the new longitudinal girders placed on the lines of the trusses.

Considerable complication was involved in devising suitable reinforcement at and over the turntable. The character of the old distributing girder system made it necessary that the reinforced girder system should be extremely rigid, in order to distribute the load effectively over the shallow drum. A deeper drum could not have been provided without costly and difficult work in cutting down the pier masonry.

The drawing Fig. 5 shows the reconstructed girder system over the drum. The main transverse girders were retained unchanged, but the longitudinal distributing girders were removed and two new ones on either side were substituted. As the overhang of the outer trusses beyond the outer distributing girders is the same as before, the moments in the transverse girders are not increased, and the additional load of the two new trusses is transferred to the drum directly through the new longitudinal girders, which take their reactions from the trusses as shown in the longitudinal section in Fig. 5. In order to distribute this load over the drum, three subsidiary girders were introduced in each half of the girder parallelogram, giving twelve bearing points on the drum in place of the original six. At the same time the drum was fitted with stiffeners on both inner and outer webs, there having been no stiffeners

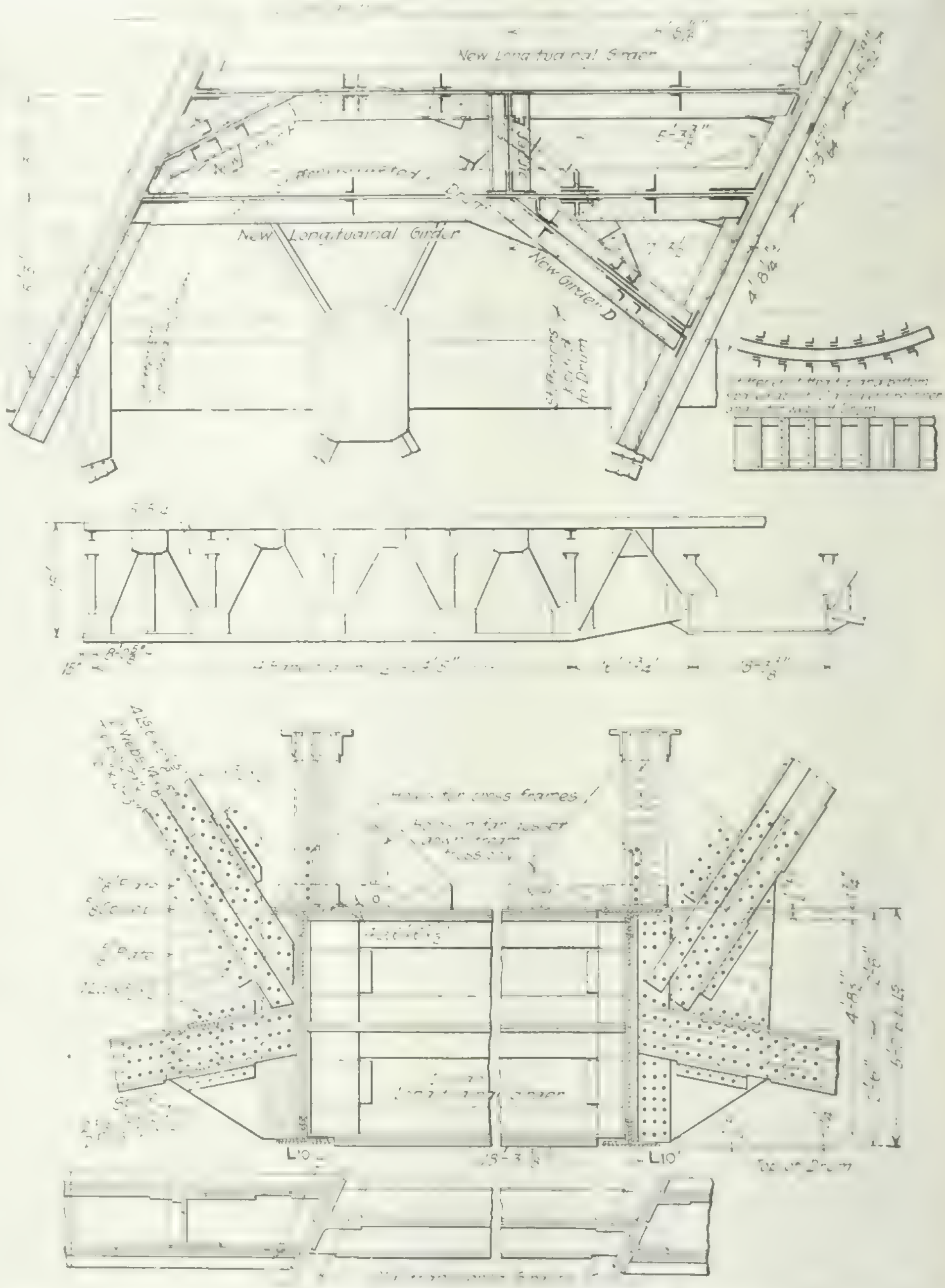


FIG. 5—RECONSTRUCTED SUPPORTING GIRDER SYSTEM OVER DRUM OF SWING SPAN

FIG. 6—CONTRAST OF OLD AND NEW TRUSSES AFTER RECONSTRUCTION OF EASTBOUND TRACK

originally. As may be seen from the longitudinal section, the bottom chords of the new trusses are carried through the distributing girders by longitudinal angles riveted to the webs of these girders.

In connection with these changes, eyebar diagonals have been put in the middle panels of the old trusses, which originally had no diagonal in the center panel, in order to avoid transmitting any shear across the turntable. Complete new machinery has also been installed, as well as a new track, while the upper tread and the body of the drum remained unchanged.

Construction Work—Two methods of carrying out the reinforcement were considered. In one it was contemplated to place first the new floorbeams, by the process of taking out one floorbeam and inserting the new one, following with the new stringers, and so progressing from panel to panel, then setting in place the top chord of the new truss in that half, and thereafter attaching the web members and bottom chord to complete the truss. The work was to be done first on one track width, then on the other, leaving one track for traffic at all times. The other plan contemplated suspending transverse stirrup beams at each panel point below the bottom chord, these beams spanning a single-track half (from center truss to one outside truss), then laying the new bottom chord on these beams, and building up the web members of the new trusses; inserting the new floorbeams in place of the old, seated on the new truss posts; and finally placing the top chord and connecting up all members of the new truss. Neither method required additional supports. The contractor elected to use the second method, supporting the new trusses at the bottom chord.

Work has proceeded very rapidly, reaching such a rate of speed as the erection crews became skilled in the details of the work that finally, in one of the 125-ft. fixed spans, the complete reconstruction of the first single-track half was carried out in 2½ days.

In the actual arrangement of the work two erection crews were used, one starting at either end of the draw span and working backward (to avoid running the cranes over the new work during construction). The eastbound track was closed to traffic and all trains were routed over the westbound track. Beginning at the ends of the draw the erectors, using a locomotive crane, took out the stringers and floorbeams and top lateral bracing of two panels, substituting crossed cable diagonals for the lateral system where interrupted by this process. The section of new bottom chord was then set in place on the stirrup beams suspended below the panel points by threaded rods attached to yokes laid over the top chords; the truss posts were next set up, and the sway frames, floorbeams, stringers and top chord were placed. When the floorbeams were being set, wedges were inserted between truss posts and floorbeams for subsequent adjustment of the span.

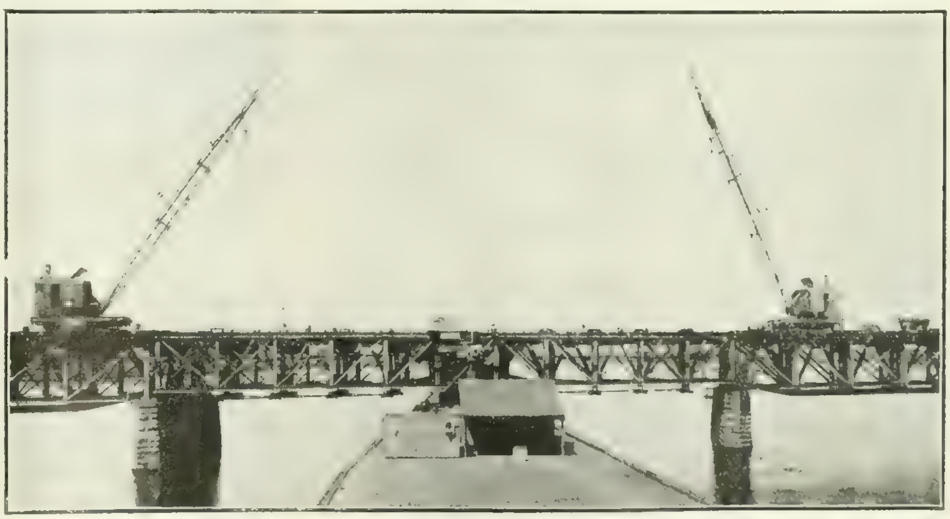


FIG. 7—LOCOMOTIVE CRANES COMPLETING ERECTION OF DRAW-SPAN TRUSSES

This process continued backward across the span, two panels at a time, until the new truss and bracing for the eastbound track were complete in that span. Up to this point no riveting had been done, the joints being merely pinned and bolted, and the weight of the new steelwork was carried by the old trusses. As soon as the span was swung, riveting began. When this was completed the wedges between floorbeams and the new truss posts were driven to a tight bearing with 15-lb. mauls. The connections for the sway bracing were left blank, and were drilled and riveted only after all the other work was completed, to avoid putting any initial stress into the sway bracing.

The erection crew meanwhile was proceeding in the next span. Both crews reached the abutments about the same time. In proceeding with the draw span they had to take care to work closely in unison, so that the draw would be balanced at all times. Navigation required that the draw should be maintained in operating condition, and as the reconstruction of the distributing girder system and machinery required the removal of the old machinery it was necessary to rig up an operating rope attached to the outer end of the fender pier by which one of the cranes could swing the draw open or shut at any time upon signal from a vessel.

Work In Draw Span—Reconstruction of the distributing girder system was the first item of the draw span work. The new longitudinal girders (on the line of the new trusses) being inserted first, the old longitudinal girders could be taken out, the new ones immediately inserted, and the subsidiary girders built into place.

In preparation for this work the entire draw span had been leveled up (the pier having tilted years ago) and moved eastward several inches into proper alignment with the fixed spans, and the new track segments placed. This work was done while the draw was closed to navigation for a 6-day period, when it was possible to jack up from the piers. River traffic was interrupted on only one other occasion, a four-day period when the end wedges and operating machinery were being changed and adjusted.

After reconstruction of the turntable girder system and attachment of the stiffeners to the drums, the erection of the new truss on the eastbound side went on, this operation completing the reconstruction of the eastbound half of the bridge. The remaining work was a repetition of the same series of operations for the westbound half.

Work in the field began May 5, 1922. Steel erection on the eastbound track was started on June 8, 1922, and completed by Sept. 11, when traffic was turned on to this track. The last steel of the westbound track was placed on Oct. 22.

Plans were prepared and the work directed by the engineering department of the Boston & Maine R.R.; A. B. Corthell, chief engineer; F. C. Shepherd, assistant chief engineer; B. W. Guppy, engineer of bridges; F. D. Hall, electrical engineer; G. L. Huckins, construction engineer; Pusey Jones, chief draftsman, and W. D. Thorne, chief inspector. The Shoemaker-Satterthwait Bridge Co., of Pottstown, Pa., was contractor for the fabrication and erection, as well as for dismantling the old structure, placing ties and painting. The contract totaled $230,000.

Simple Aerial Photography for Practising Engineers

Oblique Views Serve Useful Purposes—Camera with Shutter Speed of 1/200 of a Second Needed—Best Altitudes 500 to 1,500 Ft.

By Fred H. Tibbetts
Consulting Engineer, San Francisco, Calif.

So much has been written about aerial mapping that the uses of simpler airscapes in engineering work are in danger of being overlooked. Aerial photographs for engineering work are of two general types: (1) Vertical views for aerial maps; and (2) oblique or bird's-eye views as descriptive and illustrative aids. The oblique views have been employed frequently by the writer in connection with engineering work and it is the purpose of this article to interest other engineers in their use.

Aerial photographs of the first general type are taken with the camera pointed vertically downward and generally from considerable elevations, say 10,000 to 12,500 ft. They have been used extensively in the construction of mosaic maps for military purposes. Very recently the making of such maps has been developed to a very high degree. Descriptions of methods and results on the Tennessee River surveys, which are typical of the latest improvements in aerial mapping, were published in *Engineering News-Record*, Oct. 5, 1922, p. 552, nd also in a paper read before the American Society of Civil Engineers on Oct. 4, 1922.

Aerial mapping of this precise sort is a development of the photographic art of great importance to the engineering profession, and the writer urges that engineers consider it whenever it can be applied economically in their work. However, because aerial mapping must be done with special and costly precise apparatus not commonly available in this country except through co-operation with military authorities, it is generally too expensive for any but very large and important projects.

Bird's-Eye Views—Oblique views, on the other hand, should be used by engineers more extensively than at present because such views can be taken by any amateur with ordinary commercial apparatus. These views are of great value in illustrating preliminary reports and they enable other engineers, and particularly non-technical men who have not seen the ground to be improved, to visualize projects rapidly and accurately. Aerial photographs are also of value for illustrating progress reports. With such views it is possible for boards of directors or other executives to appraise accurately the progress that is being made on construction work in a fraction of the time required to read over a progress report.

In a study of city traffic problems, fire hazard, terminal facilities, etc., any practising engineer with any available airplane can in a few minutes, from a height of a thousand feet, obtain photographs from which can be counted automobiles or other units of vehicular traffic, freight cars, boats or buildings. For land development work oblique aerial photographs show topography in relief, a result not satisfactorily obtained by vertical views. Simple photographs of this sort also show clearly the extent of forests, the position and extent of water courses and other topographical features.

An instance of the application of oblique views in awarding clearing contracts and in developing natural drainage channels appeared in *Engineering News-Record*, Nov. 23, 1922, p. 889.

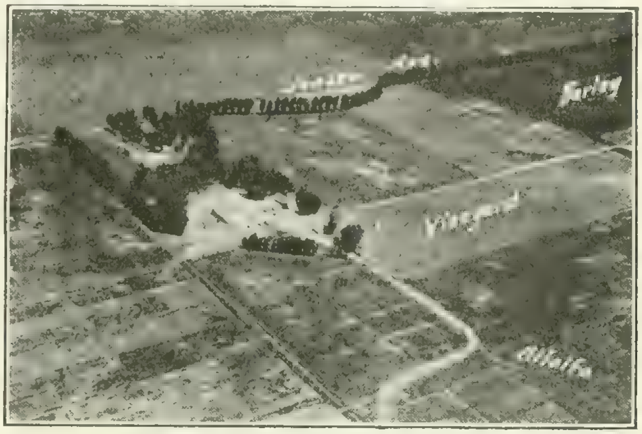
Good oblique aerial photographs can be taken with any ordinary hand camera fitted with a shutter which will work with a speed at least as rapid as 1/200 of a second. Under average conditions of good light 1/300 of a second is better, and with this timing an aperture of from F 5.6 to F 8 will ordinarily give fully-timed negatives. Care should always be used to hold the camera free from direct contact with any portion of the airplane, otherwise vibrations of the machine are transmitted to the camera, with a corresponding loss in sharpness of the negatives. A camera with a focal plane shutter, such as a Graphic or Graflex, will probably give better results and a sharper negative than one with the more common, between-lens, shutter. The writer believes that a Graphic will give just as good results as the more bulky and unwieldy Graflex camera, as the hooded focusing device and reflex feature of the Graflex is practically useless in the air. The camera can be sighted with sufficient accuracy by looking along one corner of the box toward the center of the object desired in the picture, though a rectangular direct-view finder is of advantage in showing the extent of the territory which will be covered.

Ray filters will seldom improve results, even on a hazy day. The lightest ray filter in ordinary commercial use requires about three times the normal exposure, and under light conditions which would indicate the use of a ray filter for ground work an ordinary lens would be nearly wide open with a 1/200-sec. exposure without the ray filter. To use a filter and give sufficient time under these conditions would require lengthening the exposure to a point which would preclude clear negatives. Plates probably give better results, though more difficult to use, than films—quite likely because they are less sensitive to the vibrations of the machine. Plate-holder attachments are on the market which permit the use of twelve plates which can be readily changed in the air.

CONDITIONS IN NEVADA IRRIGATION DISTRICT

Shows extent of orchard development in area previously heavily wooded. Note relative amounts of clearing required in foreground areas. Photo made on graphlex plates at an altitude of 1,100 ft., 8:30 a.m., Sept. 21, 1921. Exposure 1/200 second. F-5.4 aperture.

In the more common types of airplanes the engineer or photographer will have one cockpit to himself, with his view more or less obstructed by the wings or tail of the machine. The best photographs will be secured if an aviator can be found who has already had experience in this kind of work, or who can be carefully instructed in advance to maneuver his machine for each photograph so that the object to be photographed can be taken with the camera pointed diagonally away from the machine, about half way between the wings and the tail. The photographs should be snapped when the machine is moving straight ahead, as clearer views will thus be obtained than if the machine is turning.



VIEW TAKEN TO ACCOMPANY SEWAGE FARM REPORT

Main irrigation ditches for sewage distribution in center foreground. Note laterals and checks in alfalfa field at right. Taken with graphic camera at an altitude of 800 ft. at 11 a.m., May 6, 1922. Exposure 1/200 second. F-8 aperture.

Because of the noise of the motor communication in the air between photographer and pilot is usually by signs or written notes. The photographer can indicate by pointing the object which he wishes to take, and the aviator should then bring his machine into proper position. There should be no hesitancy in signaling the pilot to return and repeat the maneuver, if the photographer is not satisfied that he has secured a good view.

As in any photographic work, the views should be obtained looking in the direction of the light. The best results can ordinarily be obtained from an altitude of about 1,000 ft. The limits for such views, if much detail is desired, are probably between 500 and 1,500 ft. A careful aviator is often reluctant to fly at these low elevations, and ample time should be allowed to get the machine thoroughly warmed up and running satisfactorily before starting such a flight.

If the topography is broken and landing fields are few there may be some element of risk in flying so low, and in mountainous country the risk certainly becomes too great to permit of flying at low elevations. The worst conditions will obtain over rugged, and particularly bare, mountain-peaks on a warm summer afternoon when vertical, eddying and irregular air currents will ordinarily necessitate flights from 2,000 to 5,000 ft. above the ground surface. Even under these conditions, however, excellent general views can be obtained of mountain topography for water supply, railroad, highway, or other developments. Quieter air and lower safe altitudes will almost invariably be found in the first half of the morning than later in the day.

The direct benefits to the practising engineer of using an airplane for reconnaissance should not be overlooked. Most engineers have had experience with the use of the camera, and when oblique aerial photo-

graphs are to be made under their direction they can just as well take the photographs themselves. Not only is the engineer the best judge of the subjects which he wishes to photograph, but by making the flight himself he gets the benefit of direct inspection and study of the territory in which the work is projected or under way. Where the chief or locating engineer desires a comprehensive, general, first-hand idea of a mountainous watershed, for example, its topography, improvements, forest covering, etc., he can frequently obtain more information in a few hours in an airplane than he could in as many weeks of laborious and costly ground travel.

As to the costs for the services of airplane and pilot, the commercial rate on the Pacific Coast is $50 per hour for a plane carrying pilot and two passengers and capable of making 50 to 60 miles per hour (the slower the speed the better for photographic purposes). On a recent piece of work in which a plane was used at this rate for a total of four hours in the air, sixty exposures were made from which were selected twenty photographs suitable for the purposes in hand.

Design of Storm Sewer and Flood Gate, Wichita Falls, Tex.

By Julian Montgomery
Of Montgomery & Ward, Consulting Civil Engineers, Wichita Falls, Tex.

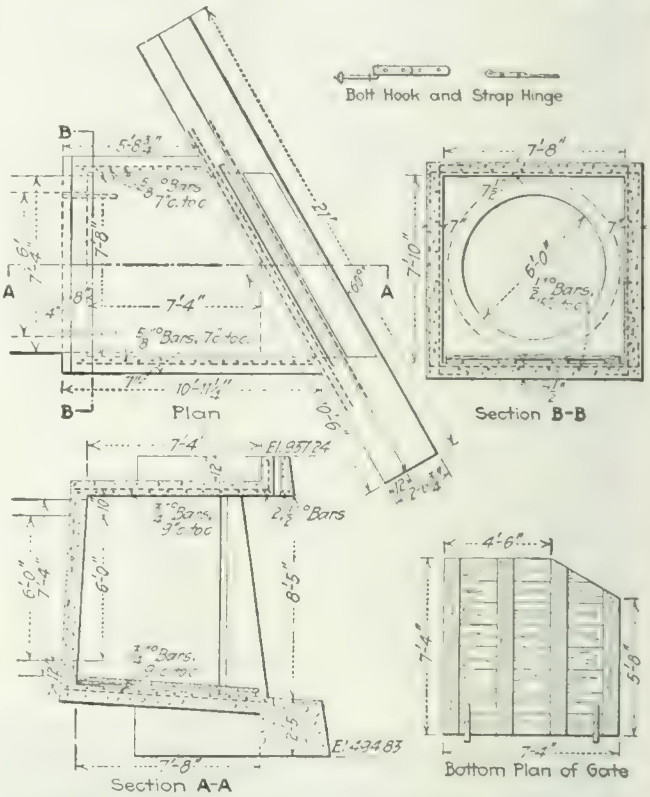
INCLUDED in the construction program launched by Wichita Falls two years ago was a storm sewer for the central residence and adjacent business district. Previous to this project none of the residence districts contained storm sewers, and only a part of the business district. On paved streets the storm water was carried by surface drainage, and as the business district is considerably lower than most of the residence districts the sudden downpours common to this part of Texas often flooded the business district. The two storm sewer mains, with their laterals, known as the Indian St. and Austin St. storm sewer systems, were designed to carry off the flood water from the business district and to relieve the more thickly populated central residence district, part of which is paved, but the major portion of which is yet unpaved.

In making the design, local conditions were carefully studied. Ordinarily, the climate at Wichita Falls is a dry one. When it does rain, sudden downpours, often of considerable quantity, are not uncommon. The storm sewers were designed for a rainfall of 2 in. per hour, using a runoff coefficient of 0.6 for the residence district and 0.7 for the adjacent business district, which district is on the edge of the main business part of the city. The rational method of design was used. A topographical map of the city had only recently been completed and it was used for obtaining the drainage areas tributary to the two systems.

After receiving bids on brick, concrete and segmental blocks, the latter type was chosen as being considerably the cheapest. The sewer was 72 in. in diameter on one street and 84 in. on another.

Flood Gate—A feature of the outfall design is the flood gate and chamber. During flood stages of the Big Wichita River, the river water, unless prevented, will back into the storm sewers, and occasionally will get high enough to come out through the inlets. Since the river water is very muddy, a considerable amount of mud and sand will be deposited in the sewers unless the water is kept out. The drawing shows a design for a flood gate which has proven very successful.

The gate, which is built of red cedar, is hinged at the bottom. The reinforced-concrete gate chamber is so built that ordinary flow through the sewer will pass under the gate and prevent a possible deposit of sand or silt on it to weigh it down and keep it from floating. As the river rises the top of the gate floats. When the water gets up within about two-thirds of the top of the sewer the gate will shut. The vertical face of the



SEWER FLOOD GATE AT WICHITA FALLS, TEXAS

chamber, or sewer, which the gate shuts against, is inclined toward the river, so that the gate closes the sewer before it comes entirely to a vertical position, thus obtaining a certain amount of additional pressure in holding it shut. In constructing the concrete gate chamber the gate itself was used as a form for the back face, so that it would fit exactly when it was shut.

The storm sewer was designed by F. M. Rugeley, office engineer, City Engineering Department, under the supervision of the writer, who was at that time city engineer. R. C. Thaxton and John A. Donald were resident engineers in charge of construction. The contractor was C. H. Foley of Wichita Falls.

Soil Gas Leakage Through Basin Floor

Failures in the floor of the reflecting pool in front of the Lincoln Memorial at Washington recently led to an investigation by the Bureau of Standards to determine their cause. Bubbles of gas had been observed rising in the pool. It was found that these bubbles consisted of methane and carbon dioxide, that they came through the floor from the ground beneath, and that they probably resulted from decomposition of buried organic matter in the soil. No means of preventing the gas formation were suggested but it was recommended that vents be provided for the gas to escape without passing through and damaging the basin floor.

Porto Rican Concrete Arch Bridge Has Novel Spandrels

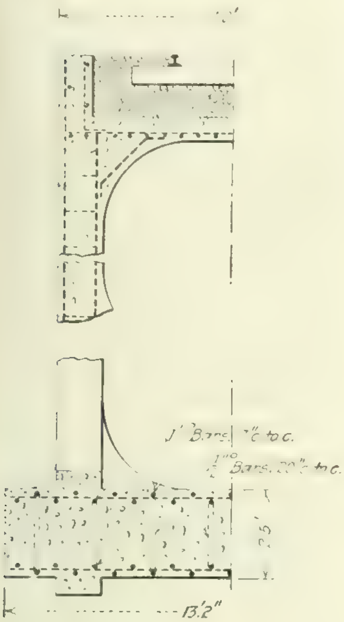
Roadway of Railway Bridge Near Seashore Is Carried on Slab Supported by Gridiron Shaped Posts and Braces

A DEEP gorge crossing on the American Railroad of Porto Rico has been solved by the use of the novel type of spandrel concrete arch shown in the accompanying view and drawing. The bridge replaces an old steel truss bridge on the shore line of the railroad between Camuy and Quebradillas (km. 108/838).

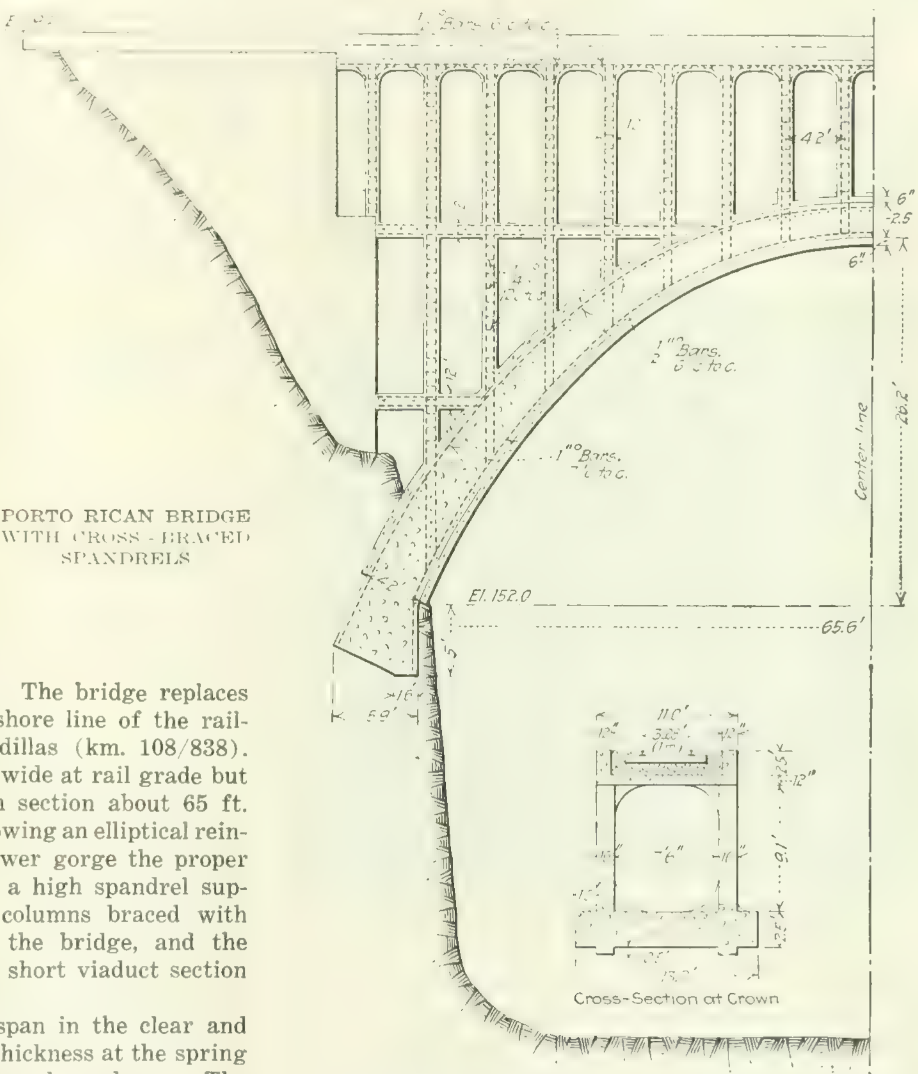
The ravine here is about 120 ft. wide at rail grade but has an almost rectangular bottom section about 65 ft. wide, with good rock sides. By throwing an elliptical reinforced-concrete arch across the lower gorge the proper rail grade could be attained with a high spandrel support. This support consists of columns braced with horizontal struts in the line of the bridge, and the construction is carried along as a short viaduct section at one of the approaches.

The arch rib is solid, 65.6 ft. span in the clear and 13.2 ft. wide, varying from 4.2 ft. thickness at the spring to 2.5 ft. at the crown and reinforced as shown. The floor is dropped slab 12 in. thick with sidewalls to retain the ballast in which are placed the ties for the meter-gage track. The spandrel columns, 12 x 16 in. in section, are reinforced with straight rods, and braced by the cross struts with curved knees. In the line of the posts the arch is increased in thickness by 6-in. extensions above and below. The heaviest locomotives on the line weigh 84 tons.

The bridge was designed by Etienne Totti, chief engineer of the railroad, and was built under his direction and the superintendence of Gabriel Martinez. Its cost is stated as $18,000.



PORTO RICAN BRIDGE WITH CROSS-BRACED SPANDRELS



CONCRETE BRIDGE ON AMERICAN R.R. OF PORTO RICO

Further Appropriation for Transandine Ry.

An increase of 1,500,000 gold pesos is proposed in a law recently submitted to the Argentine Congress, to be used for the electrification of the Argentine Transandine Ry., 45 km. long, between Zanjon and the Chilean frontier. A contract between the government and the Argentine Transandine Ry. Co., already approved, provides for joint administration of the Chilean and Argentine transandine roads connecting Mendoza and Los Andes and stipulates that the government shall place at the disposition of the railway company bonds of the Argentine external loan, not to exceed 2,500,000 gold pesos, bearing 5 per cent interest, with 1 per cent amortization.

Motor Truck Tractive Resistances on Road Surfaces

Elimination Tests of Measuring Devices Prove Superiority of Space-Time Recorders—Gasoline Consumption Measured in Relation to Tractive Resistance

BY T. R. AGG
Professor of Highway Engineering, Iowa State College, Ames, Iowa

AN INVESTIGATION of the economics of highway grades was begun in 1919 at the Iowa Engineering Experiment Station. Before the work had been under way very long it became apparent that correct values for tractive resistance would be needed to establish the theory of highway grades. An investigation of the subject of tractive resistance was therefore inaugurated at Ames and later developed into a co-operative project, with the Bureau of Public Roads and the Iowa Highway Commission participating. The work is now well along toward completion and is under the supervision of A. T. Goldbeck, of the Bureau of Public Roads, and the writer.

Equipment—Through the co-operation of F. R. White, chief engineer, Iowa Highway Commission, trucks, tires and much minor equipment were supplied by the Commission. The types and the characteristics of the several vehicles employed are indicated in Table I.

Dynamometer Measurements Unsatisfactory—The Davidson dynamometer was used for the first measurements of tractive resistance. This dynamometer is placed between the truck under test and a towing truck and is designed to record the drawbar pull for a comparatively short distance, usually either 50 or 100 ft. It is a spring dynamometer with a recording device that plats a curve of draw-bar pull and mechanically integrates the area between the curve and the zero line.

From the beginning, difficulty was experienced in securing concordant results with this method. The dynamometer operated nicely but the towed vehicle surged considerably, due to the slight unevenness of the road surface. This surging introduced impact errors which are clearly indicated by the curve of draw-bar pull in Fig. 2. In addition to these effects, difficulty was experienced in maintaining uniform vehicle velocity. Undoubtedly many of the records were affected by acceleration as well as by impact.

It was thought that if the records were made by towing the truck up grade, most of the impact effects would be eliminated. This did not prove to be the case, although records so taken are much less erratic than those taken on level roads.

In Table II there are given some values of tractive resistance obtained with the Davidson dynamometer. Later investigations show these values to be somewhat high, and they are chiefly of interest because they indicate the wide variation in individual determinations. No method was discovered for eliminating these objectionable characteristics of the dynamometer determinations, although other types of dynamometer were tried; it was therefore necessary to seek some other method of measurement.

> *CONCLUSIONS EPITOMIZED*
>
> *1. About half the fuel consumed by a motor car or truck is required to operate the mechanism and to overcome air resistance.*
>
> *2. Unevenness of surface is immediately reflected in an increase in tractive resistance.*
>
> *3. A change to a better type of surface may easily save enough fuel to liquidate the cost of the improvement.*
>
> *4. Bituminous type roads show materially higher resistance in hot weather than in cold.*
>
> *5. Rolling resistance on low-grade roads is an exceedingly variable quantity.*

Accelerometers Difficult to Read—There are several instruments in use that are intended to indicate, or record, tractive resistance by the acceleration method. The Wimperis accelerometer was developed by H. E. Wimperis, Hampstead, England, and is manufactured by Elliott Bros. Co., Ltd., London. In principle the instrument consists of an unbalanced disc mounted horizontally, with a spring for resisting rotation and for returning it to the zero position. The instrument is mounted on the vehicle and by means of the leveling screw the pointer is brought to the zero position when the vehicle is standing on a truly level place. Any acceleration or deceleration of the vehicle causes the disc to rotate and moves the pointer to the proper scale indication. The instrument is calibrated to show tractive resistance in pounds per ton.

In determining tractive resistance with this instrument, the vehicle was driven at speed to the beginning of the section of road upon which tractive resistance was to be determined, and then declutched and allowed to coast to rest, or was allowed to coast from rest down a hill. Simultaneous readings of the accelerometer and of speed were taken as rapidly as the observer was able to do so. An accurate and sensitive speed indicator must be used as the ordinary speedometer is not sufficiently accurate for the purpose.

It was found that certain difficulties were likely to be encountered in using the instrument. One was the effect of uneven road surfaces on acceleration or deceleration. The vehicle does not change speed uniformly but instead travels with a succession of erratic changes in speed which are slight but which are truly reflected in the indication on the instrument. A large number of observations must be averaged to eliminate erratic points on the curves. A similar effect is produced by the change in the relative position of the body of the vehicle and the wheels, resulting from the spring action, and this is a serious matter at high speed.

Another difficulty was that of reading the instrument. The graduations on the dial are fairly close together and it is exceedingly difficult to read the value of acceleration or deceleration, particularly when the instrument is being used on trucks.

It is believed that this instrument would be satisfactory for measuring car performance but for the small values of deceleration obtained in measuring tractive resistance it was impossible to read the scale

TABLE I. VEHICLES EMPLOYED IN TRACTIVE RESISTANCE INVESTIGATIONS

Vehicle	Gross Weight, Tons	Size and Type of Tires	Remarks
Buick 21-45 Touring Car	1.85	33 x 4 U. S. Royal Cord, inflation 65 to 70 lb. per sq.in.	Weight includes driver and observer. Car and tires nearly new at beginning of series of runs
Light Aviation Army Truck.	4.14	Front 35 x 5 Goodyear Cords, all weather tread; rear, twin 35 x 5 Goodyear Cords, all weather tread; inflation 85-90 lb. per sq.in.	Truck and all equipment new at beginning of the series of runs
Heavy Aviation Army Truck	7	Front 36 x 6 solids, rear, 36 x 10 dual solids	Truck and all equipment new at beginning of the series of runs
F. W. D. 3-ton Truck	9,120 lb. empty, 14,650 lb. loaded	40 x 8 cord tires for one series 100-125 lb. inflation, 36 x 6 smooth tread solid tires for one series	Driving centers removed from all wheels. Wheel bearing friction only internal resistance. Equipment new at beginning of the series of runs.

with sufficient rapidity, especially during the tests.

The Drewery testometer is a liquid accelerometer consisting of a U-tube attached to a small reservoir and arranged so that any retardation or acceleration in the line of the tube of the instrument causes the liquid to flow in the tube to a position of equilibrium, thus indicating the accelerating force. The instrument is attached to the vehicle, and, by means of an adjusting screw, set at zero when the car is standing on a level place. In general the use of the testometer was subject to the same difficulties as were experienced with the Wimperis instrument.

TABLE II. RESISTANCE TO TRANSLATION ON GRAVEL SURFACE
(Rolling, Impact and Air Resistances and Internal Resistance up to the Neutral Gear)

Run	Draft Pounds per Ton	Remarks
1	114.4	Dynamometer tests were made up a 5.85% grade with a good, hard smooth gravel surface. Speed approximately 6 mi. per hour. Tires inflated to 75 lb. per sq.in. Gross load 8,300 lb. Gear shift in neutral.
2	187.8	
3	174.6	
4	175.9	
5	143.4	
6	173.3	
7	121.6	
8	91.6	
9	146.9	
10	122.8	
11	186.6	
12	174.6	
13	174.6	
14	144.5	
15	177.2	
16	127.7	
17	91.6	
Average of all determinations		148.5
Subtract for effect of grade		117.0
Equivalent average draft for 0.0 grade		31.5 lb. per ton

Space-Time Recorder Most Dependable—Several years ago David L. Gallup, consulting engineer for the Nordyke-Marmon Co., of Indianapolis, Ind., served as chairman of a committee of the Society of Automotive Engineers that developed an accelerometer for use with motor vehicles and used it in some research work. The instrument and its use are described in *The Automobile*, June 28, 1917, p. 1230.

TABLE III. RESISTANCE TO TRANSLATION ON BITULITHIC PAVEMENT
(Rolling Impact and Air Resistances and Internal Resistance up to the Neutral Gear)

Run	Draft Pounds per Ton East	Draft Pounds per Ton West	Remarks
1	48.7	21.2	Heavy aviation truck. Gears in neutral. Runs on Bitulithic pavement. Lincoln Way, Ames, Iowa. Speed approximately 8 miles per hour. Gross load 8 tons. Temperature 65° F.
2	38.2	36.9	
3	39.4	37.5	
4	35.6	39.4	
5	35.6	36.2	
6	28.8	35.7	
7	28.2	41.2	
8	28.2	36.2	
9	24.4	35.7	
10	27.5	13.8	
11	28.2	20.0	
12	24.4	21.8	
13	23.8	25.0	
14	30.0	24.4	
15	30.6	25.0	
16	34.4	17.5	
17	34.4	23.1	
18	40.0	18.5	
19	35.6	16.5	
20	40.0	21.9	
21	36.3	21.2	
22	40.6	40.6	
Average for all determinations			30.5 lb. per ton

Mr. Gallup loaned his instrument for the work at Ames and after giving it a thorough trial we concluded that it offered a most dependable means of measuring tractive resistance by the retardation method. Mr. Gallup had to recall his instrument before the Ames work could be finished and one of our own design, but similar in principle, was constructed for the completion of the Ames investigations.

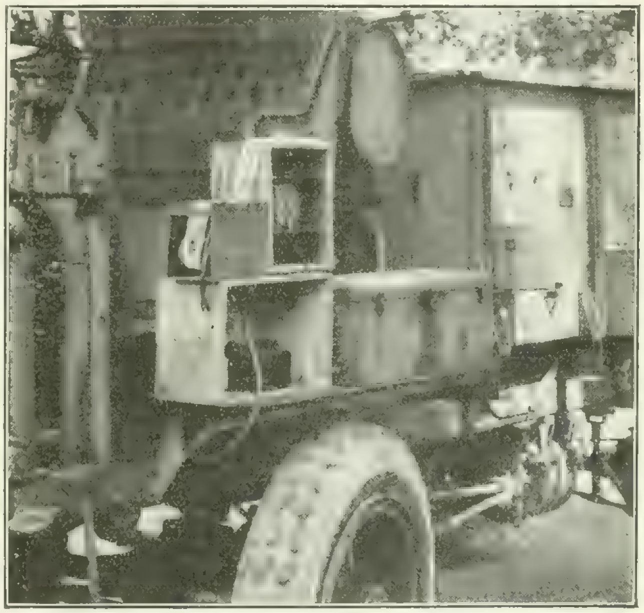


FIG. 1—SPACE-TIME RECORDER ATTACHED TO TRUCK

In its final form the instrument, which is illustrated in Fig. 1, consists of a paper feed that moves the paper through the recorder at a fixed ratio to the distance the vehicle travels, and a time recording pen. The paper-feed roll is driven from a gear on the front wheel of the vehicle, through an ordinary speedometer cable. A clock mechanism actuates the pen so that a break occurs in the ink line every one-half second. Fig. 3 shows a section of one of the records from the instrument.

It does not seem to be generally understood that the resistance to the translation of a motor vehicle really consists of several quantities that may vary independently of each other. It is convenient to consider the following combination of these factors:

1. Rolling resistance, due to the interaction of wheel and road surface, and which usually is understood to include wheel bearing friction.

2. Internal resistance, which is made up of bearing friction and gear friction, including the effect of the lubricant in the gear housings, in all parts back of the clutch. Usually wheel bearing friction is excluded.

3. Motor resistance, which includes friction in the

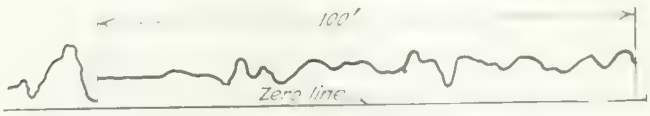


FIG. 2—RECORD FROM THE DAVIDSON DYNAMOMETER

motor itself and the power requirements of engine auxiliaries, such as the pump, generator and fan.

4. Air resistance, which is the effect of the relative speed of the vehicle and the air.

These various resistances are usually expressed in terms of equivalent force applied at the rear axle and the customary unit is *pounds per ton* of weight of vehicle.

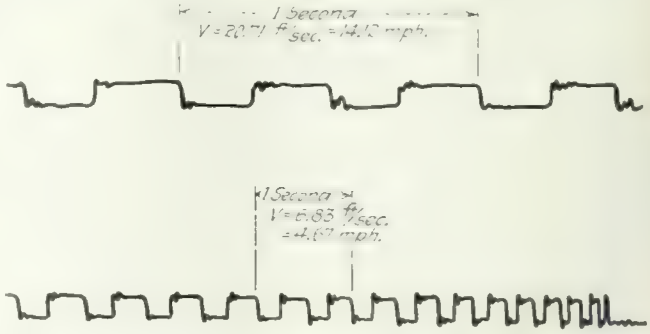


FIG. 3—RECORD FROM THE SPACE-TIME RECORDER

The diagram in Fig. 4 shows the approximate values of certain of these resistances for the light aviation truck when traveling on a paved road surface.

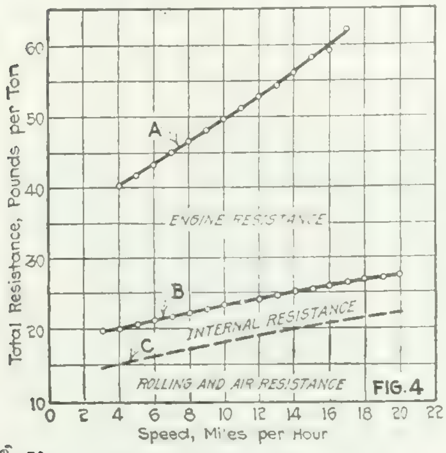


FIG. 4

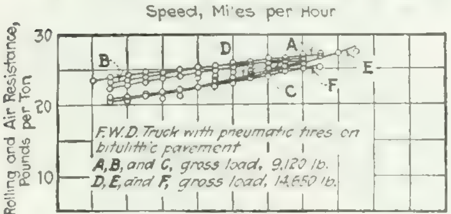


FIG. 5

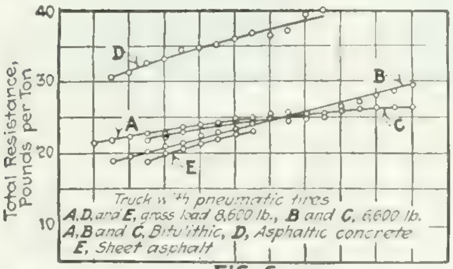


FIG. 6

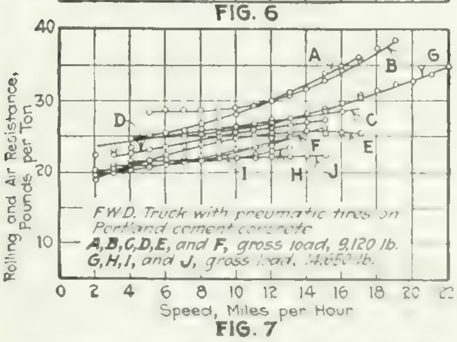


FIG. 7

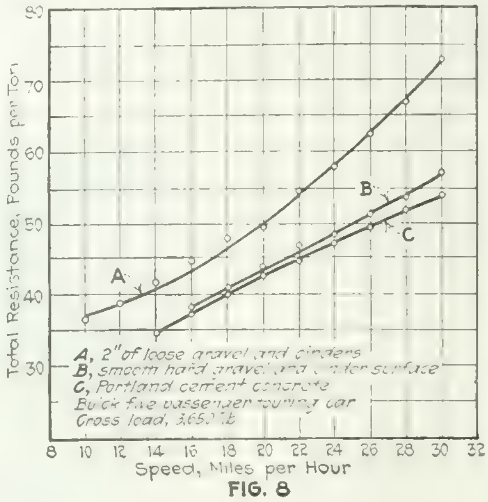


FIG. 8

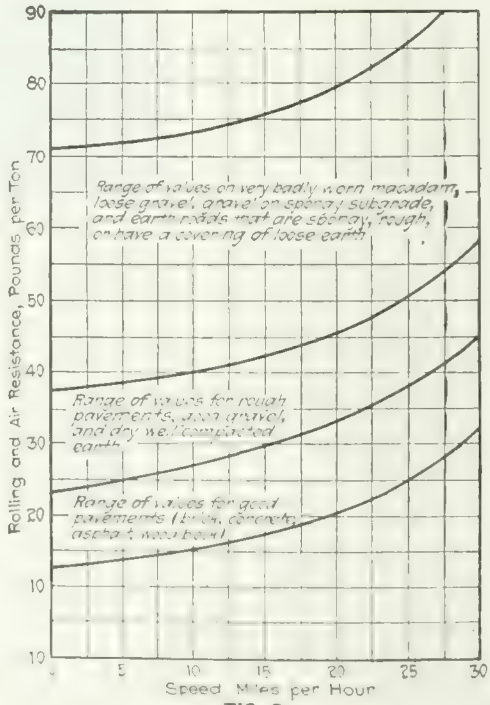


FIG. 9

FIGS. 4 TO 9—TYPICAL AND SUMMARY CURVES OF TRACTIVE RESISTANCE ON VARIOUS ROAD SURFACES

Fig. 4—Approximate values of the various resistances of the "Light Aviation" truck on a paved road surface. Fig. 5—Values of rolling resistance plus air resistance. Fig. 6—Values of total resistance up to the neutral gear, pneumatic tire truck. Fig. 7—Values of rolling resistance plus air resistance. Fig. 8—Values of total resistance up to the neutral gear, Buick touring car. Fig. 9—Range of values of rolling resistance on various classes of surface. From about 100 determinations with many types of vehicles.

It will be noted that rolling resistance is directly influenced by the character of the road surface, although internal resistance may be influenced indirectly. The other resistances are not particularly influenced by the character of the road surface.

Figs. 5 to 8, inclusive, show the results of some of the measurements of tractive resistance. In some instances the total resistance up to the clutch was measured. The significant information so far obtained is indicated by Fig. 9 which shows the range of values of rolling resistance (including air resistance) for all determinations that have been made at Ames or those made elsewhere in so far as the reports have been available. Specific investigations are now in progress with a view to developing the law of variation within the zones indicated in Fig. 9. The averages of the values from this diagram are used in Table V.

Gasoline Consumption Determinations—In order to secure a check on the relation of tractive resistance to fuel consumption, a number of trial runs were made on a few types of road surface, on highways with very low grades, for the purpose of securing data on fuel consumption. Needless to say these data are comparative only and even the same vehicle will give periodic variations in fuel consumption. It would not be safe to assume that exactly the same number of ton-miles per gallon of gasoline could be obtained on the same road with another vehicle, even of the same type. The

TABLE IV. GASOLINE CONSUMPTION DETERMINATIONS

Run	Kind of Road Surface	Distance Traveled Miles	Ton-Miles per Gal of Gas
1	Gravel—Some soft places	60	19.8
2	Gravel—Hard and smooth	51	21.7
3	Gravel—After summer shower	6	18.5
4	Gravel—Hard and dry	10.5	21.9
5	Gravel—After summer shower (same road as run 4	10.5	19.0
6	Gravel—Hard and smooth	71.0	22.0
7	Monolithic brick in excellent condition	10.78	29.4
8	Same as run 7 on another day	10.78	30.0
9	Portland Cement concrete—excellent condition	68	30.7
10	Bitulithic, excellent, in August	13	22.7
11	Bitulithic, excellent, in September	8	24.3

Averages for all runs

Type of Surface	Ton-Miles per Gal of Gas
Earth (generally in poor condition)	14.0
Gravel	21.2
Monolithic brick	29.7
Portland cement concrete	30.6
Bitulithic	23.4

runs were all with the heavy aviation army truck carrying a gross load of 8 tons and a net load of 3.5 tons.

Table V shows the relation between fuel consumption and tractive resistance and is of interest as a check on the results obtained by two widely different methods of studying the subject.

The gasoline consumption on good paved surfaces is shown as unity and consumption on other surfaces in comparison therewith. Obviously the values for inferior surfaces can be only general averages. The relative tractive resistance is shown in the column at the extreme right. This table indicates surprisingly close agreement among the various quantities.

With Table V as a basis, and a known tonnage over a highway, the engineer can compute the minimum justifiable expenditure for any change in surface type.

Conclusions—The results of the experiments indicate that about half of the fuel consumed by the motor car or truck, under normal operating conditions on good surfaces, is required to operate the mechanism of the vehicle and to overcome air resistance. The possibilities of saving fuel to the motor car driver who uses paved surfaces are confined to the prevention of dissipation of energy by impact on rough surfaces.

TABLE V. RELATION BETWEEN FUEL CONSUMPTION AND TRACTIVE RESISTANCE

Type	Source of Data: Ames[1]	Canadian[2] Engineer	A. N.[3] Johnson	Relative Tractive Resistance
Good pavement	1.00	1.00	1.00	1.00
Macadam and Bit. Mac.	.	1.23	1.24	1.20
Gravel	1.43	2.1	1.64	1.6
Earth	2.10	2.03	2.04	2.20

[1]See Table IV; [2]Canadian Engineer, Aug. 29, 1922, p. 303; [3]Engineering News-Record, Nov. 7, 1918, p. 843.

There is no marked difference in the actual rolling resistance of rubber tired vehicles over concrete, brick or sheet pavements that are in good repair. Unevenness of surface due to poor construction or inadequate maintenance is immediately reflected in an increase in tractive resistance which may reach a value equal to 1.25 times that of the same type of surface in good repair.

If the motor car driver must use low grade surfaces, a markedly larger fuel consumption is required to propel the vehicle than on paved surfaces and it is easily possible that on heavily traveled trunk lines, the change to a better type of surface would save enough fuel to liquidate the cost of the improvement.

The sheet asphalt and asphaltic types show much higher resistance in hot weather than in cold.

The rolling resistance on the low-grade surfaces such as macadam, gravel and earth is an exceedingly variable quantity, as would be expected.

Navigable Waters in the Water Power Act

MUCH doubt exists as to the exact authority of the federal government in the execution of the Water Power Act to control intra-state streams under the commerce clause of the Constitution and a suit by the State of New York to define this authority is now before the courts. It is interesting, therefore, to note the interpretation of the situation given by O. C. Merrill, executive secretary of the Federal Power Commission, in a paper read at the San Francisco meeting of the American Society of Civil Engineers, Oct. 4, 1922. His remarks on this phase of the act follow:

When power projects involve lands or other property of the United States the jurisdiction of the commission admits of no doubt. Ownership is a question of fact, and when the fact is established, the authority of the commission is clear and is exclusive. Outside of the public lands and reservations the jurisdiction of the commission involves two classes of streams; first, those streams which are defined in the act as "navigable waters," over which the commission has direct jurisdiction, and in which development cannot lawfully be made without its prior approval; and second, those nonnavigable tributaries of navigable waters in which power development by altering the natural flow would affect the navigable capacity of the navigable waters. The second class come under the jurisdiction of the commission only when declarations of intention to construct dams within them are filed with the commission.

The Act defines navigable waters as "those parts of streams or other bodies of water over which Congress has jurisdiction under its authority to regulate commerce with foreign nations and among the several states, and which either in their natural or improved condition notwithstanding interruptions between the navigable parts of such streams or waters by falls, shallows, or rapids compelling land carriage, are used or suitable for use for the transportation of persons or property in interstate or foreign commerce, including therein all such interrupting falls, shallows, or rapids; together with such other parts of streams as shall have been authorized by Congress for improvement by the United States or shall have been recommended to Congress for such improvement after investigation under its authority."

Whether a stream has been recommended for improvement, or improvement has been authorized or actually made, is a simple question of fact. Whether it is used in the transportation of persons or property in interstate or foreign commerce is also a question of fact which may be determined upon investgation; but whether if so, the amount or character of such commerce is sufficient to warrant the assertion of jurisdiction by the commission is a matter for decision in the individual case. Similarly, whether a stream whch is not now used in interstate or foreign commerce is suitable for such use is a matter of judgment, and decision must rest upon the character of the stream and upon the probability of the future development of commerce.

The Act provides a procedure whereby anyone proposing to build a dam in any stream of doubtful status may make declaration of his intention and have the matter conclusively determined by the commission. There has been criticism, particularly in the New England States, that the definition contained in the Act is not clear and that the Act should be so modified or the definition so interpreted by the commission that the limit of navigability on any stream may be determined with such exactness that no one need ever be in doubt or apply to the commission for determination.

The question of navigability is not one of mathematical formulas, and there is no more probability that it can be removed from the domain of individual judgment, than that our laws in general can be drawn with such precision that the services of the courts in their interpretation can be dispensed with. The decisions of the commission in the individual cases presented to it will establish precedents that will gradually clear the situation.

Wide-Web Column Tests for Delaware River Bridge

Web-Plate Proportioning Is Being Studied to Check Tower Design—Bending Tests of Cable Sections Also Planned

STRENGTH tests of fourteen wide-web columns are in progress at the Bureau of Standards for the Delaware River Bridge Joint Commission, which is building the 1,750-ft. suspension bridge between Philadelphia and Camden. In the construction of the towers of this bridge, which are cellular columns built up of plates and angles, the permissible ratio of thickness to unstayed width of plate webs is an important factor. Under existing practice, well fixed in bridge specifications since the tests reported by Bouscaren before the American Society of Civil Engineers in 1880, a compression plate should not be wider between lines of support than thirty times its thickness.

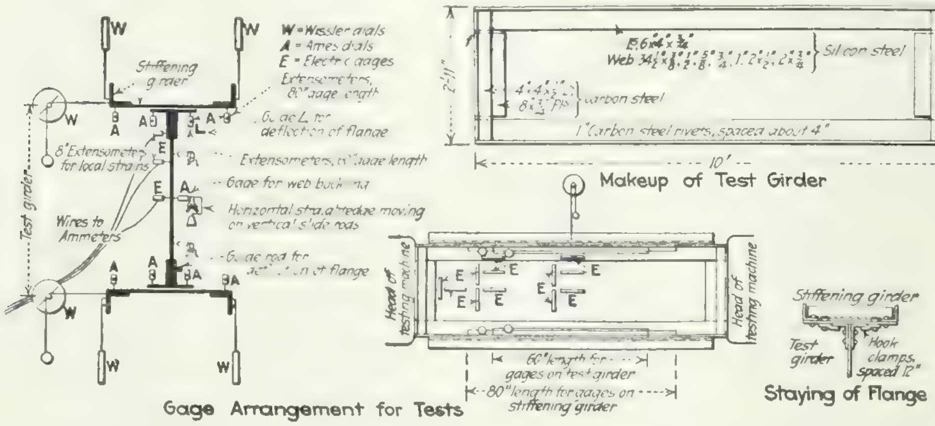
The tests are planned to investigate the validity of this rule, based on tests of three columns with 12-in. channel webs, as well as to determine the effect of various elements of manufacture, such as the inevitable presence of slight buckles or waves in the web plate, on the strength of the column.

These tests are part of a larger test program which will be carried out to verify important elements of the construction of this bridge, or to give a more adequate basis for the calculation of certain auxiliary actions. Among the other tests for which definite plans have been made are bending tests on a 20-ft. length of 10-in. cable, wrapped as in the finished cable, to determine the influence of slip between the individual cable wires upon the resistance to bending (which determines the secondary stresses in the cable); and tests of the strength of a cable strand laid up around a strand shoe.

Column-Test Program—The fourteen test specimens of the present column tests, as represented in the sketch herewith, are square-end columns of I-shaped section 35 in. wide by 10 ft. long, composed of four 6 x 4 x ¾-in. angles and a 34½-in. web, giving a clear width of web plate between edges of flange angles of 23 in. The web thicknesses of the several columns are ⅜ in., ½ in., ⅝ in., ¾ in., 1 in., 2 x ½ in., and 2 x ¾ in. The material is silicon steel, with about 80,000 lb. per square inch ultimate strength and 45,000 lb. per square inch yield point.

The tests are made in the large horizontal hydraulic Emery machine of the Bureau of Standards; the columns are tested with the plane of the web vertical. Directly above and below the flanges are horizontal channel-shaped stiffening girders to hold the test column against lateral deflection just as it would be held by transverse webs or bracing in the actual structure. These stiffening girders take no longitudinal stress; they are shorter than the test girder and are not connected to it but hold it laterally by means of lubricated hook-shaped clamps.

Four extensometers of 60-in. gage length on the outstanding legs of the flange angles measure the general longitudinal compression of the column in the test. Check measurements of compression are taken on the stiffening girders, to verify the absence of longitudinal stress in them. The lateral and longitudinal strains in the web of the test column are measured by ten 8-in. extensometers of a new form, in which the longitudinal movement is measured by the variation of resistance of carbon plates in contact, indicated by ammeters at the reading table.



TEST COLUMN FOR INVESTIGATING RATIO OF WEB WIDTH TO THICKNESS

Seven test sections with different web thicknesses have been built, and two specimens of each are being tested. Under present practice a compression plate should not be wider between lines of support than thirty times its thickness; in these tests, widths ranging up to twice as great will be tested.

In addition, the shape of the web plate is measured by offset readings from fixed straightedges adjacent to one side of the web, these offsets being measured by dial gages. Readings are taken along three gage lines, one on the middle line of the web and one near each of the flanges, and at 3-in. intervals on each gage line.

Character of Test Indications—Two of the test columns have been tested at the time of writing, one with ⅝-in. web and the other with ⅜-in. web. The maximum loads reached in the two cases were approximately 41,000 and 44,000 lb. per square inch, respectively, the thinner web unexpectedly showing the higher strength, probably because of its containing metal of slightly higher inherent strength.

The significant fact observed in both of these tests was that the outward buckling of the web during the test and after failure was precisely the same (though magnified) as that which existed before the test. Thus, in one test the original offset measurements on the web showed two slight dome-shaped buckles, several feet apart, each occupying most of the width between flange angles; during the test these buckles grew outward, without change in position or size, and remained as permanent distortions of the web after failure. The stress lines which appeared on the web toward the close of the test were everywhere related to the outline of these pre-existing irregularities of web profile.

State Auctions Old Steel Bridges

Nineteen old steel bridges were sold at auction by the Indiana Highway Commission this week, following the successful trial of this method last year, when ten or twelve bridges were sold.

Colorado River Compact Provides Definite Water-Use Allocation

Treaty Must Be Ratified by Congress and Seven Legislatures—Agricultural, Domestic Uses First—Present Rights Guarded

As reported in Engineering News-Record, Nov. 23, p. 902, a treaty has been formulated whereby equitable allocation of the uses of the Colorado River has been arrived at. At the time that the item referred to above was printed definite details concerning the compact were lacking. On Nov. 25 the U. S. Department of Commerce issued a report in explanation of the conf rence, attended by executives involved and by federal representatives. That report, only slightly modified, is reprinted herewith.—EDITOR.

THE STATES of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming have resolved to enter into a compact under the act of Congress approved Aug. 19, 1921 (42 Statutes-at-Large, page 171), and the acts of the legislatures of the said states. Their commissioners, W. S. Norviel for Arizona, W. F. McClure for California, Delph E. Carpenter for Colorado, J. G. Scrugham for Nevada, Stephen B. Davis, Jr., for New Mexico, R. E. Caldwell for Utah, Frank C. Emerson for Wyoming, after negotiations participated in by Herbert Hoover, appointed by the President as the representative of the United States, have agreed upon the following articles:

Article I. Purposes of Compact—The major purposes of this compact are (1) to provide for equitable division and apportionment of the use of the waters of the Colorado River System, (2) to establish the relative importance of different beneficial uses of water, (3) to promote interstate comity, (4) to remove causes of present and future controversies, and (5) to secure the expeditious agricultural and industrial development of the Colorado River Basin, the storage of its waters, and the protection of life and property from floods. To these ends the Colorado River Basin is divided into two basins, and an apportionment of the use of part of the water of the Colorado River system is made to each of them with the provision that further equitable apportionments may be made.

Article II. Territorial Definitions—As used in this compact: (A) The term "Colorado River System" means that portion of the Colorado River and its tributaries within the United States of America. (B) The term "Colorado River Basin" means all of the drainage area of the Colorado River System and all other territory within the United States to which the waters of the Colorado River System shall be beneficially applied. (C) The term "States of the Upper Division" means the states of Colorado, New Mexico, Utah, and Wyoming. (D) The term "States of the Lower Division" means the states of Arizona, California, and Nevada. (E) The term "Lee Ferry" means a point in the main stream of the Colorado River 1 mile below the mouth of the Paris River. (F) The term "Upper Basin" means those parts of the states of Arizona, Colorado, New Mexico, Utah, and Wyoming within and from which waters naturally drain into the Colorado River System above Lee Ferry, and also all parts of said states located without the drainage area of the Colorado River System which are now or shall hereafter be beneficially served by waters diverted from the system above Lee Ferry. (G) The term "Lower Basin" means those parts of the states of Arizona, California, Nevada, New Mexico, and Utah within and from which waters naturally drain into the Colorado River system below Lee Ferry, and also all parts of said states located without the drainage area of the Colorado River System, which are now or shall hereafter be beneficially served by waters diverted from the system below Lee Ferry. (H) The term "domestic use" shall include the use of water for household stock, municipal, mining, milling, industrial, and other like purposes, but shall exclude the generation of electrical power.

Article III. Allocation of Water—(A) There is hereby apportioned from the Colorado River System in perpetuity to the upper basin and to the lower basin, respectively, to exclusive beneficial consumptive use 7,700,000 acre-ft. of water per annum, which shall include all water necessary for the supply for any rights which may now exist. (B) In addition to such apportionment the lower basin is hereby given the right to increase its beneficial consumptive use of such waters by 1,000,000 acre-ft. per annum. (C) If, as a matter of international comity, the United States shall hereafter recognize in the United States of Mexico any right to use of any waters of the Colorado River System, such waters shall be supplied first from the waters which are surplus over and above the aggregate of quantities specified in (A) and (B); and if such surplus shall prove insufficient for this purpose, then such deficiency shall be equally borne by the upper basin and the lower basin, and whenever necessary the states of the upper division shall deliver at Lee Ferry water to supply one-half of the deficiency so recognized in addition to that provided in (D). (D) The states of the upper division will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-ft. for any period of ten successive years reckoned in continuing progressive series beginning with Oct. 1 succeeding the ratification of this compact. (E) The states of the upper division shall not withhold water, and the states of the lower division shall not require the delivery of water which cannot reasonably be applied to domestic and agricultural uses. (F) Further equitable apportionment of the beneficial uses of the waters of the Colorado River System unapportioned in (A), (B) and (C) may be made in the manner provided in (G) at any time after Oct. 1, 1963, if and when either basin shall have reached its total beneficial consumptive use as set out in (A) and (B). (G) In the event of a desire for a further apportionment as provided in (F) any two signatory states, acting through their governors, may give joint notice of such desire to the governors of the other signatory states and to the President of the United States, and it shall be the duty of the governors of the signatory states and of the President forthwith to appoint representatives, whose duty it shall be to divide and apportion equitably between the upper basin and lower basin the beneficial use of the unapportioned water of the Colorado River System as mentioned in (F) subject to the legislative ratification of the signatory states and the Congress of the United States.

Article IV. Agricultural and Domestic Uses Dominant—(A) Inasmuch as the Colorado River has ceased to be navigable for commerce, and reservation of its waters for navigation would seriously limit the developments of its basin, the use of its waters for purposes of navigation shall be subservient to the uses of such waters for domestic, agricultural, and power purposes. If Congress shall not consent to this paragraph, the other provisions of this compact shall nevertheless remain binding. (B) Subject to the provisions of this compact, water of the Colorado River System may be impounded and used for the generation of electrical power but such impounding and use shall be subservient to the use and consumption of such water for agricultural and domestic purposes and shall not interfere with or prevent use for such dominant purposes. (C) The provisions of this article shall not apply to or interfere with the regulation and control by any state within its boundaries of the appropriation, use and distribution of water.

Article V. Compilation of Hydraulic Data—The chief official of each signatory state charged with the administration of water rights, together with the director of the U. S. Reclamation Service and the director of the U. S. Geological Survey shall co-operate, ex officio: (A) To promote the systematic determination and co-ordination of the facts as to flow, appropriation, consumption, and use of water in the Colorado River Basin, and the interchange of available information in such matters; (B) to ascertain and publish

the annual flow records of the Colorado River at Lee Ferry; and (C) to perform such other duties as may be assigned by mutual consent of the signatories from time to time.

Article VI. Claim Adjustments—Should any claim or controversy arise between any two or more of the signatory states: (A) With respect to the waters of the Colorado River System not covered by the terms of this compact; (B) over the meaning or performance of any of the terms of this compact; (C) as to the allocation of the burdens incident to the performance of any article of this compact or delivery of waters as herein provided; (D) as to the construction or operation of works within the Colorado River Basin to be situated in two or more states, or to be constructed in one state for the benefit of another state; or (E) as to the diversion of water in one state for the benefit of another state, the governors of the states affected, upon the request of one of them, shall forthwith appoint commissioners with power to consider and adjust such claim or controversy, subject to ratification by the legislatures of the states so affected.

Nothing herein contained shall prevent the adjustment of any such claim or controversy by any present method or direct future legislative action of the interested states.

Article VII.—Nothing in this compact shall be construed as affecting the obligations of the United States of America to Indian Tribes.

Article VIII. Existing Rights Unimpaired—Present perfected rights to the beneficial use of waters of the Colorado River System are unimpaired by this compact. Whenever storage capacity of 5,000,000 acre-ft. shall have been provided on the main Colorado River within or for the benefit of the lower basin, then claims of such rights, if any, by appropriators or users of water in the lower basin against appropriators or users of water in the upper basin shall attach to and be satisfied from water that may be stored not in conflict with Article III. All other rights to beneficial use of waters of the Colorado River System shall be satisfied solely from the water apportioned to that basin in which they are situated.

Article IX. Enforcement Provisions—Nothing in this compact shall be construed to limit or prevent any state from instituting or maintaining any action or proceeding, legal or equitable, for the protection of any right under this compact or the enforcement of any of its provisions.

Article X. Treaty Termination—This compact may be terminated at any time by the unanimous agreement of the signatory states. In the event of such termination all rights established under it shall continue unimpaired.

Article XI.—The compact shall become binding and obligatory when it shall have been approved by the legislatures of each of the signatory states and by the Congress of the United States. Notice of approval by the legislatures shall be given by the governor of such signatory state to the governors of the other signatory states and to the President of the United States, and the President of the United States is requested to give notice to the governors of the signatory states of approval by Congress.

The compact, signed by each of the commissioners and approved by Secretary of Commerce Hoover, has been sent to the State Department archives. A certified copy has been forwarded to the governor of each of the signatory states. The compact was signed at Sante Fé, N. M., Nov. 24, by the commissioners mentioned in the first paragraph of this article.

I.C.C. Postpones Hearing on Utah Central

The hearing scheduled to take place before the Interstate Commerce Commission on Nov. 25, in the matter of the application of the Utah Central R.R. for a certificate of public convenience and necessity, authorizing it to construct a line of railroad, has been postponed until Dec. 29. The hearing will take place in Washington before Examiner H. C. Davis.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Hydraulic Laboratories in the United States

Sir—Since the publication in *Engineering News-Record*, Sept. 28, p. 507, of the table of hydraulic laboratories compiled by Engineering Foundation, we have received information from four additional laboratories and transmit this in the form of your table.

Name of Laboratory	Year Established	Possibilities for Outside Work	Number on Regular Staff
U. S. Engineer Department	1921	No	One
L. P. Morris Hydraulic Testing Laboratory	1919	Not given	Six
Midwest Engine Co.	1912	Have not done testing for outside concerns	Six
Oregon State Agricultural College	1919	Limited	Two

Besides the laboratories listed, we have been informed that the following also have hydraulic laboratories, but have not yet received responses to our inquiries for detailed information:

Underwriters' Laboratories, Chicago, Ill.; State College of Washington, Pullman, Wash.; University of Washington, Seattle, Wash.

ALFRED D. FLINN,
New York City. Director, Engineering Foundation.

Repairing the Gibraltar Dam Spillway

Sir—In *Engineering News-Record*, Nov. 9, p. 798, there appeared an article written by me on "Repairing the Spillway to the Gibraltar Dam." I wish to correct an error in the third line on p. 801. This sentence should have read: "Because free discharge into air can be secured, the work will be constructed so as to prevent the formation of a standing wave on the paving." The use of the word "cannot" is quite misleading and might easily bring about an erroneous conclusion.

R. A. HILL,
Quinton, Code & Hill, Consulting Engineers.
Los Angeles, Calif., Nov. 22.

Driving Piles Near Existing Structures

Sir—The article "Pile Driver Slides Back and Forth on Two Greased Poles," in the *Engineering News-Record* of Nov. 23, p. 895, reminds the writer of an experience of a number of years ago when such practice caused serious trouble.

In 1893 the New York, New Haven and Hartford R.R. built a two-track pile trestle across the West Haven meadows adjacent to an existing two-track pile trestle. The work was done in connection with the four track work between New Haven and the Housatonic River. The meadow consists of alternate layers of apparently stiff clay and spaces filled with very soft marshy mud. Driving was started at the west end with a driver mounted as described in the article referred to. Bents had eight piles each, and were in line with the bents of the old trestle, the ends of the caps touching but not being connected otherwise. The first bent was started by driving the pile next the old trestle. The driver was slid sideways for each successive pile until the bent was completed, and was then rolled back to the next bent which was driven from the outside in. The third bent was then driven from the inside out, and the fourth from the outside in, and so on until about two-thirds of the 2,300 ft. were completed.

There had been slight movements of the old trestle due to the displacement from the new piles, but nothing serious had occurred. At about the two-thirds point, however, where the hardpan bottom was some 50 ft. below the marsh surface, the old trestle suddenly moved sideways, an amount which actually proved to be but a trifle over 2 ft., but which

put a kink in the track that made the movement appear ten times as much.

Luckily the movement occurred in daylight just after a heavy train had passed. It was possible to reline the track sufficiently to permit slow operation before the next train was due, and some additional movement which occurred throughout the next day or two was easily taken care of. The rest of the bents were driven from the trestle outward. This necessitated sliding the driver back for each bent, and somewhat slowed down the work, but it entirely obviated any further trouble.

The large amount of material displaced by a pile group is not often realized, and as a rule it causes little trouble. It is, however, a matter which should be given consideration whenever piling is driven in proximity to other structures, particularly if they are of a character or age which renders them liable to disturbance. CHARLES RUFUS HARTE,

New Haven, Conn., Nov. 25. Construction Engineer.

Sanitation, Ventilation and Vaccination

Sir—Many engineers would like to see our profession given its due share of recognition for what it has accomplished in the work for public health, both in civil and military life. We are told that the span of life is increasing; is this due to shortening the work day and sanitation or to something else? For years the work day was twelve hours, then it was ten, and now it is eight. Eight hours appears to be the proper working period for manual labor. Paralleling this shortening of hours has been the development of sanitation and safety, to which engineers have been large contributors.

During the war there was an absence of typhoid and smallpox epidemics. Was this due to supplying the camps with good water, providing for sewage disposal and burning garbage and other camp refuse or to vaccination and inoculation?

The Army Medical *Bulletin* for Aug. 15, 1922, under the caption "Anti-Pneumonia Vaccination," states: "The ideal method of controlling the spread of an epidemic disease is that of rendering the susceptible individual immune by artificial measures. This procedure is peculiarly applicable to military life, where each person is governed by regulations promulgated by a central authority. Certain diseases, typhoid and paratyphoid fevers and smallpox, have been practically eliminated from the Army by the production of an active immunity by vaccination, but on the other hand we still have the great group of respiratory diseases which have remained unconquered by either vaccination or sanitary measures.

"The control of infections of the respiratory tract constitutes the greatest problem in present day preventive medicine. Modern sanitation has to a great extent failed to prevent the spread of these diseases, especially that of influenza and the pneumonias. Consequently, many workers in the field of preventive medicine are directing their attention to methods of rendering the individual immune to the infection rather than protecting him from the invading organism. Should their efforts be successful the result will be removal of the greatest menace to the life of the soldier in time of war."

Without splitting hairs would it not be truer to state that modern ventilation, and not modern sanitation, has to a great extent failed to prevent the spread of infections of the respiratory tract? In the Jerry built barracks where men were quartered during the late war, windows were kept open without any regard to the health and comfort of the enlisted men. Drafts would sweep through the rooms with the intensity of Arctic gales, carrying germs from scores of coughing men into every nook and cranny. As the bedding was scant and insufficient, the soldiers at night would close the windows. Guards tramping through the buildings would rout such violators from their cots and make them let in the four winds of heaven. To men sick and feverish from the reactions of smallpox and typhoid inoculations such treatment is not soon forgotten.

In our schools we have the same things to contend with. Our children are required to sit in drafts, and as a consequence are out of school with coughs and colds. Common sense and teaching seems to be as far apart as the poles, or a greater effort would be made to air the rooms during recess time, thus protecting the children from drafts during the study periods.

The solution of this problem is squarely up to the engineer and architect. We must learn how to ventilate our buildings. Air can be carried between the walls, and floors should have registers or suitable openings. The objects of ventilation would be to supply fresh air and maintain the proper temperature. Windows are for light and should only be used for this purpose during the winter months.

The means for attaining health depend largely upon the point of view. If a man wants to improve upon the work of God, then inoculations are no doubt a good thing, but if on the other hand he only aspires to improve upon his own handiwork, then his time can be more profitably employed in studying the preparation of foods, sanitation, heating and ventilation. F. W. HARRIS.

Renton, Wash., Nov. 20.

[Why not sanitate, ventilate and vaccinate?—Editor.]

Bridge Floor That Resisted Fire

Sir—The article on fire prevention in timber floors of highway bridges in *Engineering News-Record* for Nov. 9, p. 796, is timely and full of interest. In this connection I desire to call your attention to a fire on a county bridge known as No. 6 Little Deer Creek, in the mining village of Russelton.

This is a 31-ft. steel through plate-girder with 17 ft. clear width between girder flanges. The floor system consists of steel floor beams, steel stringers, creosoted nailing pieces bolted to the stringers, creosoted yellow pine plank and creosoted wood block. The roadway is defined by steel angle wheel guards on either side. There is an open space of about 8 in. between the web of the girder and the edge of the floor. The clear water-way below the girders is slightly more than 6 ft. A 2-in. oil line, laid in the bed of the stream, passed under the bridge and, in September of this year, it sprang a leak from some unknown cause, permitting the oil to spread over the surface of the water. It was reported that a miner crossing the bridge lighted a newspaper and dropped it into the floating oil. The resulting fire caused the greater portion of the surface of the stone to spall off, burned nearly all the paint off the steelwork, charred the under side of the planking, and then went out.

As the bridge was not put out of service, these facts did not come to the attention of this office for nearly a month. Conditions seemed so favorable for complete destruction of the floor that it was a matter of surprise that no more serious damage resulted.

V. R. COVELL,
County Engineer, Allegheny County.

Pittsburgh, Nov. 28.

Purchase-Valuation of Stockton Water-Works

The water-works property of the Pacific Gas & Electric Co., at Stockton, Calif., has been valued at $1,400,000 by the State Railroad Commission in proceedings brought by the city to acquire the property. Engineers for the city valued the property at $841,683 and $1,332,736. The company's claim was $2,555,185, but this included some items not in the other inventories for which the commission made an allowance. The commission states in its report that the revenues of 1921 are at the rate of only 1.65 per cent on the company's valuation, but that for some years past the company has earned more than its operating expense and thus is entitled to some "going concern" allowance—an amount not stated in the commission's valuation, which under the statute is reported as a lump sum. The population of Stockton by the last three censuses was: 1920, 40,296; 1910, 23,252; 1900, 17,506.

NEWS OF THE WEEK

New York, December 7, 1922

End Long Controversy Over Morris Canal

State Gets Water Rights and Small Basin while L. V. R. R. Retains Big Terminal Basin

Agreement for the abandonment of the Morris Canal across New Jersey by the Lehigh Valley R.R. has been reached between the railroad company and the state Morris Canal Commission. The company is to retain the big basin on the Hudson River waterfront of Jersey City, all the canal bed in that city west of the basin and a strip of canal bed at Phillipsburg. The state gets the canal bed east of Washington St., Jersey City, the little basin, which contains about 20 acres, and the canal bed between Jersey City and Phillipsburg. The state gets also all water-rights, securities, other personal property of the Morris Canal & Banking Co., and the sum of $875,000 payable in five instalments beginning Dec. 15. The railroad company is to maintain the canal until March 1, 1923.

The Morris Canal is 107 miles long and connects the Hudson, at Jersey City, with the Delaware at Phillipsburg, N. J. It was built under a charter granted in 1824 to run for 99 years. If at the end of that period the state should fail to exercise a purchase option the charter was to run for another 50 years and in 1974 the entire property was to revert to the state.

Canal Leased in 1871

In 1871 the canal was leased to the Lehigh Valley R.R. and about 20 years ago navigation was practically abandoned. Since then the waterway has been the occasion of much controversy between the state, the railroad company, and the communities along its banks. The river terminals at Jersey City have become of great value to the railroad company and the water-rights involved in its charter have been a matter of considerable concern to the state and to the municipalities of northern New Jersey.

The Morris Canal Commission was created by the state legislature at its last session to negotiate an agreement with the railroad company and to report its action to the legislature not later than Dec. 1, 1922.

New York City Adopts 1923 Budget of Over $353,000,000

The budget of the City of New York for the year 1923, as adopted by the Board of Estimate and Apportionment Oct. 31 and approved by the Board of Aldermen on Dec. 4, totals $353,350,976. This includes budgets for the five counties within the city aggregating nearly $10,600,000 and nearly $12,600,000 of state tax. The detailed budget was published in the *City Record* (New York City) for Nov. 14, 1922. Nearly $85,000,000 of the $353,000,000, or almost 25 per cent, for debt service, is $17,000,000 less for 1923 than for 1924.

"What Is a Contractor" to Be Subject of Prize Essay

In order to get the views of members of the proper relation among contractor, engineer and architect, the Associated General Contractors of America has invited essays on the functions of a general contractor, with the award of a prize of $100 for the best.

The questions asked, which are to be answered in the essays, are: "When is a contractor not a contractor; when is an architect or engineer a contractor; should the contractor hire architects, or vice versa; what lines should be drawn in regard to a contractor's functions?"

The essays must not exceed 500 words and must be in the hands of officials at the Washington headquarters of the Association before Dec. 31.

To Ballot on Road Builders' Revised Constitution

Ballots on the revision of the constitution and by-laws have been mailed to the members of the American Road Builders' Association. The revision is due to the dissatisfaction with the existing constitution and by-laws expressed at the last annual meeting. A revision committee was accordingly authorized. The chief changes are:

1. The transfer of the election of officers from the board of directors to the membership.
2. The nomination as an "official nomination," of only one candidate (instead of two, as now) for each directorship.
3. Provision for nominations by petition.
4. The transfer from the by-laws to the constitution of the sections relating to the election of officers, meetings, quorum and amendment of by-laws.

Ballots must be returned to the office of the association not later than Dec. 29.

Fletcher To Leave California Highway Commission

Austin B. Fletcher, chief engineer, California State Highway Commission and director of the California Department of Public Works, has filed his resignation with Governor Stephens to take effect before the first of the year. This action is the result of a change in the state administration which will take effect Jan. 8, when Governor Stephens will be replaced.

Mr. Fletcher has been chief engineer of the California State Highway Commission since its formation in 1911. Prior to that time he was connected with the Massachusetts Highway Commission. He has been director of the California Department of Public Works since it was created last year.

Water Famine in Mexico City Causes Riot and Deaths

Improper Gate Operation Floods Pumps Causing Shut-Down—15 Are Killed; 50 Hurt

Flooding of electrically-driven pumps on Nov. 26 caused a water famine in Mexico City, Mexico, which in turn led to a riot of several hours' duration in which 15 persons were killed and 50 were injured. A temporary pump was installed and on Dec. 1 the first of the disabled pumps was restored to service.

The water supply of Mexico City is obtained from springs near Xochimilco where four low-pressure pumping stations lift water into a concrete conduit leading to a high-pressure pumping station at Condesa where water is pumped to service reservoirs located at Molino del Ray and to the Mexico City mains. Two sluice gates are provided in the conduit about two kilometers from the Condesa pumping station towards Xochimilco. The gates control the level of water in the suction chamber of the Condesa pumps.

On Sunday, Nov. 26, the Condesa pumps shut down owing to surge on the conduit. Notwithstanding instructions issued to the operator to open gates wide he only opened them partially. The water level therefore rose in the suction chamber of the Condesa pumps and discharged through an overflow pipe into a drain leading to a sewer.

The drains of the transformer pockets are connected to the drain from the suction chamber. The discharge from the suction chamber backed up in the transformer pocket drains and flooded the pump house, partially submerging the pumps, which are horizontal, direct-connected to 3,000-volt synchronous motors. The motor windings were soaked.

The drying out of the motors had progressed sufficiently by Friday afternoon, Dec. 1, to make it possible to put the first pump back into service.

Soon after the flooding a small pump was installed at Condesa, pumping water from the suction chamber to furnish a small supply from fire hydrants, whence the population carried away water in buckets. Old private wells were also used.

A serious disturbance occurred on the evening of Thursday, Nov. 29, due to popular resentment over the water famine. Fifteen persons were killed and 50 injured in this riot.

Water Superintendent's Job in Oregon Given State Engineer

The office of state water superintendent in Oregon has been abolished according to advices from that state and has been combined with the office of state engineer. The change is to become effective Jan. 1, 1923. George Cochran is now water superintendent of the state and Percy Cuffer is state engineer.

Citizens Committee Reports on Pennsylvania Roads

Numerous Changes in Highway Policy Recommended by Body Headed by William H. Connell

The new administration that assumes the handling of Pennsylvania state affairs for the coming four years will make certain changes, it is believed, following the recommendations in the exhaustive report of William H. Connell, former chief engineer of the Philadelphia Bureau of Highways and now adviser to the Citizens Committee appointed by Governor-Elect Pinchot.

The Connell report, given to the members of the committee in an all-day session at Philadelphia recently, suggests numerous changes, all of which were adopted unanimously by the committee and given the approval of the governor and the governor-elect, who attended the meeting. The report of the Subcommittee on Highways was as follows:

In the state are 100,000 miles of public roads, excluding mileages in cities and boroughs of which 10,321 comprise the state system and are under the jurisdiction of the state highway department. Of this mileage 4,944 miles have some sort of hard surfacing and 5,377 are unimproved. There are 3,942 miles of roads in the primary system. The remaining 6,379 miles comprise the secondary system or the feeders to the main trunk-line roads.

Highway Expenditures

During the period from 1911 to 1923 about \$50,000,000 were spent on maintenance, \$123,000,000 on construction and about \$18,000,000 on general miscellaneous expenses. This expenditure resulted in the construction or reconstruction of 3,150 miles of highways.

The total cost of improving and completing the highway system with an improved type of paving will be about \$350,000,000. The report recommends the following policies for completion of the highway system:

1. Comprehensive highway transport survey so that plans can be formulated on an economic basis.

2. Standardization of right-of-way widths on both primary and secondary systems. Provisions should be made for eventually widening roads in their approach to large cities.

3. Condemnation of land as soon as possible for the ultimate highway systems.

4. Installation of a budget system insuring rigid control and economy.

5. Perfection of plans for financing the entire system of highways within a given time.

6. Legislative appropriations to insure federal aid.

7. Provision for the collection of motor license fees every two years instead of every year.

8. Discontinuance of the payment of labor by county highway superintendents.

10. Prohibition of political activity by employees of the highway department.

11. When detours cause general hardship, construct roads half their width, permitting public use of the half not under construction.

12. Important dirt roads should be oiled.

W. E. Wood Is Killed in an Automobile Accident

W. E. Wood, prominent building contractor of Detroit and Flint, Mich., and president-elect of the Associated General Contractors of America, was instantly killed on Nov. 24 when the automobile in which he was driving alone skidded and overturned on the Dixie Highway about 15 miles north of Flint. Mr. Wood was on his way from Flint, where the W. E. Wood Co., of which he was president, has the contract for constructing a \$1,500,000 high school building, to Saginaw.

Mr. Wood was born in Vincennes, Ind. in 1864 and began his career as a contractor in Flint. He was first connected with the Moses Construction Co. of Chicago, and later formed his own company. Besides erecting a number of the Buick and Chevrolet plants and school buildings in Flint, the W. E. Wood Co. has erected a number of the larger buildings in Detroit and other Michigan cities.

Besides being prominent in the affairs of the A. G. C., Mr. Wood was a member of the Detroit Athletic Club, Old Colony Club and the Detroit Golf Club.

Engineers Plan Banquet for New Italian Ambassador

A reception and banquet at which Prince Gelasio Caetani, the new Ambassador of Italy to the United States, will be guest of honor, is being planned by the Federated American Engineering Societies. L. W. Wallace, the executive secretary of the Federation has written Ambassador Caetani telling him of the desire of the engineers in this country to pay him this mark of respect. No information has been received as yet at the Italian Embassy as to the time of the new Ambassador's arrival. It is believed, however, that he will be in this country by the first of the year, in which case Mr. Wallace hopes to arrange to have Prince Caetani as the guest of honor at the annual banquet of Engineering Council.

13. Name highways with appropriate titles wherever possible.

14. Information signs of historical interest to supplement present signs.

15. Extensive use of central markings on pavements to guide drivers.

16. Plan state work in four divisions under four divisional engineers.

17. Combine construction and maintenance divisions.

18. Standards of county superintendents of highways be raised to correspond to those in the engineering division.

20. Waterbound macadam roads that are heavily traveled should be resurfaced with bituminous penetration.

21. Priority should be given to widening and elimination of dangerous curves on heavily-traveled roads.

22. Super-elevate all curves.

23. Recommendations relative to the acceptance or rejection of bids should be made matters of public record immediately after every award.

Government Files Six More Cantonment Suits

Would Recover \$29,000,000 From Builders of Travis, Lee, Custer, Pike, Dodge and Dix

Six additional suits against contractors who constructed army camps during the war were filed by the government Dec. 4. The first group of civil actions was instituted against cantonment builders Nov. 24, as reported in *Engineering News-Record* Nov. 30, p. 948. With the suits begun Dec. 4 the amount of money which the government seeks to recover from these eight cantonment constructors is brought up to \$50 000,000.

The projects, contractors and sums involved in the six latest suits are:

Camp Travis, San Antonio, Tex., Stone & Webster, \$3,000,000.

Camp Lee, Petersburg, Va., Rinehart & Dennis, Inc., \$7,000,000.

Camp Custer, Battle Creek, Mich., Porter Bros., \$5,000,000.

Camp Dodge, Des Moines, Ia., Charles Stewart & Co., Inc., \$3,000,000.

Camp Dodge, Des Moines, Ia., Charles Wietz Sons, \$4,500,000.

Camp Dix, Wrightstown, N. J., Irwin & Leighton, \$6,500,000.

A suit involving the construction of one of the major New England camps was expected but the bill of complaint was apparently not completed in time to file with the others.

Complaints Filed Simultaneously

The six bills of complaint, practically identical in form, were filed simultaneously in federal district courts at San Antonio, Richmond, Detroit, Little Rock, Des Moines and Trenton. All charge connivance, fraud, waste and improper use of funds and material. As in the case of the four initial suits one of the specifications in the complaint filed Dec. 4 is the charge that contractors took advantage of the government's preoccupation in other matters to violate the confidence the government reposed in them.

According to official figures Camp Lee with one exception was the most costly of the cantonment projects. More than \$18,000,000 was spent on Lee, \$13,846,000 at Camp Custer; \$11,296,000 at Dodge; \$13,545,000 at Dix; \$12,748,000 at Pike; and \$9,880,000 at Travis. Camp Knox at Stithton, Ky., holds the high record in cost, \$18,733,184 having been paid for its construction, according to the official figures.

Following the filing of suits on Dec. 4 an announcement was made by the Department of Justice officials that still more suits were to follow against contractors who built major wartime construction projects.

Interest Increases in Michigan Highway Short Course

According to word received from A. H. Blanchard, professor of highway engineering and highway transport, University of Michigan, extreme interest is expected in the highway engineering and highway transport short course to be held from December, 1922, to March, 1923. The attendance at these courses has increased during the past three years as follows: 1919-20, 29 men; 1920-21, 45 men; and 1921-22, 94 men.

Debate Rail Consolidations at I.C.C. Hearings

Hill Roads Oppose Commission Plan—Southern Pacific Would Retain Cenlral Pacific Lines

Two hearings now in progress before the Interstate Commerce Commission have developed much controversy over the proposal that the railroad systems of the country be consolidated into eighteen or twenty systems. One of these has to do with the northwestern roads, while the other touches the Southern Pacific and the Union Pacific Systems.

The commission's plan for grouping the northwestern roads has aroused strong opposition on the part of the Hill roads. Under the plan proposed, these would be separated, the Great Northern linked with the Chicago, Milwaukee & St. Paul and the Burlington and the Northern Pacific left in another group. The Colorado & Southern, now controlled by the Burlington, would be grouped with the Santa Fe.

In behalf of the Hill roads it is maintained that the Burlington, the Northern Pacific, and the Great Northern now have a strong community of interest built up through twenty years, and that the Burlington is in no way competitive with either the Northern Pacific or Great Northern. Practically all the freight handled by the Northern Pacific and the Great Northern is said to be competitive with other lines, such as the Chicago, Milwaukee & St. Paul, the Soo Line, the Chicago Northwestern, and the Union Pacific, so that by consolidating the Northern Pacific and the Great Northern with the Burlington, competition will still be protected without breaking up the existing Hill system.

In the course of his testimony, Hale Holden, president of the Burlington road, criticised the plan of the commission as based too largely on east and west traffic instead of giving due importance to the north and south traffic. He pointed to the great north and south lanes of traffic that are developing and that will continue to develop, and urged that this possibility be given due weight in planning the primary systems.

Southern Pacific Hearing

The hearing on the appeal of the Southern Pacific to retain control of the Central Pacific, despite the recent dissolution order by the Supreme Court, has developed sharp difference of opinion among the shippers and the communities interested. The railroad commissions of California and Nevada urge a continuance of the union between the companies, while those of Wyoming and Idaho urge approval of the separation.

Many shippers in California favor the strong California railroad system that is insured by the present union of the roads, and point to the havoc that would be worked on the Southern Pacific by the loss of the Central Pacific lines and branches. Others point to the traffic benefits that might be derived from an independent Central Pacific or one joined to the Union Pacific.

Some witnesses from Utah and Colorado favor the separation of the lines because of their belief that the Southern Pacific control of the Central Pacific property results in a diversion of transcontinental business over the lines of the former through El Paso rather than through their own states. Others fear a transportation monopoly by the Union Pacific and urge a continuation of the existing relationship.

Western Society Promotes Short Story Contest

"To encourage and develop the power of expression as a step toward making the members of the Western Society of Engineers more useful as dreamers, builders and leaders," a short (6,000 word) story contest has been initiated by that society. Prizes are to be offered for excellence in expression, humor and research. Contestants are to be divided into two classes, under and over 30 years of age. The society is to sell the successful papers and turn the proceeds over to the author.

For the purpose of encouraging versatility and increasing the popular interest, the first competition closing April 15, 1923 is to be for non-technical, popular stories built on a foundation of engineering facts. Full credit will be given for humor and the use of fiction when not in conflict with established facts. The writers are to be encouraged to discover or to create the story, romance and human interest that inspires every great venture.

Ohio Water Purification Men Adopt High Standards

Special Correspondence

Sixty-five water filtration plant superintendents and chemists from sixty-two cities and towns having water purification plants met in Columbus, Nov. 16-18 as the second Ohio Conference on Water Purification. Various problems connected with water treatment and water analysis were discussed and a rigid standard for the quality of filter effluents was adopted. It was shown at the conference that the majority of the filter plants in the state now have no difficulty in reaching the standard adopted by the conference, which is to the effect that all filter effluents *before chlorination* virtually equal the "Treasury standard" of 2 B. coli per 100 cc.

The discussions at the conference showed a recent trend toward water softening in Ohio. Three new water treatment plants in the state, those at Defiance, Delaware, and Newark, have incorporated softening with purification, and many other Ohio cities are considering doing the same.

Serious water shortage in various cities and villages in Ohio during 1922 was also brought out. The reserve supplies of Ashland, Blanchester, Jefferson and Washington C. H. are completely exhausted, while on Nov. 16 Columbus had only 26 days' supply in storage.

The presiding officer of the conference was J. W. Ellms of Cleveland. The chairman for the ensuing year will be Charles P. Hoover of Columbus. The next conference will be held in November, 1923—probably at Newark, Ohio, where an 8-m.g.d. water purification and softening plant is under way.

Howells-Hood Design Wins Chicago Tribune Building Prize

In the competition for architectural designs for the new building for the *Chicago Tribune* the first prize of \$50,000 has been awarded to John Mead Howells and Raymond M. Hood, of New York. Under the terms of the competition they will be the architects for the structure. The second prize of \$20,000 was awarded to Eliel Saarinen, of Helsingfors, Finland, in association with Dwight G. Wallace and Bertell Grenman, of Chicago. The third prize of \$10,000 goes to Holabird & Roche, Chicago. The remainder of the \$100,000 prize fund will be distributed among ten American architects who were invited to submit designs.

This new building is to be erected at 431 No. Michigan Ave., outside of the congested business district and just north of the Chicago River bridge, where it will be a very conspicuous structure. The building will occupy a site 100 x 135 ft. and will have a total height of 400 ft.

J. L. Harrington Installed as A.S.M.E. President

During its annual convention in New York City this week the American Society of Mechanical Engineers installed as its new president John Lyle Harrington, of the consulting engineering firm of Harrington, Howard & Ash, Kansas City, Mo.

Mr. Harrington was born in Lawrence, Kan., in 1868 and is an A.B., B.S. and C.E. of the University of Kansas. He has been designer for the Berlin Iron Bridge Co., assistant chief engineer of the Bucyrus Co., So. Milwaukee, Wis., assistant engineer of bridges and buildings for the Baltimore & Ohio R.R., and chief engineer and manager of the Locomotive & Machine Co. of Montreal. For three years he was executive engineer of the C. W. Hunt Co. of West New Brighton, N. Y.

In business for himself, he was first associated with J. A. L. Waddell of Kansas City. He is now with E. E. Howard and L. R. Ash.

Contract Let on Reaction Turbine for Record Head of 850 Ft.

The Portland Ry. Light & Power Co., of Portland, Ore., has awarded to the Pelton Water Wheel Co. contract for a 35,000-hp. reaction turbine to be delivered within 12 months for installation at the Oak Grove hydro-electric plant now being built on the Clackamas River. The new unit will be of the Francis type, designed for a head of 850 ft. It will operate at 514 r.p.m. and will have a specific speed of twenty-one. The Moody spreading draft tube will be used.

The world's record for high-head reaction turbines is now held by the Kern River No. 3 plant of the Southern California Edison Co. where two 25,000-kw. Francis turbines are operating under an 806-ft. head. The design of the Oak Grove unit will have the benefit of experience at Kern River No. 3 and will embody features of design of both the Pelton Water Wheel Co. and the I. P. Morris Department of the William Cramp & Sons Ship & Engine Building Co., recently consolidated with the Pelton company.

Forty-Eighth Annual Meeting of New Jersey Sanitarists Held

Among the fourteen papers read at the forty-eighth annual meeting of the New Jersey Sanitary Association at Lakewood, N. J., Dec. 1 and 2, were several dealing with engineering or related topics. In the course of his presidential address on "Municipal Zoning and Health" Dr. Charles V. Craster, health officer of Newark, gave as some of the benefits of zoning the better distribution of light, air and population. Dr. Haven Emerson, formerly health commissioner of New York City, in an outline of "The Nature and Purpose of a Health Survey," stated that the health officer should be the diagnostician of his community just as the private practitioner is of his individual patients.

A typhoid carrier was defined by Dr. Louis Harris, New York City health department, in discussing a paper on "The Use of a Laboratory in the Epidemiology of Typhoid Fever" by C. K. Blanchard, bateriologist, New Jersey Department of Health, as a person who, six months after having had typhoid fever excretes typhoid germs from time to time. Those excreting typhoid germs during the second three months after having had typhoid are called temporary carriers, while former typhoid patients up to three months are termed typhoid convalescents.

A fairer method of distributing construction costs between the communities included in the Elizabeth and Rahway Rivers Sewer District than is practiced in the Passaic Valley Sewerage District was mentioned by Alexander Potter, consulting engineer, New York City, as one reason why the former district has had its trunk outfall sewer in use so long (since 1902) that a supplementary sewer is now projected, while the Passaic Valley outlet is not yet completed. In the Passaic district the cost is distributed among the municipalities concerned in accordance with the assessed valuation of years back, which plan has caused opposition in some municipalities, while in the Elizabeth-Rahway district the distribution is based on the proportionate cost of the carrying capacity provided for each community.

The election of officers for 1922-23 resulted in the choice of Dr. E. J. Marsh, of Paterson, as president, and Chester G. Wigley (with Clyde Potts, consulting engineer, New York City) as chairman of the Executive Committee. Dr. Edward Guion, Atlantic City, N. J., was continued as secretary. The association voted to become an affiliate of the American Public Health Association.

Local Bodies Addressed by City Managers in Convention

Ninety-four delegates, most of whom were engineers, attended the convention of the City Managers' Association at Kansas City, Mo., Nov. 14 to 16—the best attended meeting of this organization since its inception. While the managers were in the city they addressed the Chamber of Commerce, City Club, Woman's Athenaeum, Woman's City Club, Rotary Club and Engineers' Club. The last-named tendered the managers a banquet and an excursion around the city, each automobile containing a local engineer as guide.

The Engineer in Public Life

WILLIAM B. POWELL

As chairman of its engineers and architects group and a member of its ways and means committee, William B. Powell, treasurer of the Industrial Planning Corp., engineers, has taken a prominent part in the activities of the Buffalo (N. Y.) Chamber of Commerce. During the recent revision of the city's building code Mr. Powell served on the committee which drafted the new regulations and recently he has been actively associated with the Buffalo City Planning Association. He has worked to decrease the number of motor accidents, and as a member of the National Safety Council is an advocate of safeguards for workers in factories.

Mr. Powell is a graduate of Stevens Institute of Technology, class of 1892, and has served on various committees of national engineering societies in their relations with the public. He has been a supporter of the movement to establish a national department of public works and was one of the organizers of the Federated American Engineering Societies.

Hon. Henry Allen, governor of Kansas, in his address on "Municipal Government," stressed the shortcomings of the aldermanic form, the commission form and the city manager form of government, but held the manager form superior to anything yet tried.

"Modern Charters" was the title of an address by Prof. C. M. Fassett, of the department of municipal engineering, University of Kansas. He spoke of the present day tendency to shorten charters and eliminate partisanship in municipal elections. Professor Fassett was formerly mayor of Spokane, Wash. From his personal knowledge in that position he recalled the evils of political administrations and compared them with business administrations.

Municipal versus private onership of public utilities was debated by Delos Wilcox, New York City, on the affirmative, and Paul Haynes, of Indianapolis, on the negative. Mr. Wilcox criticized privately owned utilities, especially in their handling of refinancing, in which bond issue after bond issue has been pyramided without provision for payment. He compared this procedure with the programs of many cities where the utilities have been entirely paid for or where those that are not paid for have rates that will retire the entire bond issue before the expiration of the bonds. Mr. Haynes, who is an ex-member of the Indiana Public Utility Commission, deplored the socialistic tendencies of the day.

The newly elected officers are as follows: President, Louis Brownlow, Petersburg, Va.; vice-presidents, R. B. Rigsby, Durham, N. C., I. C. Brower, Pontiac, Mich., and C. W. Koiner, Pasadena, Calif.; secretary, John G. Stutz, Lawrence, Kan.

Locomotive Blast Raises Bridge Planks; Police Close Structure

The effect of heavy blast from a locomotive in raising a few sidewalk planks in the Van Buren St. plate girder span over the tracks to the Chicago union station on Nov. 16 led a police officer to report the structure as dangerous and it was closed to traffic until inspection of the "accident." Although the structure is old it is in safe condition, but will be rebuilt next year in connection with improvements for the new union station.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

The Western Society of Engineers was addressed Dec. 4 by Col. H. M. Byllesby, president, H. M. Byllesby & Co., on "Finance and Engineering." The Dec. 11 meeting will be a symposium on "Smoke Abatement," a subject the public affairs committee has actively promoted. E. H. Colpitts, assistant chief engineer, Western Electric Co., New York, will address the society Dec. 18 on "Research in the Art of Communication."

PERSONAL NOTES

GERALD L. FINCH has been elected county engineer of Garfield County, Wash., with headquarters at Pomeroy. At the time of his election he was a member of the engineering staff of the state highway department.

FRANK R. GOODMAN, of Flagstaff, county engineer of Coconino County, Arizona, has been selected by Governor-Elect Hunt of that state as state engineer for the incoming administration. Mr. Goodman has been prominent in highway work in Arizona during a large part of his 19 years' residence there, having served the state for several years as division engineer. Mr. Goodman will succeed THOMAS MADDOCK.

COL. F. G. JONAH, chief engineer of the St. Louis & San Francisco Ry., has been appointed assistant to the president. His appointment became effective on Dec. 1. Colonel Jonah's association with the Frisco road dates

m 1903 when he was appointed assistant engineer, having served earlier in his professional career as resident engineer for the St. Louis, Peoria and Northern Ry., engineer, maintenance-of-way, of the Chicago & Alton, and chief engineer of the Blackwell, Enid & Southwestern Ry. In 1913 Colonel Jonah was made chief engineer of the Frisco road, having served several years previously as chief engineer of construction of that and allied roads. He is a Canadian by birth and while studying engineering served with the Intercolonial Ry.

ROBERT H. HIGGINS, superintendent of maintenance of the Colorado Highway Department, having passed a civil service examination, has been retained in the permanent organization. His appointment was temporary, after the passage of the 1921 highway act, until such time as an examination could be held.

COL. W. G. ARN has been promoted from assistant engineer of maintenance-of-way, Illinois Central R.R., to assistant engineer of the Chicago terminal improvement, which improvement work is under an organization distinct from that of the general engineering department of the railroad. He entered the army early in 1917 and was in active service during the war, attaining the rank of lieutenant-colonel.

MAJ. L. D. BLAUVELT, appointed last year as state highway engineer of Colorado until such time as a civil service examination could be held, has been appointed permanently to that position. At the recent examination Major Blauvelt received the highest percentage among applicants for the position. Though the Colorado highway law of 1921, under which Major Blauvelt received initial appointment, places the appointment of the state highway engineer in the hands of the governor, that law is at variance with the state constitution which requires that all state employees other than specifically stated elective officers shall be under civil service.

ABRAM SWAN, JR., city engineer of streets, Trenton, N. J., is a candidate for the city commission at Trenton, N. J., Commissioner J. RIDGEWAY FELL has announced that he will retire. MR. FELL is also an engineer.

ERNEST PAFFRATH, an engineer in the department of streets and sewers of St. Louis, has been appointed superintendent of sewers of that city to fill the place made vacant two months ago by the death of WILLIAM CLANCY. WILLIAM J. DUGGAN, first assistant under Mr. Clancy, has been acting head of the department Mr. Paffrath now fills.

WILLIAM F. WILLIAMS, bridge engineer of the Massachusetts Department of Public Works, has been appointed by Governor Cox as head of that department to succeed the late JOHN N. COLE, whose death was announced in these pages recently. Mr. Williams has had wide engineering expreience. He served as city engineer of New Bedford, Mass., for almost 20 years, resigning that position in 1912 to become chief engineer of the state board of harbor and land commissioners. Several years later he entered the bridge department of the public works bureau. Mr. Williams was graduated from Columbia College with a C.E. degree in 1881 and an E.M. a year later. He followed mining in the West and South after graduation, becoming city land surveyor of New Bedford in 1893 and city engineer in 1895.

WILBUR S. SAMPLE, formerly manager of the Montreal, Can., office of the George A. Fuller Co., Ltd., has recently left for Dairen, Manchuria, to assume the duties of district manager of the George A. Fuller Co. of the Orient, Ltd., for that and other Chinese territory. Mr. Sample will direct the construction of a general hospital for the South Manchurian Ry. Co. at Dairen, together with additional construction work which is to follow both in that section and in Shanghai. WILLIAM OEHRLE is New York manager of the George A. Fuller Co. of the Orient, Ltd.

ARTHUR W. THOMPSON of Pittsburgh has been elected a director of the Pennsylvania R.R. to succeed the late THOMAS DEWITT CUYLER. Mr. Thompson is head of the Philadelphia Co. and subsidiary companies which furnish transit, electric light and gas in Pittsburgh and vicinity. He is a former vice-president in charge of operation and traffic of the Baltimore & Ohio R.R.

F. S. MCKAY, formerly a draftsman with the Duquesne Light Co., Pittsburgh, Pa., has become associated with the Chicago, North Shore & Milwaukee R.R. as office valuation engineer.

M. C. KENNEDY, until recently in the employ of the Texas, Oklahoma & Eastern R.R. as assistant engineer and stationed at DeQueen, Ark., has become associated with the engineering department of the Pennsylvania R.R. He is attached to the assistant chief engineer's office in the construction department and stationed at Beaver Falls, Pa.

M. L. TIEFENBRUN, who for the past twelve years has been a structural engineer and highway engineer and lately connected with railroad valuation, has established offices in Asbury Park, N. J., where he will give special attention to the design of steel and concrete structures, municipal work, valuation and surveys.

DR. ELWOOD MEAD has resigned as chief of the division of land settlement, California State Department of Public Works, to take effect Jan. 1. As reasons for his resignation Dr. Mead states that the defeat of the land settlement bond issue makes it at least doubtful whether any new settlements are to be created in the near future, and the two developments already started are practically completed. By relinquishing charge of the land settlement division Dr. Mead expects to gain time for researches in rural organizations to which he plans to devote attention in connection with his work as professor of rural institutions at the University of California.

THE UNION CONSTRUCTION CO., Oakland, Calif., engineering contractors, have opened offices in the Van Nuys Bldg., Los Angeles, to handle contracts in the southern section of the state.

J. J. MCCARTHY of Tekoa, Wash., has been made road engineer for the fourth division of the Oregon-Washington Railroad & Navigation Co., taking the place recently made vacant by the death of J. J. LAWLER.

ERNEST R. CHILDS, who was a captain of engineers during the World War, has been elected county surveyor of San Diego County, Calif., succeeding GEORGE BUTLER. He will take office Jan. 1.

MAJOR GEORGE M. RICE has been appointed superintendent of streets for Seattle, Wash., to succeed MAJOR OSCAR H. PIPER. Major Rice served overseas with a railway engineering regiment. He was formerly chief engineer of construction for the Copper River and Northwestern Ry., and was for a time with the Northern Pacific and the White Pass & Yukon railroads.

C. W. WOOD, chief engineer for the South San Joaquin Irrigation District, Manteca, Calif., has tendered his resignation, effective Jan. 1, 1923.

F. W. MCCARTON, formerly assistant engineer with the Modesto Irrigation District, has been appointed city engineer of Modesto, Calif., to succeed GEORGE FREITAS, resigned.

OBITUARY

GEORGE DICKSON, former city engineer of Alton, Ill., died in that city Nov. 25, aged 74 years. He also served as Madison County engineer for eight years.

WILLIAM DOUGLAS, president and general manager of the William Douglas Co., contractors of Providence, R. I., died in that city, Nov. 26, aged 83 years.

JOHN J. MURRAY, who for almost thirty years was employed as civil engineer in the Boston city engineering department, died in that city recently, aged 45 years. Mr. Murray had been with the city since his graduation from Somerville, Mass., High School.

ZAC T. DUVALL, a civil engineer who had practiced his profession in Denver, Colo., died recently, aged 69 years. Mr. Duvall was born in Missouri but went to Denver when 13 years of age, spending most of his life there. Some of the important work engaged in by him were: The construction of Cheesman dam, the largest contributor to Denver's water supply; the Amity canal at Lamar, Colo., and railroad work through the Royal Gorge near Canon City.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

COMING from the accredited spokesman of the cast-iron pipe industry, Mr. Wolfe's announcement on this page of a policy whereby both maker and user of pipe will share in economies effected by winter purchases has a large significance for water-works engineers, city officials, and other users of pipe on public and private works. Mr. Wolfe, it should be noted, speaks for eight of the leading cast-iron pipe manufacturers, including the American Cast Iron Pipe Co., Lynchburg Foundry Co., James G. Clow & Sons, National Cast Iron Pipe Co., Donaldson Iron Co., U. S. Cast Iron Pipe & Foundry Co., Glamorgan Pipe & Foundry Co., and Warren Foundry & Machine Co.

The arguments for spreading the buying of pipe over the entire year, instead of concentrating it in the summer months, were presented by "Engineering News-Record" in its issue of Oct. 19, 1922, p. 675. Succeeding issues carried a comprehensive discussion from the pipe user's point of view, in which a dozen of the country's leading water-works engineers participated.

The evidence has been presented—it now rests with the purchasers of pipe, individually and through their organizations such as the American and the New England Water Works Associations, to take action on a program which will make possible the economies indicated.—Editor.

Pipe Buyers Will Share in Savings Effected by Winter Buying, Manufacturers Pledge

Industry's Spokesman Concludes Discussion Initiated by "Engineering News-Record" by Announcing Policy Benefiting Both Maker and User

By Thomas F. Wolfe
Secretary, Cast-Iron Pipe Publicity Bureau, Chicago

FROM the opinions expressed by the water-works men who have taken part in the discussion on the "Winter Buying of Pipe" in *Engineering News-Record* during the past few weeks it appears that the buyers and sellers of pipe agree both as to the advisability as well as the feasibility of doing business in this way. Some objections were raised, many of which were local in character or affected only certain phases of pipe-laying, and many new arguments in favor of all-year buying were brought out. The one point of common interest is the matter of price.

The cost of cast-iron pipe is made up of several factors: First, cost of pig-iron, coke, hay, and other supplies; second, cost of conversion; third, transportation charges; fourth, overhead; and fifth, profit. Of these items the only ones that can be controlled by the makers is the conversion cost, the overhead and the profit. The remaining factors are fixed by conditions outside the pipe industry and represent the greater part of the final cost of pipe. Any effort, therefore, on the part of manufacturers to reduce the cost of pipe must be along the line of economies that lower the factors of production and overhead costs and profit.

> ***Points in Policy of Pipe Makers***
>
> The one point of common interest is the matter of price.
>
> Winter buying must lower production and overhead costs.
>
> The manufacturers realize that if winter buying is to be encouraged the buyer must profit.
>
> The policy of cast-iron pipe manufacturers will be to pass on to the buyer the saving in production costs resulting from winter buying.

Winter Production Lowers Costs

The desire on the part of the pipemakers to make and sell pipe on a basis that would keep the shops going at a fairly even rate throughout the year is prompted solely by their desire to bring about these savings. Winter buying of necessity must lower production and overhead cost, since annual charges are evenly distributed and there would be no slack-period charges to be borne by the product of a few months' operation. The efficiency of individual laborers is improved and costly labor turnovers lessened. The savings made in conversion costs and overhead expenses will lower the cost of pipe produced throughout the entire twelve months of the year.

Manufacturers have always been glad to accept winter orders at a lower figure than pipe would bring during the summer, assuming pig-iron costs were the same. During the past 17 years there were only 5 years when the summer cost of pipe was lower than the winter cost, and this in spite of the fact that no concerted effort was made to encourage winter buying. The pipe makers have gone even further along the line of lower prices—in addition to the saving made in manufacturing costs part of the profit has been cut off during the winter months. These factors are attested by the experience of those who, in the past, have been able to place orders in the winter. The proportionate saving will be even greater when this practice becomes more generally adopted.

Many arguments against winter purchase are offset by the advantages gained. It is true that in some of the northern parts of the country it is practically impossible to lay pipe in the winter. On the other hand, many contractors in the colder sections have clamored for early delivery, so that they could take advantage of the comparatively short construction season and get a maximum amount of work done. The purchase and delivery of pipe during the winter will help not only contractors in these sections, but also municipalities where work absolutely must be done on some kind of a schedule during their short construction season. A better class of labor can usually be procured for hauling and stringing the pipe during this season and better teaming prices should prevail during the slack period.

Temporary Storage Possible

Large pipe, of course, cannot be strung along busy city streets, but pipe for cross-country lines can best be delivered when the ground is frozen, and as a rule it is not a nuisance to any one. Smaller pipe placed in the parkway of outlying streets during the winter months is not usually considered objectionable by the fronting property owners. Temporary storage in vacant lots along the proposed pipe line has been found economical in some places. The cost of rehandling pipe is a factor that probably would be offset by the saving in first cost and even where this is not the case the advantage of a sure supply of material should be considered as a real economy. During the recent railroad strike, many pipe buyers begged for early delivery and were willing to pay a premium if this could have been brought about. The purchase of pipe in the winter would insure better deliveries of pipe in summer as well as winter.

The main issue in the winter buying program resolves itself into whether or not it is an economical practice. The manufacturers believe that it is and conceived the idea of promoting winter purchases with the thought in mind of passing on to the buyers the results of this more efficient production basis. They realize that if winter buying is to be encouraged, the buyer must profit. Confidence in the manufacturers whose interests are as much at stake as the pipe buyers' should bring about the adoption of all-year pipe buying and the result will be economy for all concerned.

> ***Beginning in Next Week's Issue***
>
> A discussion of "Better Equipment Maintenance and Repair Parts Service."
>
> Suggestions by manufacturers for contractors.
>
> Orders for repair parts often omit necessary information.
>
> A recital of actual experiences, showing possibilities of cooperation between user and maker of construction plant.

New Guide for Business with Latin America

Social Amenities Important, Says U. S. Commerce Department's Book, Just Published

WHEN a commercial traveler goes to Latin America he should take his dress clothes and frock coat with him as indispensable accessories to the carrying on of business, according to Ernst B. Filsinger in the new edition of the "Commercial Travelers' Guide to Latin America," just released by the U. S. Department of Commerce. The social amenities, it is pointed out, are strictly observed by our southern neighbors, and business and social activities are intermingled and blended in a manner inconceivable to the average American business man. The observance of customs such as the sending of appropriate greetings to customers on New Year's, the presentation of little gifts and novelties by commercial travelers' are more widespread and far more necessary than in the United States.

Holidays are numerous in all the Latin American countries and in mapping out itineraries they should be taken into consideration. Crops and seasons play an important part; the most profitable month to go to Costa Rica is April when the coffee comes to bearing, and the most agreeable month to visit Honduras is February, says Mr. Filsinger. These and countless other suggestions and facts are contained in this commercial "Baedeker" of Latin America.

Facts About 20 Republics

Everything a commercial traveler ought to know about the twenty republics and the many colonies to the south of us to make a trip profitable as well as enjoyable is encompassed within the 734 pages of the new government publication; steamship lines and railroads, time tables and connections, road routes, hotels and rates, taxes on travelers and restrictions, duties on samples and advertising matter. The traveler is told about the banks, postal service and postal rates, weights and measures, and all things that may obviate those vexatious delays which are especially troublesome to the uninformed and inexperienced traveler in Latin America.

Every city and market of importance in the Latin Americas is listed with information as to its characteristics, trade regulations, license fees, routes by which to reach it, etc., and the traveler is given abundant advice for canvassing each section.

This publication is quite a departure from the usual routine of official bulletins. Its attractive format — the standard guide book size with stout flexible covers, thin paper, and convenient paragraph headings—is a feature. One of the most important items in the guide is the series of more than 40 maps which were specially drawn for this publication and are based upon the most recent authentic data regarding railway lines, commercial centers, etc. The guide may be obtained at a cost of $1.25 by applying to the Superintendent of Documents, Government Printing Office, Washington D. C., or to any of the District or Co-operative offices of the Bureau of Foreign and Domestic Commerce.

To Picture Story of Steel

"The Story of Steel," a six-reel motion picture, will be shown by the Iron League of New York in the Engineering Societies' Building, 29 West 39th St., New York City, at 8 p.m., Dec. 13.

Economy and Efficiency in Plant Selection

From an address by Brig.-Gen. R. C. Marshall, Jr., general manager, Associated General Contractors; before the New York State Industrial Conference at Buffalo, Nov. 22, 1922.

IN ADOPTING a suitable layout of plant and procedure for building a highway or any other type of project, one of the first problems of the construction company is to decide upon the most economical method of construction. This is not purely a study in job mechanics and engineering, but is also a study in economics. It requires a decision as to whether the company should purchase special equipment, or execute the work with equipment on hand; and if special equipment is advisable, how much of its expense the low bid can stand and how much the equipment will bring in salvage. If, as is commonly presumed, the most efficient method were always the most economical the problem would be simple—a question in job mechanics; but since this is not the case, the real problem is to determine whether the most efficient method will in the end prove the most economical. . . . In China the most economical manner of transporting road-building material is frequently on the head of a cooley. This is obviously not an efficient method, but in that particular locality is the one which would deliver the owner's project at a minimum cost. In Illinois, where materials are delivered by motor truck and industrial railway, we find the method that is both very efficient and very economical for that locality.

Salesmen Study Lumber at Forest Products Laboratory

A group of short courses given at the Forest Products Laboratory of the Department of Agriculture to lumber salesmen was so successful that further courses will be given in January. The object of these courses is to present through lectures and demonstrations technical information on the structure, shrinkage, strength, durability, seasoning, and grading of lumber.

Coffin Foundation Created by General Electric Co.

Income from $400,000 to Be Used as Reward for Service in Electrical Field

BY ACTION of its board of directors, the General Electric Co. has set aside a fund of $400,000 to be known as the Charles A. Coffin Foundation, the income from which, amounting to approximately $20,000 per year, will be available for encouraging and rewarding service in the electrical field by giving prizes to its employes, recognition to lighting, power and railway companies for improvement in services to the public and fellowships to graduate students and funds for research work at technical schools and colleges. Mr. Coffin has been identified with the development of the electrical industry since 1882. He was the founder and creator of the General Electric Co., of which he was the inspiration and leader for thirty years until his retirement on May 16 in his 78th year.

The foundation will be controlled and administered by a Foundation Committee, appointed by the board, which will distribute the income of the foundation.

Power and Mechanical Exposition to Be Held in New York

Arrangements have been completed for holding the National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City, Dec. 7-13.

Business Notes

AIR REDUCTION SALES CO. has discontinued its offices at 120 Broadway and 160 Fifth Ave. and consolidated them at the new address, 342 Madison Ave., New York City.

DERRICK & HOIST CONSTRUCTION CO., INC., New York, engineers and contractors specializing in sand, coal and stone-handling plants, has arranged to continue the business of William J. Haskins, consulting engineer for material-handling equipment, who died recently. The Derrick & Hoist Construction Co. has taken over Mr. Haskins' drawings and other records and is prepared to make alterations or repairs to plants which he built.

UNDERWRITERS' LABORATORIES has removed its New York office from 25 City Hall Place to the Union Laboratories Building, 109 Leonard St. At the new location will be continued the work of the electrical testing laboratory, the planning of inspections at factories and label service in the metropolitan district, New York State, New Jersey, and southern Connecticut.

WILSON WELDER & METALS CO. is now represented exclusively in Maryland, Virginia and the District of Columbia by the Alexander Milburn Co. of Baltimore. A stock of color-tipt welding metals and plastic-arc welding machines is available at this point for

distribution throughout the territory and a demonstration plant is in operation.

HARDWOOD MANUFACTURERS' INSTITUTE, Memphis, Tenn., has announced the appointment of Roy H. Jones as assistant to J. M. Pritchard, secretary-manager. Mr. Jones, who has been with the Department of Commerce in Washington as assistant to Axel H. Oxholm, chief of the Lumber Division, since that division was established by Mr. Hoover, is a practical lumberman of wide experience.

STANDARD TURBINE CORP., New York City, manufacturing steam turbines, announces the appointment of E. E. Maher as district sales manager in Chicago, with offices at 2237 Insurance Exchange Building.

A. E. JONES, sales engineer in the New York office of the Terry Steam Turbine Co., has accepted a position with W. B. Connor, Inc., N. Y. City, in a similar capacity. Mr. Jones will assume his new duties Jan. 1.

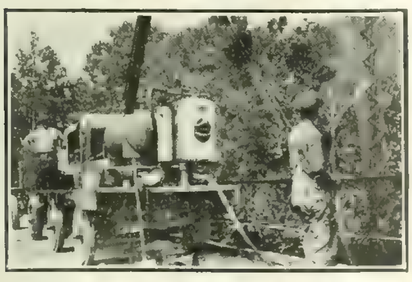
BERNARD L. McNULTY, general manager of the Lehigh Lime Co., has been elected president of the Marblehead Lime Co., with offices in Chicago.

GIBB INSTRUMENT CO., Detroit, manufacturer of electric welding equipment, announces the removal of its plant and offices to Bay City, Mich., effective Dec. 1. The purpose of this move is to provide increased manufacturing facilities. For the past two years this company has concentrated on the development of automatic and semi-automatic arc, spot and seam welders.

Equipment and Materials

Portable Sand-Blast Outfit for Cleaning Steel Bridges

A combination compressor and sand-blast outfit mounted on a motor truck for mobility is manufactured by the Pangborn Corp., Hagerstown, Md., for cleaning bridges, buildings and other

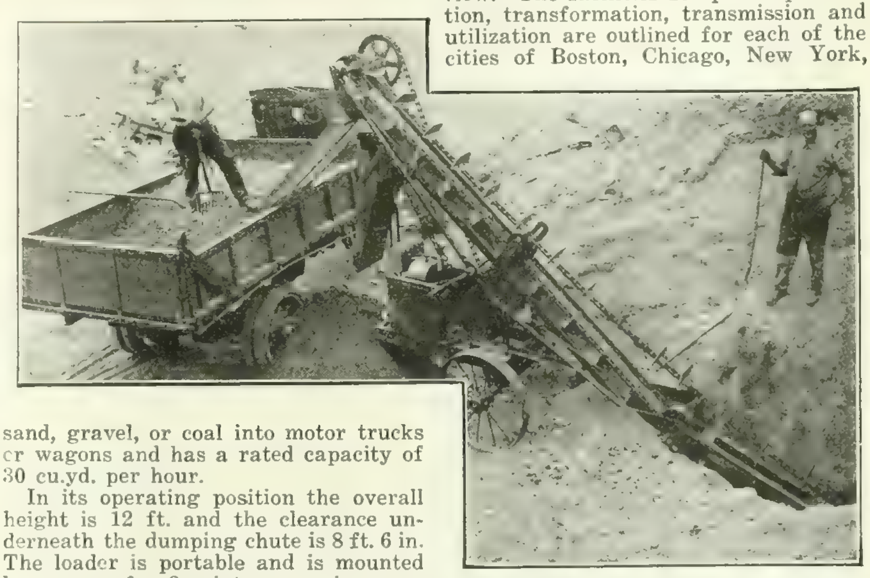


structures. In repainting structural bridges the permanence of the protective coating, it is pointed out, is dependent in a great measure upon the condition of the surface when the paint is applied. Sand-blasting is claimed to be the best means of preparing the surface by removing rust, scale, old paint or foreign material, and exposing the metal. In addition, the surface is slightly roughened or pitted, depending upon the size of the abrasive used, thus providing an additional hold for the paint.

With the mobile outfit illustrated county bridges over a wide range of territory can be sand-blasted. This means of cleaning bridges is in use by the state highway commissions of Ohio, North Carolina, and California. The sand-blast cleans from 2 to 4 sq.ft. per minute.

Scraper-Plate Wagon Loader Has Self-Feeding Arm

A self-feeding arm hinged at the base of the elevator frame is one of the features of the wagon loader manufactured by the N. P. Nelson Iron Works, Inc., Brooklyn, N. Y. The device consists of a 13-ft. inclined steel trough up which material is moved by 5x14-in. scraper plates on an endless chain operated by either a 5-hp. gasoline engine or a 3-hp. electric motor. The equipment is designed for loading



sand, gravel, or coal into motor trucks or wagons and has a rated capacity of 30 cu.yd. per hour.

In its operating position the overall height is 12 ft. and the clearance underneath the dumping chute is 8 ft. 6 in. The loader is portable and is mounted by means of a 3-point suspension on a four-wheeled chassis, as shown in the accompanying illustration. The elevator arm is raised and held in any position by a hand wheel, and, when moving from one job to another, is brought to a horizontal position in which its height above the ground is 6 ft. 3 in. The weight of the Type A (gasoline engine) unit is 1,800 lb. and of the type B unit (electric motor) 2,000 lb. The drive is by reduction gears in the case of the gasoline engine type and by Diamond roller chain in the case of the electric motor type.

In the illustration the shaft of the chain guide wheel at the foot of the loader trough rests in vertical guide slots which allow the wheel to rise when large or odd shaped pieces of material enter the trough. This feature prevents strain on the conveyor chain and scraper plates.

Dry Batteries for Blasting

For small-scale blasting operations the National Carbon Co., Inc., is advocating the use of its Columbia dry batteries; for this purpose the new steel case hot shot battery has been developed. In its suggestions for the use of this battery for blast firing the company states that the blasting caps should be connected in parallel across the line instead of in series as is customary with the generator method. A No. 6 dry cell will fire eight caps simultaneously. For each 100 ft. of wire, counting both sides of the line, one dry battery in series should be added to the original cell. It is advisable from the safety standpoint to connect two ordinary push buttons, one on each side of the line, with the wires of the circuit. When ready to fire, both buttons are pressed at once.

Publications from the Construction Industry

Subway Systems—GENERAL ELECTRIC Co., Schenectady, N. Y., has just published an illustrated pamphlet describing the more important of the country's rapid-transit systems from an electrical engineering point of view. The facilities for power production, transformation, transmission and utilization are outlined for each of the cities of Boston, Chicago, New York, and Philadelphia. Small maps showing the locations of the lines are included. No attempt is made to comment on the civil engineering features of the several projects, the text being confined to electric power problems.

Portable Electric Tools—BLACK & DECKER MANUFACTURING CO., Baltimore, in a 31-p. illustrated catalog, features its line of portable electric tools, including drills, grinders, screw drivers, and air compressors. Various models of portable electric drills have a pistol grip and trigger switch, enabling the operator to control the tool like an automatic pistol. Two pages are devoted to an explanation of the best method for grinding drill bits.

Copper Steel—AMERICAN SHEET & TIN PLATE CO., Pittsburgh, has published a 14-p. illustrated pamphlet entitled "The Testimony of a Decade," which presents service records indicating the rust-resisting qualities of its Keystone copper steel in comparison with sheets and plates of other compositions. Galvanized sheets of copper steel are recommended for culverts, tanks, bins, flumes, roofing, sidings, gutters, ventilators, and skylights. Terne plates of the same material are applicable to roofing where durability and fireproof qualities are desired.

Business Side of Construction

Facts and Events that Affect Cost and Volume

November Contracts 11 Per Cent Heavier Than in 1921

About 22 per Cent Under Lettings For October—Gains In Bridges and Commercial Buildings

Lettings in the United States and Canada on important engineering construction projects, as announced in the five November issues of *Engineering News-Record*, aggregate $134,697,000, compared with $137,877,000 reported in the four October issues. This represents a weekly average of $26,939,400 for November as against $34,469,250 during October. Awards for November, 1921, totaled $96,635,000, an average weekly rate of $24,158,750 or about 11 per cent under the value of contracts let during November of this year.

Minimum costs observed in Construction News, on each class of construction, are as follows: Water-works, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

The weekly average for bridge construction during November was $1,351,800 as against $474,750, the weekly rate for October. Commercial buildings averaged $14,383,800 and miscellaneous construction, $975,800 weekly, compared with $13,953,500 and $830,500, respectively, for the two classifications during October.

Lettings in the Middle Atlantic States exceeded the totals for the Middle West by over $11,000,000. Only in three instances have the Middle Western states surpassed the Middle Atlantic group, in total values of contracts let, since the beginning of the year.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 291 to 304, are the following:

High school, Kansas City, Mo., for Board of Education, $1,400,000.

Annex to State Capitol, Nashville, Tenn., for State, County and City, $1,400,000.

Apartment, New York, N. Y., for S. & L. Building Corporation, $1,200,000.

School building, Trenton, N. J., for Board of Education, $1,000,000.

Two school buildings, New York, N. Y., for Board of Education, $1,000,000 and $1,750,000, respectively.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 291 to 304, are the following large projects:

Bank and office building, Chicago, Ill., to Thompson-Starrett Construction Co., $7,000,000.

Office building, Boston, Mass., to G. A. Fuller Co., $3,000,000.

Factory, Kansas City, Mo., to Frank Hill Smith, Inc., Dayton, O., $1,250,000.

Store, Atlanta, Ga., to Selden Breck Construction Co., $1,250,000.

Hotel, Chicago, Ill., to F. A. Siebold, Jr., $1,200,000.

Apartment, Cleveland, O., to W. Dunbar Co., $1,000,000.

Hotel, Hamilton, Bermuda, to J. Stewart Co., 30 Church St., New York, N. Y., $1,000,000.

Rapid-Fire Survey of Business Conditions

Transportation situation remains an important factor in retarding business. Loadings for the week of Nov. 18 were 178,731 cars heavier than a year ago, but the volume of railway business will probably decline in December.

Labor is another prime factor and is carefully considered on p. 999 of this section. *Engineering News-Record's* figures show the average hourly rate paid common labor in eighteen cities up 2c. during November.

Money on demand ruled between 4 and 5½ per cent, the same as the previous week, in New York. Time money rate continued at 5 per cent, with borrowers reluctant to pay it, resulting in a small volume of business.

(Continued on p. 999)

Engineering News-Record Construction Cost Index Number

December, 1922	**192.60**
November, 1922	188.60
December, 1921	167.82
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number advanced four points since last month, due to rise in average common labor rate. Steel is still $2.00 per 100 lb., Pittsburgh mill. The average rate for common labor is now 47c. Thus, general construction cost is 14 per cent higher than one year ago and 30 per cent under the peak; it is 92.6 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
November, 1922 (*5 issues of E. N.-R.*)	**122**
October, 1922 (*4 issues of E. N.-R.*)	127
November, 1921 (*4 issues of E. N.-R.*)	101
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 122 for the month of November, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money-value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 122 for November, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA IN NOVEMBER, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Waterworks	$16,000	$1,185,000	$39,000	$520,000	$287,000	$114,000		$2,161,000
Sewers	105,000	243,000	89,000	2,442,000	2,135,000	242,000	$113,000	5,369,000
Bridges	30,000	3,111,000	2,265,000	372,000	575,000	97,000	259,000	6,709,000
Excavation, drainage and irrigation			881,000	252,000	583,000	25,000		1,741,000
Streets and roads	238,000	2,600,000	7,531,000	899,000	7,068,000	2,163,000	393,000	20,892,000
Industrial works	2,045,000	5,509,000	688,000	4,392,000	1,993,000	1,018,000	2,934,000	18,579,000
Buildings	5,101,000	27,610,000	4,520,000	19,651,000	8,506,000	5,418,000	1,113,000	71,919,000
Federal Government	28,000	251,000	145,000	1,623,000	203,000	198,000		2,448,000
Miscellaneous	84,000	1,006,000	677,000	281,000	192,000	438,000	2,201,000	4,879,000
Total	$7,647,000	$41,515,000	$16,835,000	$30,432,000	$21,542,000	$9,713,000	$7,013,000	$134,697,000

(Continued from p. 998)

"Conservative first mortgage loans on improved real estate have invariably proved the most satisfactory form of investment," says Harold W. Watson, a mortgage specialist, as quoted in the New York Times, "and during the construction and reconstruction period of the last four or five years we know that money has been in great demand at rates 6 per cent and more, while in some states an 8 per cent rate is considered reasonable. There is every indication that the interest rate of 6 per cent, which has held up for several years in Greater New York, has more or less settled down to a 5 per cent basis in Manhattan."

Stock market has shown an interesting feature recently, in its lack of response to favorable news. The Annalist asserts that stock dividends have lost their influence as a market factor, as have reports of good business and large crops. This indicates real dullness, particularly as money for stock market requirements is plentiful. Reasons are not difficult to find: Europe, the railroads, possible legislation in the next two years, fear of increased taxation. The Annalist concludes: "In the meantime not a few holders of securities who bought for the rise may take their profits and sell, and those who were not fortunate

Labor Rates and Conditions Throughout the Country

That industrial conditions are steadily improving has remained undisputed, among generally accepted economic authorities, since the recent depression. But wide differences of opinion seem to prevail regarding the labor supply. Reports received by the National Industrial Conference Board, from the U. S. Department of Labor, state that in 355 industrial centers an increase in employment was noted in twelve of the fourteen industrial groups. According to a survey conducted by the American Federation of Labor, reports of a labor shortage in this country are greatly over-estimated. A comparison of excerpts, taken from the respective reports of the two industrial authorities, for the same five cities, proves interesting.

Local industrial conditions as reported by *News-Record* correspondents are given as follows:

Atlanta—Building continues active, with fairly good supply of labor.

Birmingham—Common labor sufficient but not abundant; awarded advance of 5c. per hour.

Boston—Just about enough bricklayers, carpenters and hodcarriers, but not all piledrivers and structural ironworkers employed. Plenty of hoisting engineers, but scarcity of good common laborers.

Cincinnati—Bricklayers scarce; labor supply normal, otherwise.

Dallas—Plenty of common laborers; hod carriers fairly plentiful, but limited supply of skilled crafts.

Denver—All trades, 100 per cent employed.

AMERICAN FEDERATION REPORT

Milwaukee, Wis. "There is no industry here that has a shortage of labor."

Youngstown, Ohio. "This central body reports that steel mills cry labor shortage and force men to undergo a physical examination. Low wages, which make it impossible to live, is the rule. Men appear at the factory gates but are not employed."

Detroit, Mich. "There is a line-up in front of every employment agency in the city. The mission houses are full. More men are seeking employment at local factories than can be used by them. There is a big over-supply of common labor and considerable of a surplus of skilled workers in Detroit."

Kenosha, Wis. "There is unemployment galore and we expect same to be much worse—a month from now."

Pittsburgh, Pa. "There is no material labor shortage." "This letter states that steel mills shortage is because men refuse to work long hours for low wages. Men are being brought from South, but do not stay."

DEPARTMENT OF LABOR REPORT

Milwaukee, Wis. "Upward trend in employment. Shortage of workers in building trades, machinery and textiles...."

Youngstown, Ohio. "Gradual increase in employment. Shortage of common labor exists, especially in the steel mills. Surplus of helpers, handymen and clerical workers. Demand for farm help fair...."

Detroit, Mich. "Employment in industries decidedly improved. Slight shortage of brick masons; no surplus in any lines.... Building operations steady. Public improvements increasing. Housing in Detroit not equal to demand."

Kenosha, Wis. "Increase in employment. Shortage of common labor. All plants operating, majority full time."

Pittsburgh, Pa., District. "Demand for mechanics, with the exception of bricklayers and painters, is still in excess of the supply.... Iron and steel industry is steadily increasing employment.... An acute shortage of common labor persists, mills, factories and construction work making strong demands."

Kansas City—Shortage of bricklayers, hodcarriers and carpenters; other trades plentiful.

Montreal—Scarcity of bricklayers only.

New Orleans—Fair supply of labor.

New York—Armistice declared in dispute between the two building laborers' helpers' unions. The International Union men had refused to use materials handled by members of the Independent Union, which had in turn been sponsored by the employers. Lockwood committee, acting as arbitrator, adjourned until Dec. 12, pending permanent settlement.

St. Louis—Common laborers paid 35c.@45c. as compared with 30c.@40c. per hr., one month ago.

San Francisco—Plenty of work for all trades.

Philadelphia—Demand for labor easing up perceptibly.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$0.70	$0.30	......	$0.65	$0.30@.35
Baltimore	1.25	.80	.87½@.90	.60@.75	$0.75	1.00	.35@.40
Birmingham	1.00	.75	.50@1.00	.15@.25	......	1.00	+.20@.25
Boston	+1.25	1.00	90@1.00	.75@.80	1.00	1.00	.50@.55
Cincinnati	+1.35	.95	.95	.72½	.....	.95	+.35@.40
Chicago	1.10	1.00	1.10	......	1.10	1.05	.72½
Cleveland	1.25	1.10	1.10	.75	.91	1.10	+.75
Dallas	+1.37½	1.00	1.00	—.40	—.87½	1.00	+.30@.50
Denver	1.25	1.00	1.00	.75@.81¼	1.00	1.03⅛	.35@.50
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.12½	1.00	1.00	+.80	1.00	+1.07½	+.40@.50
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.56¼@.62½
Minneapolis	1.00	.80	.80	.65	......	.80	.35@.50
Montreal	.90	.65	.50	.35	.50	+.65	.30@.35
New Orleans	1.00	.85	.90	+.65	.80	1.00	.35@.40
New York	1.25	1.12½	1.25	.87½	1.00	1.12½	.45@.60
Pittsburgh	1.30	1.12½	1.00	.90	1.00	1.00	.50
St. Louis	1.25	1.10	1.12½	.85	1.12	1.12½	+.35@.45
San Francisco	1.12½	1.00	1.00	.75	1.00	1.12½	.47½@.50
Seattle	1.00	.80	.90	.70	1.00	.80@.90	.50@.60
Philadelphia	1.25	.90@1.00	.90@1.00	.75@.90	1.00	.90@1.00	.35@.45

enough to get in at lower levels may dispose of stocks around current prices, feeling that the somewhat uncertain character of the market is a warning for the exercise of great caution; consequently, stocks held by such persons may come on the market, and this, with profit taking and short selling and the absence of outside buying to support the selling, will undoubtedly exert a pressure on the market such as may bring about a further recession in quotations."

Price movements since July are shown by this list of index numbers

INDEX NUMBERS OF WHOLESALE PRICES

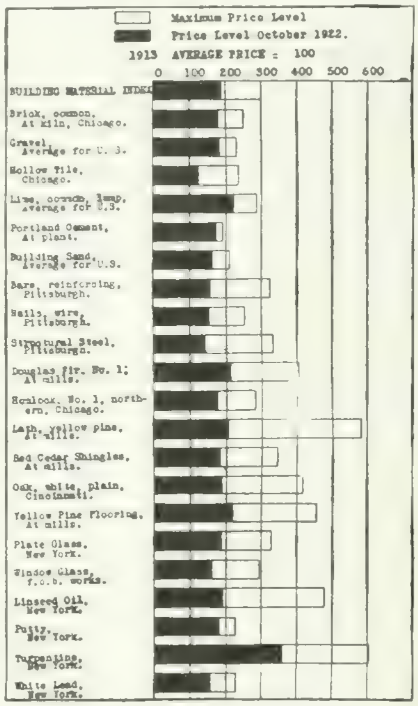
(Compiled by D. L. Bissell)

1922	July	Sept.	Nov.
Farm products..	126	124	133
Crops	128	127	143
Live-stock	122	119	119
Orchard products	165	161	131
Citrus	100	138	85
Deciduous	211	175	162
Foods	140	136	142
Provisions	164	142	144
Dairy	117	139	168
Meats	127	124	123
Textiles and leather	193	187	206
Fuel and metals	155	157	149
Materials of construction	172	178	178
Building materials index, Dept. of Commerce	169.6	179.7	.....
E. N.-R. Constructiono Cost Index No	169.7	185	188.6
All commodities	151	149	155
Raw materials	138	133	143
Manufactured products	164	166	167

by D. L. Bissell, San Diego, Calif., to which has been added the Building Materials Index of the Department of Commerce and the *E. N.-R.* Construction Cost Index.

New York incorporations thus far this year exceed the number for the whole of 1921, and will reach 17,000, establishing a record. Up to Dec. 1 there have been 16,301 companies, capitalized at $582,197,530.

Building materials index numbers issued by the Department of Commerce are shown for October and the 1920 peak in the chart. Shapes are



shown to have dropped 60 per cent since the peak, cement 17, sand 23, gravel 22, common brick 23.

Bond market was firmer, probably due chiefly to slightly easier money. Municipals were quiet; new offerings small, but a much better volume in prospect.

Business failures in the United States in November numbered 1,758, an increase of 9.8 per cent over last month, according to Bradstreet's figures, but were 10.7 per cent fewer than in November, 1921. November liabilities totaled $54,080,825, which is 46 per cent heavier than for October, though 25.7 under November, 1921. For eleven months of this year failures number 20,548, an increase of 16.7 per cent over last year, which was the peak year in number of failures. Liabilities for the eleven months, however, are 11.2 per cent below the same period a year ago.

Bids Received for Towers of Philadelphia Bridge

Four bids were received by the Delaware River Bridge Joint Commission on Nov. 29 for the steel main towers of the Philadelphia-Camden suspension bridge. The material involved comprised 13,600,000 lb. of silicon steel, 4,890,000 lb. of carbon steel, and 290,000 lb. of cast steel. The unit prices bid ranged from 7.43c. to 9.55c. for silicon steel, 6.63 to 9.55c. for carbon, and 12.1c. to 18.08c. for cast steel. The four bidders and their total bids on the estimated quantities were: Bethlehem Steel Co., $1,386,974; Keystone State Construction Co. and New York Shipbuilding Co., $1,469,304; McClintic-Marshall Co., $1,513,495; American Bridge Co., $1,805,670.

It is expected that the contract will be awarded to the low bidder.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig-Iron—Prices continue to decline; but further increase in production is indicated. No. 2 foundry iron down $3.50 per ton in Birmingham, $1 in Chicago, and $6 in Pittsburgh. Basic dropped $2 in Philadelphia, $2.50 in Pittsburgh and $3 in Cincinnati. Bessemer declined $2 in Pittsburgh; Eastern Pennsylvania, $2 in Philadelphia during month.

Railway Supplies—Light rails down $4@$5 per ton at Pittsburgh, despite continued railroad buying of car and track materials. Red oak ties 5c. higher in St. Louis.

Pipe—Steel pipe trade showing increased volume; but no changes in mill or warehouse discounts. Cast-iron pipe up 50c. in Birmingham; $2.50 in Chicago and $3 per ton in San Francisco, since last month. Clay drain tile, higher in St. Louis. Advances in sewer pipe quoted in Atlanta, Dallas, St. Louis and Philadelphia; no declines reported.

Road and Paving Materials—Both bulk and package asphalt down 50c. in Boston and Maurer, N. J., and $1 per ton in St. Louis and Atlanta. San Francisco also reports drop of $2 in bulk and $2.50 in package asphalt. Detroit, however, quotes rise of $1.18 per ton in packages. No change in road oils. Wood paving blocks up 5c.@ 11c. per sq.yd. in New York; down 12c. in Philadelphia.

Sand, Gravel and Crushed Stone—Birmingham reports advance of 5c. per ton in sand, due to readjustment of freight rate prices; also higher in St. Louis, but down in Dallas and Atlanta. Gravel prices rose slightly in Denver, St. Louis and Dallas, and declined in Cincinnati, San Francisco and Atlanta, during month. Crushed stone declined 10c. per cu.yd. in San Francisco, and rose sharply in Cincinnati, Kansas City and Montreal.

Lime—Hydrated finishing lime advanced $2 per ton in St. Louis and $1 in Cincinnati; but dropped $2 in Chicago and $2.50 in Dallas. Hydrated common up $1 in Cincinnati and St. Louis, and $1.50 in Detroit. Lump finishing lime advanced 6c. per bbl. in Kansas City; common lump, $1.25 per ton in Detroit, 25c. per ton in St. Louis and 20c. per bbl. in Kansas City.

Cement—Mill prices unchanged during month. Kansas City, however, quotes $2.45 as against $2.85 per bbl. Detroit reports $2.47 as compared with $2.48 per bbl., one month ago, owing to correction in freight rate.

Structural Steel—Steel shapes, plates and bars still frequently quoted under the $2 per 100 lb. level. Independent makers, however, adhere to the $2 base on steel plates; with attractive tonnages on railway steel quoted as low as $1.90@$1.95. Heavy buying of tank plates for oil storage.

Brick and Hollow Tile—Common brick, $15@$15.50 as compared with $14@$15.50 per M. wholesale, alongside dock, New York, one month ago. Atlanta and Detroit both report declines of 50c., with a drop of $1 per M. in Dallas. San Francisco and Kansas City, however, quoted advances of 50c., with a rise of $1 in St. Louis. Hollow tile down in St. Louis, Minneapolis, Cincinnati and Kansas City; but higher in Atlanta and Montreal, due to heavy demand and high fuel costs.

Lumber—Although colder weather and an increase in surplus cars are expected to divert quotations downward, many cities report higher lumber prices during month. Yellow pine timbers, base sizes, up $3 in Dallas; $3.25 in Kansas City; $4 in Birmingham and $6.50 per M ft. b. m. in Philadelphia. Douglas fir rose $1 in Minneapolis and hemlock, $5 in Montreal. The declines were as follows: pine, $6 in Atlanta; fir, $1 in Seattle; fir, $2, hemlock, $5 and spruce, $6 per M. ft. in Philadelphia.

Scrap—Market weaker, due to seasonal dullness. St. Louis quotes reduction on all except cast borings.

Explosives—Average drop of 2c. per lb. in five out of eighteen cities reporting. St. Louis, however, quotes advance of 1c. on 60 per cent and Birmingham 1c. per lb. on both 40 and 60 per cent, during month.

Linseed Oil—Down 3c. in New York; up 1c. per gal. in Chicago, since last month. Price stable in other cities.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	*$27.55*	$22.50
Northern Basic	*30.27*	22.02
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	*30.27*	23.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	*35.27*	28.50
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	*24.00*	18.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25 @ 2.75 sil.)	*31.64*	23.26
Virginia No. 2 (silicon 2.25 @ 2.75)	37.17	28.74
Basic	*27.50*	20.75
Gray Forge	*29.14*	22.50
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	*30.00*	21.70
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*30.00*	24.66
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	*27.50*	22.46
Basic	*27.50*	20.96
Bessemer	*30.50*	21.96

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$40.00	.....	$43.00	43.00
Standard openhearth rails	43.00	40.00	$43.00	43.00	43.00
Light rails, 8 to 10 lb.	*40@43*	31@33	2.00*	43.00	**43.00**
Light rails, 12 to 14 lb.	*40@43*	31@33	2.00*	43.00	**43.00**
Light rails, 25 to 45 lb.	*40@43*	31@33	2.00*	43.00	**43.00**
Rerolled Rails	28@32	....	....	...	...

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.40	$1.55
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco...... Green Douglas Fir	*.84*	*1.17*
San Francisco, Empty Cell Creosoted, Douglas Fir	*1.60*	*2.25*
St. Louis, Red Oak*	**1.05**@1.30	**1.30**@**1.55**
St. Louis (creosoted) (zinc treated)	**1.70**	**2.05**

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, $\frac{9}{16}$-in. and larger	$2.75	$2.25	$2.55	**$3.65**	$4.45	$3.29
Track bolts	3.85@4.50	3.25@3.50	3.65	**4.75**	5.45	4.29
Standard section angle bars	2.75	2.75	2.40	**3.50**	4.10	2.94

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	66	54½	¾ to 1½	34	19

LAP WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	59	47½	2	29	15
2½ to 6	63	51½	2½ to 4	32½	19
7 to 8	60	47½	4½ to 6	32½	19
9 to 12	59	46½	7 to 12	30	17

BUTT WELD, EXTRA STRONG, PLAIN ENDS

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 1½	64	53½	¾ to 1½	34	20
2 to 3	65	54½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	57	46½	2	30	17
2½ to 4	61	50½	2½ to 4	33	21
4½ to 6	60	49½	4½ to 6	32	20
7 to 8	56	43½	7 to 8	25	13
9 to 12	50	37½	9 to 12	20	8

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	57%	62½%	61½%
2½ to 6 in. lap welded	54%	59½%	58½%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	44%	48½%	51½%
2½ to 6 in. lap welded	41%	45½%	50½%

Malleable fittings, Class B and C, from New York stock sell at list less 10% Cast iron, standard sizes, *32-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Current	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	**$47.50@48**	*$59.30*	$50.30	**$55.20@56.20**	**$53.10**	**$58.00**
6 in. and over	43@**43.50**	*54.30*	47.30@48.30	**51.20@52.20**	**49.10**	**54.00**

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$40.00	**$55.00**	$50.00	.....	$55.00
4	55.00	50.00	**65.00**	60.00	$76.50	65.00
5	80.00	80.00	**84.00**	80.00	97.75	84.00
6	105.00	105.00	**110.00**	100.00	127.50	110.00
8	170.00	175.00	**181.00**	150.00	212.50	181.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.14	$0.105	...	.	$0.12	$0.12	...
4	.14	.105	$0.10	$0.0875	.12	.15	*$.175*
5	.20	.1575	.125	**.1225**	.18	.18	**.20**
6	.20	.1575	.150	**.16**	.18	.21	**.2625**
8	.34	.245	.225	.20	.28	.30	**.435**
10	.51	.3675	.2925	.28	.42	.42	.64
12	.65	.4725	.3825	.36	.54	.54	**.82**
15	1.03†	.63	.5625	.52	.72	.90	1.18
18	1.50†	.875	.765	.68	1.00	1.32	1.65
20	1.80†	1.05	1.0125	.92	1.20	......	.....
22	2.40†	1.40	1.2375	.....	1.60	......	2.10
24	2.70†	1.575	1.4625	1.20	1.80	2.16	**2.73**
27	4.50†	2.795	....	2.25	3.75†	3.00	.....
30	5.00†	3.096	..	2.70	4.75†	3.60	.....
33	6.50†	4.14	....	3.35	5.50†	......	.....
36	7.50†	4.715	....	3.65	6.00†	......	.....

	3	5	8	12	24	36
Boston	$0.13	$0.19	$0.29	$0.56	$2.43†	$6.46†
Minneapolis	....	....	.40	.72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	....	.325	.65†	2.34†	.....
Los Angeles	....	..			...	.....
New Orleans	.1120*	.168*	.28	.476	1.82†	.....
Cincinnati	.111*	.1665	.259	.4995	1.665	3.7925†
Atlanta	**.108***	**.162***	**.27**	**.459**	**1.75**	.....
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	
Detroit	.102	.153	.238	.459	1.98†	6.15†
Baltimore	.1225	.2275	.35	.6870	2.29	5.23
Kansas City, Mo	.135	.19	.30	.54	2.16	
Philadelphia	**.12**	**.18**	**.28**	**.54**	**1.80†**	**4.10†**

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named

	Current	One Year Ago
New York, 45% asphalt.... (at terminal)	$0.06	$0.05½
New York, 65% asphalt..... (at terminal)	.06	.05
New York, binder......... (at terminal)	.06½	.08
New York, flux.............(at terminal)	.06½	.06½
New York, liquid asphalt ... (at terminal)	.07	.06½
St. Louis, 50@60% asphalt	**.07**	*.01½**
Chicago, 40-50% asphalt	.05¼	.05
Chicago, 60-70% asphalt	.05½	.05¼
Dallas, 45% asphalt	.040	.10
Dallas, 55% asphalt	.048	.13
Dallas, binder	.053	.15
San Francisco, binder, per ton	*9.50†*	15.00†

* Freight $21.75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbl. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$20 00	$16.00
Boston (*Mexican*)	[illegible]	15 50
Chicago (*Standard*)	26 00	22 00
San Francisco, *f.o.b. refinery*, Oleum, Cal	[illegible]*	11 00*
Dallas, (*Texas*)	35 00	27 00
Seattle "D" *grade* (*California*)	23 75	13 00†
Denver (*California*)	40 00	
Minneapolis *f.o.b. Twin Cities* (*Mexican*)	33 00	27 50
St. Louis (*Mexican*)	[illegible]	21 00
Baltimore (*Mexican*)	20 00	16.00
Los Angeles, *at factory, Bakersfield* (*California*)		
Montreal (*Mexican*)	28 00	21.00
Atlanta (*Mexican*)	22.00	16 50
Detroit (*Mexican*)	**23 68**	18 95
Cincinnati (*Mexican*)	22.50	19 50
Maurer, N. J. (*Trinidad and Bermudez*)	28 00	26 00
Maurer, N. J. (*Mexican*)	18.00	15 50
Philadelphia (*Mexican*)	20.00	16 00
Kansas City, *petroleum*	28.83	**22 83**

*Freight to San Francisco, 80c. per ton.

†F.o.b. Richmond, Cal.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums.

PAVING STONE—

New York *delivered*	5-in granite, 28@29 blocks per sq yd.	$135.00 per M
Chicago	About 4x8x4 dressed	3 35 sq yd.
	About 4x8x4 common	3.10 sq.yd.
San Francisco	Basalt block 4x7x8	70 00 per M
Boston	5-in. granite	2.00 per sq yd.
Atlanta	Granite	2.10 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	100.00 per M
Baltimore	Granite	2.00 sq.yd.
Montreal *delivered*	Granite	100.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 sq.yd.
Cincinnati	Granite	1 35 per M.
St. Louis	4x8x4 dressed	3 10 sq.yd.
	4x8x4 common	2.90 sq.yd.
Kansas City	No. Granite	3.95 sq.yd.
Philadelphia	Granite	128.00 per M.

FLAGGING—

New York	Bronx, 5 ft.	$0.30@35 sq.ft.
	Manhattan, 4 ft.	.26 sq.ft.
	Queens, 5 ft.	.26 sq.ft.
	6x20-in. cross-walk	1.00 lin.ft.
Chicago	18 in. wide	.99 lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c.@85c. for 5x16 in.; 88c. for 5x18 in., in cargo lots. 5x18 in., 1.44c. per lin.ft. delivered in St. Louis. 6x18 in., Chicago, $2 per lin.ft.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	**$2 21**
New York (*delivered*)	3½	16	**2 39**
New York (*delivered*)	4	16	**2.77**
Boston	3½	16	2 32
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50
St. Louis	3½	16	2.00
St. Louis	4	16	2.00
Seattle	4	16	Off market
Minneapolis	3½	16	2.09
Atlanta	3½	16	2 30
New Orleans	3	16	1.70
New Orleans	3½	16	1.95
New Orleans	4	16	2.25
Dallas	4	18	3.90
Baltimore	3½	16	3.44
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.35
Kansas City	4	16	3.25
Philadelphia	3½	16	2 48

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel				Sand	
	1½ In.		¾ In.			
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
New York	$2 00	$1.75	$2.00	$1.75	$1.00	$1.00
Denver	**1 90**	2 50	**1 90**	2 50	1 00	1 10
Chicago	2 25	2 00	2 25	2 00	2 25	2 00
St. Louis, *per ton*	**1 45**	1 30	**1 50**	1 25	**1 45**	1 20*
Seattle	1.00	1.50	1.00	1.50	1.00	1.50
Dallas	**2.52**	2.25	**2.52**	2.25	*1.87½*	2.25
Minneapolis	1 75	1 50	1 75	1 50	1 00	0 50†
Cincinnati	1.40	1.87½	*1.15*	2.03	1.15	1.60
San Francisco	*2.15*	2.25	*2.15*	2.25	1.50	1.50
Boston	1.40	2.65	1.40	2.65	1.10	2.00
New Orleans	2.85	2.85	2.85	....	1.35	1.35
Los Angeles, per ton	....	1.35	....	1.35	....	1.20
Atlanta, per ton	*1 75*	1 85	*1 75*	1 85	[illegible]	1 25
Detroit	2@2.25	2.00	2@2.25	2.00	2 00	2.00
Baltimore, per ton	1 40	1 40	1 60	1 60	0 70†	2 40
Montreal, per ton	1 25	1 25	1 50	1 50	1 25	1 25
Birmingham, per ton (Crushed slag used instead of gravel)					**1.25**	1.28
Philadelphia	1 70	1 40	1.75	1 55	1 65	1.90
Kansas City, per ton	2.00‡	....	2.00‡	....	0.66†	....

New York—Grit, $1.75 per cu. yd.

Los Angeles—Freight from quarry, 85c. per ton, and is included in above price.

* Fine white sand: Pacific, $4 per ton; Ottawa, $4.50.

† At pit.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In.		¾ In.	
	Current	One Year Ago	Current	One Year Ago
New York	$1.65	$1 80@1.90	$1.75	$1.80@1.90
Chicago	2.25	1 60	2.25	1.60
St. Louis *delivered*	2.10	1.55*	2.20	1.55*
Dallas	1.65	3.20	1 65	3.20
San Francisco	*2.15*	2.25	*2.15*	2.25
Boston, *delivered*	1.65	3.00*	1.65	3.00*
Minneapolis, *at plant*	2 00	2 00	2 25	2.25
Kansas City	**2 40**	2.75	**2 40**	2.75
Denver	3.50	3.50	3.50	3.50
Seattle *delivered*	3 00	3.00	3.00	3.00
Atlanta	2.10*	2 00*	2 10*	2 00*
Cincinnati *delivered*	**1 95***	2.37½	**1.95***	2.08
Los Angeles	.	1 60*	...	1.70*
Detroit	1.90@2*	1.90*	1.90@2*	1.90*
Baltimore	1.70*	1.75*	1.60*	1.65*
Montreal	**1 80***	2.00*	1.90*	2.10*
Birmingham *delivered*	3.20	3.20	3.10	3.10
Philadelphia	1 75*	1.70	1 60*	1.60
Pittsburgh	2.85	..	2.85	....
Cleveland	3.00*		3.00*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In	¾-In.	Roofing	Sand
Youngstown District	$1 30	$1 30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
East Canaan, Conn.	1.25	1 35	4.00	1.00
Easton, Catasaqua, Pa.	1.00	1 00	2.00	0.90
Birmingham, Ala.	**1.25**	**1 25**	**1 25**	**1.25**
Buffalo, N. Y., and Erie, Pa.	1.25	1 25	2.25	1.25
Cleveland, Ohio	1.20	1.20		1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$16.80@*$17.10*	$13.10	$3.63½*	$2.75@$3.13½*
Chicago	*18.00*	18 00	1.50†	1.40†
St. Louis	**32 20**	**20 00**	.	**18 00‡**
Boston	17 00	13.00	3.75*	2.90*
Dallas	*22 50*	.	...	2.50†
Cincinnati	**15 80**	**13 30**	....	10 75‡
San Francisco	22 00	16 00	....	1.75†
Minneapolis	25.50	22.00 (white)	1.70†	1.40†
Denver	24.00		....	2.70†
Detroit	**19 50**	**17.50**	.	**18.25‡**
Seattle *paper sacks*	24.00	.....	2.80†	. .
Los Angeles	.	.	....	
Baltimore	21.00	15.75	....	15.00‡
Montreal	21.00	21 00	15.00‡	11.00‡
Atlanta	23.00	13.00	2.25†	1.85†
New Orleans	.....	17.25	2.40†	.
Philadelphia	15 50	14 50	13 00‡	12 00‡
Kansas City	25.60	24.00	**2.40†**	**2 40†**

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.55, Sheboygan $1.45. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	*1.50*	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	1.72	1.77
Boston (Rosendale) per bag	....	0.85@0.95
St. Louis (Carney)	*1.75*	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Dec. 7	One Month Ago	One Year Ago
New York, del. by truck	$2.60	$2 60	$2.40
New York, alongside dock to dealers	2.30	2.30	2.10
Jersey City	2 48	2.73	2 13
Boston	2.85	....	2.61
Chicago	2.20	2.20	1.97
Pittsburgh	2 24	2.24	2.02
Cleveland	2.46	2.46	2.28
Detroit	*2.47*	2.48	2.31
Indianapolis	2 41	2.41	2.23
Toledo	2.48	2.48	2 31
Milwaukee	2.37	2.37	2 19
Duluth	2.14	2.14	1.95
Peoria	2.39	2.39	2.14
Cedar Rapids	2.45	2.45	2.28
Davenport	2.43	2.43	2.22
St. Louis	2.35	2 35	1 97
San Francisco	2 71	2.71	2 84
New Orleans	3.30	3.30	2 88
Minneapolis	2.39	2.39	2 26
Denver	2 85	2.85	3.10
Seattle	2.90	2.90	3.10
Dallas	2.25	2.25	2.55
Atlanta	2.54	2.54	2 69
Cincinnati	2.51	2.51	2 37
Los Angeles	.		3 31
Baltimore	2.90	2 90	2.88
Birmingham	2 40	2 40	2 27
Kansas City	*2.45*	2 85	2.45
Montreal	2 88	2.88	3.12
Philadelphia	2.51	2.51	2.50
St. Paul	2.39	2.39	2.26

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind.	$1 95	Mason City, Ia.	$2 05
Universal, Pa.	2.00	La Salle, Ill.	2 05
Steelton, Minn	1.95	Hudson, N. Y.	2.20
Fordwick, Va.	2 20	Leeds, Ala	2 20
Mitchell, Ind.	2.05	Hannibal, Mo.	2.10
Iola, Kan	2 10	Lehigh Valley District	2.10

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse New York	Chicago	Dallas	San Francisco
032	22	$0 85	$0 95	$0 92	$1 172	$1 03
049	28	1 08	1.23	1 18	1 488	1.34
068	35	1 31	1 48	1 43	1 835	1 64
093	45	1 69	1 91	1 84	2 345	2.10
126	57	2 08	2 35	2 27	2 917	2 60
153	68	2 48	2 81	2 71	3 468	.....
180	78	2 85	3 22	3 12	4 08	.....
245	103	3 76	4 25	4 11	5 253	.....
287	119	4 34	4 90	4 74	6 079	5.43
336	138	5 04	5.69	5 51	7 458	....
395	160	5 84	6 60	6.38	8 16	...
PAVING						
036P	17	$0.65	$0 72	$0 71	$0 897	....
053P	24	.91	1.02	99	1 284	....
072P	31	1.15	1.29	1 26	1 601	.....
097P	40	1 48	1 67	1 62	2 06	....
049R	24	.91	1.02	99	1 264	....
067R	31	1.15	1 29	1.26	1 601	....
089R	40	1.48	1.67	1.62	2 06	..

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St Louis	San Francisco	Dallas
27Dia.	2 3	$22 00	$20 39	$20 22	$20 78	$25 50
26 "	2.5	22 00	21.93	21 64	21 43	27 58
25 "	3.0	22 00	24 45	24 28		30 71
24 "	3.4	24 00	26 33	26 10	24 28	33 16
22 "	4.33	27.00	31.06	31 60		35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut New York	Chicago	St. Louis	Dallas	San Francisco
¾ and larger	$2 00@2 15	$2 35	$3 04	$2 92	2 75	$4 00	$3 35
⅝	2 05@2 20	2 45	3 09	2 97	2 80	4 05	3 40
½	2.10@2.25	2 55	3 14	3 02½	2 85	4 10	3 45
⅜	2 25@2 40	2 60	3 19	3 17½	2 95	4 15	3 60
¼	2 50@2 65	2 65	3 54	3 42	3 20	4 40	3.85

Includes 15c charge for cutting to lengths of 2 ft and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	$2 10	$2.45	$3 50	⅜	$2 35	$2 75	$3 95
⅝ in.	2.15	2 50	3 75	¼	2 60	3 00	4 20
½	2.20	2 55	3 80	.....	..	..	....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common Current	One Month Ago	One Year Ago	Paving Block 3-inch*	4-inch*
New York (del.)	$18 00@18.55	$16 90@18 55	$18.40	$42 00†	$50 00†
New York (at dock)	15@15.50	14@15.50	15.00		......
Chicago	11 00	11 00	11 00	34 00	42 00
St. Louis, salmon	15 00	14 00	17 00	35 50	40.00
Denver, salmon	12 00	12 00	14 00	....	......
Dallas	9 90	10 90	12 72	no market	
San Francisco	15 50	15 00	18 00	.. ..	
Los Angeles (del.)	.....	.....	15 50	(not used)	
Boston (del.)	22 00	.. ..	17 00	44.00†	53.00†
Minneapolis (del.)	18@19	18@19	17 00	.....	43 00
Kansas City	14 50	14 00	14 50	.....	......
Seattle	14 00	14 00	14 00	44 00	
Cincinnati	17.00	17 00	18 00	42 00	41.00
Montreal	16 00	16 00	16 00	...	68 00
Detroit (del.)	17.00	16 50@17.50	15 00	36 50	39 50@41
Baltimore (del.)	20 00	20 00	20 00	36 00‡	.. ..
Atlanta	11.50	12 00	9.00	39.00	......
New Orleans	15 75	15 75	14 00	.. ....	......
Birmingham	12 50	12 50	11.50		
Philadelphia	20@28	20@28	16@19	40 00	48.00
Pittsburgh (del.)	16.00	16.00	.....		
Cleveland	16.00	16.00		......	......

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Current on Trucks*	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12	$0 123	$0 1112	$0 0674	$0 12	$0 08	$0 108	...
6x12x12	1844	1516	0926	..	.114	156	
8x12x12	2305	.2021	1263	.1875	.16	.244	$0.2147
10x12x12	....	.	1621	.	.18	.....	2653
12x12x12	......		1853		22	......	3448

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0.1027	$0 1926	..
Minneapolis (f.o.b. cars)	0696	.115	$0 204
Minneapolis (delivered)	.0796	.13065	.229
Cincinnati	.0859	.1611	....
Kansas City	.083	.105	..
Denver	.065	123	188
Seattle (delivered)	.11	.25	.36
Los Angeles factory	.. .		....
New Orleans	.12	23	.36
Detroit (delivered)	.09	175	.260
Montreal	.09	16	30
Baltimore	.14	25	39
Atlanta	0859	16110	.....
Dallas	115	....	.....
Birmingham	11	18	......
Pittsburgh (delivered)	.068	.128	.179
Cleveland	.08	164	....

San Francisco, Philadelphia, Atlanta, New York and Chicago quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburg and Birmingham together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh, *Mill*	Birmingham *Mill*	Warehouse New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.00	$2 40	$3.14	$4 40	$3.00	$3.02½	$3.25
Channel, 3 to 15 in.	2 00	2 40	3 14	4 40	3.00	3.02½	3.25
Angles, 3 to 6 in., ¼ in. thick	2 00	2 40	3.14	4 40	3.00	3.02½	3.25
Tees, 3 in. and larger	2 00	2.40	3.14	4.40	3.05	3.02½	3.25
Plates	2 00	2.40	3.14	4 50	3.00	3.02½	3.35

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse New York Current	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$3@3.15	$3.85	$3.70	$3.75	$3.85	$4.75	$6.00
CONE HEAD BOILER							
¾ in. and larger	3.10@3.25	3.95	3 80	3 85	3.95	4.85	6.15
⅝ and 11/16	3.25@3.40	4.11	3 95	4.00	3.95	5.00	6.30
½ and 9/16	3.50@3.65	4.35	4 20	4.25	3 95	5.25	6.55

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.70	$3 45	$4 00	$4 40	$3.40	$4 95
Cut	3.35	5.50	5.65	7.75	5.60	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square, f.o.b., as follows:

	New York 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.	Philadelphia 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.
No. 1 grade	$2.10	$2.55	$3.00	$1.90	$2 35	$2.80
No. 2 grade	1.85	2.15	2.55	1.70	2.00	2.40

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.50 per package (sufficient to cover 50 sq.ft.) in carloads; $5.75 in smaller quantities, in Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia. l.c.l., $5.90

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft.	$2.00
Tar pitch (in 400-lb. bbl.), per 100 lb.	1.65
Asphalt roofing (in barrels), per ton, f.o.b. plant*	40.50
Asphalt felt (light), per ton, f.o.b. plant*	64.50
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3,00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.50@$2.60	4.10	$4.00	$4.35	$4 19
No. 12	2.60@2.70	4.15	4.05	4.40	4.24
No. 14	2.70@2.75	4.20	4.10	4.45	4 29
No. 16	2.90@3.05	4.30	4.20	4.55	4.39
Black					
*Nos. 18 and 20	3.20@3.25	4.65	4.70	5 70	4 70
*Nos. 22 and 24	3.25@3.30	4.70	4 70	5 75	4 75
*No. 26	3.30@3.35	4.75	4.75	5 80	4.80
*No. 28	3.35@3.40	4.85	4.85	5.90	4.90
Galvanized					
No. 10	3.35@3.50	4.85	4.85	....	4.90
No. 12	3.45@3.60	4.95	4.95	5.85	5.00
No. 14	3.45@3.60	4.95	4.95	5.85	5.00
Nos. 17 to 21	3.75@3.90	5.10	....	6 15	5.30
Nos. 22 and 24	3.90@4.05	5.40	5.40	6.30	5.45
*Nos. 25 and 26	4 05@4.20	5.55	5 55	6 45	5.60
*No. 28	4.35@4.50	5.85	5.90	6.75	5.90

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Chicago Current	Chicago One Year Ago
Raw in barrel (5 bbl. lots)	$0 90	$0 72	$0 95	$0.76

WHITE AND RED LEAD—Base price in cents per pound

	Red				White	
	Current		1 Year Ago		Current	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	**13 25**	**14 75**	12 25	13 75	**13 25**	12 25
25 and 50-lb. kegs	**13 50**	**15 00**	12 50	14 00	**13 50**	12 50
12½-lb. keg	**13 75**	**15 25**	12 75	14 25	**13 75**	12 75
5-lb. cans	**16 25**	**17 75**	15 25	16 75	**16 25**	15 25
1-lb. cans	**18 25**	**19 75**	17 25	18 75	**18 25**	17.25

LUMBER

Prices wholesale, per M ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6, 8 and 12 Ft.	10, 16, 18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$30 00	$33 00	$33 00	$35 00
3x6 and 8	30 00	33 00	33 00	36 00
4x4-6 and 8	30 00	33 00	34 00	37 00
3x10 and 12	30 00	35 00	34 00	38 00
3x14	34 00	35 00	36 00	38 00
4x10 and 12	30 00	33 00	34 00	37 00
4x14	34 00	35 00	36 00	38 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$32 00	$35 00	$37 00
6x14	34 00	37 00	39 00
8x10	32 00	35 00	37 00
8x14	34 00	37.00	39 00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine

	New York*		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x 4 to 8x8	$47 00	$48 00	**$46 00**	**$48 00**
3x10 to 10x10	50 00	51 00	**49 00**	**51 00**
3x12 to 12x12	54 00	55 00	**52 00**	**54 00**
3x14 to 14x14	60 00	61 00	**57 00**	**59 00**
3x16 to 16x16	67 00	68 00	**61 00**	**63 00**
3x18 to 18x18	80 00	81 00	**68 00**	**70 00**
4x20 to 20x20	90.00	91 00	**78 00**	**80 00**

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 16 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$55.00	$100 00		$55.00	$65.00	$110 00
Seattle		*22 00*		..	....	*23.50*
New Orleans	30.00		.	...	35 00	.
Baltimore	58 00	...	...	.	70 00	.....
Cincinnati	**44 00**	48 50	$48 50	...	**57 50**	50 50
Montreal	50.00	50 00	**40 00**	38 00	78 00	50.00
Los Angeles	.....			....	.....	
Denver	.....	**39 75**	38 75	38 75		39 75
Minneapolis	47 00	**40 75**	*41 00*	.....	50 00	**40 75**
Atlanta	*[illegible]*	...	. .	. .	*36 00*	..
Dallas	45 00	.	....	....	**48 00**	
Kansas City	*38.75*	47 00	47.00	49 50	**52 75**	
Birmingham	**32 00**			...	**40 00**	.
Philadelphia	**44 00**	38.00	*[illegible]*	*44 00*	**55 00**	*38 00*
Detroit	44 75	46 75			53.75	46.75
St. Louis	44 00				51 00	

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$45 00	....	$45 00	$50 00	
Seattle	.	*$1[illegible]*		.	*$1[illegible]*
New Orleans, at mill	70.00	.....	.....	37 00	.....
Baltimore	40 00	.....	.....	40 00	
Cincinnati	*[illegible]*	[illegible]	68 25	*[illegible]*	78 25
Montreal	66 00	45 00	27 00	45 00	45 00
Los Angeles	.....	.....		...	
Denver	.....	30 25	30 25	.....	33.25
Minneapolis	48 50	**39 25**	38 00	43 75	**38 25**
Atlanta	*18 50*	.....	.....	28.00	.
Dallas	**45 00**	36 00	.	48 60	. .
Kansas City	**77 00**	[illegible]	[illegible]	**74 00**	40 00
Birmingham	**28 00**		. .	30 00	. .
Philadelphia	**34 00**	**40 00**	*40.00*	**44 00**	38.00
Detroit	**48 25**	39 50		45 00	[illegible]
St. Louis	**76 00**	....	.....	50 00	

Montreal—Up to 32 ft.; over which, $3.00 per M. ft. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $1 50 additional per M. ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractors on large projects.

St. Louis—Wholesale price to contractors, $7@$11 per M. ft. additional

Seattle—Price to contractors, delivered

Dallas—Wholesale to contractors, $10 per M. ft. additional

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.

Baltimore	$0.315	Detroit	$0.295
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.50†
Cincinnati	.295	Philadelphia	.325
Cleveland	.215	St. Louis	.43
Denver	1.275*	St. Paul	.595

*Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2 50	$2.50	$1 80@1.90

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	25%
Patent flattened strand, special and cast steel	25%
Patent flattened strand, iron rope	10%
Plow steel round strand rope	40%
Special steel round strand rope	35%
Cast steel round strand rope	27½%
Round strand iron and iron tiller	10%
Galvanized steel rigging and guy rope	12½%
Galvanized iron rigging and guy rope	+7½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¾-in., 8 ft., ⅞-in., 6; 1-in., 4½; 1-in., 3⅓; 1⅛-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0 17	New Orleans	$0.17½
New York	.17	Los Angeles	.
Chicago	*.18*	Seattle	.18
Minneapolis	*.18½*	St. Louis	*.16½*
San Francisco	.16	Montreal	.30
Atlanta	.20	Detroit	.19
Denver	.20	Baltimore	.17
Cincinnati	.19	Kansas City	.19½
Dallas	.22	Birmingham	.20½
Philadelphia	.18¼		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	**$0.27**	**$0.30**
Boston	.22	.24
Kansas City	*.2125*	*.2325*
Seattle	.165	.195
Chicago	*.22*	*.25*
Minneapolis	.189	.2094
St. Louis	.22	**.25**
Denver	.2025	.2325
Dallas	*.23*	*.25*
Los Angeles	. .	.....
Atlanta	*.23*	*.26*
Baltimore	.195	.225
Cincinnati	*.215*	*.245*
Montreal	.195	.235
Birmingham, *delivered*	**.20**	**22**
New Orleans	.235	.265
San Francisco	*.1625*	*.1925*
Philadelphia	.2475	.28

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$14 50	$11 50	*$1[illegible]*
Stove plate	13 50	12 00	*[illegible]*
No. 1 machinery cast	18 00	16 50	*17 [illegible]*
Machine shop turnings	9 00	4.00	*9 00*
Cast borings	12.00	5.50	10 50
Railroad malleable cast	15 00	12.50	*17 00*
Re-rolling rails	16 00	13.00	*16.50*
Relaying rails	28.50	30.00	25@30

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
[illegible]	$6 75	$5 50	$8 [illegible]
[illegible]	6 30	5 05	7 [illegible]
[illegible]	6 15	4.90	7.70

Pittsburgh base in lots of 200 kegs or more $3 50.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—James H. McGraw, President

Engineering News-Record

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 89 NEW YORK, DECEMBER 14, 1922 Number 24

As to Highway Location

SO MANY of our readers have been moved to comment on the subject of locating skill in highway engineering, raised by R. S. Blinn in *Engineering News-Record* of Nov. 9 and discussed editorially in the same issue, that we will publish in the highway issue of Jan. 11 a selection of extracts from letters that have been received or that may be received in time for publication.

Professional Ideals

IT HAS often been said that the ideals which actuate some engineering societies depart from the strictly professional viewpoint and have a commercial flavor. Such viewpoints are difficult of definition; departures from them are measured largely by individual opinion. Examples, though, enable one to illustrate the difference between the professional and the commercial attitudes. Last week at the annual meeting of the American Society of Mechanical Engineers one of the sessions was broadcast by radio. The object was laudable. The session was devoted to a discussion of human relationships in industry, about which sound thought deserves a wide hearing. In introducing *each* speaker, the chairman announced that the speech was being broadcast by the courtesy of the Radio Corporation of America and the Westinghouse Electric and Manufacturing Co. The repetition became monotonous and ludicrous—as the laughter of the audience proved. An announcement at the opening of the session regarding the broadcasting arrangements was, of course, called for. It is to the repetition, featuring the commercial elements involved, that the professional spirit objects. Possibly the broadcasting privilege could not have been bought in any other way. We are inclined to believe, however, that a society with stringent professional ideals would have considered the price too high. Some will argue that the resulting benefit to the public and the advertising of the American Society of Mechanical Engineers justified the means. With that viewpoint we cannot agree. We believe, too, that the number of engineers is still large who feel that such injection of a commercial flavor does not comport with the ideals which should dominate a professional society.

The Coming Road Convention

EVIDENCE is available on every hand indicating that the forthcoming convention of the American Road Builders Association and the Good Roads Show in Chicago, Jan. 16-19, will be an event without precedent in the history of American highway development. Never before has interest been so keen and so widespread. A technical program has been planned with extreme care to cover the major topics of road construction, maintenance, design, finance, economics, and traffic, and the leading men in the field have been secured to contribute papers and participate in the discussion. As for the exhibit of road-building equipment and materials, it is sufficient to say that the space available for the display of these products was oversubscribed twice by prospective exhibitors. The prediction can be confidently made that this year's convention and show will measure up in size and quality to the great industry it represents. More than that could not be desired. This prediction is reflected clearly in the twenty-three page announcements of the Chicago meeting which appears in the advertising pages of this issue; the space for it was donated by manufacturers as part of a comprehensive, forceful plan to arouse the entire industry to the opportunities offered by the forthcoming meeting. This twenty-three page advertisement is expressive of the spirit in which the committee responsible for the convention and show are working.

Mutual Benefits from Winter Buying

REASONAL fluctuation in activity is grouped with inefficient methods and transportation difficulties to form the eternal triangle of the construction industry. In one field—that of cast-iron pipe—a discussion has been in progress in these pages for several weeks past dealing with the feasibility of spreading purchases throughout the twelve months of the year instead of concentrating them during the summer. Last week, the discussion was concluded by Thomas F. Wolfe, official spokesman for the pipe manufacturers. His rebuttal carries a significant message to water department officials and other users of pipe. The one point of common interest in the matter of winter buying is price. Mr. Wolfe points out that "the manufacturers realize that if winter buying is to be encouraged, the buyer must profit." If purchasers would co-operate with producers by placing orders, where possible, during the cold months, substantial economies in production costs could be realized and these savings, according to Mr. Wolfe's definite statement, will be passed on by manufactureres to purchasers in the form of reduced prices. The pipe buyer, however, is human. He wants something more definite than the assurance that he will share in the production savings effected by winter purchases. He has been paying a certain price for pipe bought largely during the summer. Assuming that through some central agency, it were possible to prepare an approximate estimate of the aggregate tonnage of orders that might be placed this winter, what reduction in price below present levels can be expected? To be convincing and to serve as the basis of nationwide action by the buyers of pipe the manufacturers must be in a position to supply something fairly specific as to the actual amount of price reductions in the event of orders for certain definite tonnages. This being assured, the pipe users, through the technical societies interested, could well go ahead on a constructive program looking toward winter buying of pipe.

An Industrial Message to Congress

STRIKING testimony to the fact that our national problems are mainly industrial problems will be found in President Harding's message to Congress. Of some eight or nine major topics he selected as of outstanding importance all but two or three deal with primarily industrial problems and several are affected with a decidedly technical interest. They include the proposal to consolidate the railroads into a limited number of systems, the pooling of equipment and terminal facilities; changes in the powers and scope of the Interstate Commerce Commission that would enable it to take over the functions of the present Railroad Labor Board, the regulation of immigration, child labor, restriction of the issue of tax-exempt securities by communities, and the so-called superpower program for the eastern industrial region.

The Railroads

As to the railroad situation in general, the President defines problems and indicates possible solutions, but he lays down no definite proposals. He presents as "suggested ways of economy and efficiency" the merger of lines into systems, the pooling of freight cars, and the consolidation of terminal facilities. He thinks well also of a central agency under the control of the railroads to provide means of financing equipment for carriers unable otherwise to provide their share.

The merger of lines into systems, which may well be the key to the rest of his suggestions, is now under discussion by the Interstate Commerce Commission and the carriers. Developments so far point to the improbability of any such step being taken voluntarily by the roads on the basis of the tentative groupings laid down by the commission. The roads are willing to consolidate providing they can pick their own partners. Such a procedure almost certainly would result in no provision for the weaker roads whose plight had much to do with the origin of the merger proposal. Grave doubts prevail as to the constitutionality of the compulsory consolidation that has been suggested, but there remains always the possibility of adjustment under government sponsorship of the differences that now stand in the way of mergers held to be desirable in the public interest.

The President regrets that when the freight rates were reduced last summer he was unable to prevail upon the railroad managers to accept a rational readjustment geared to our economic needs, rather than the horizontal reduction which dissipated on unessential commodities savings that might have been of material help had they been concentrated on the heavy tonnage of the basic industries. As was expressed at the time of the decision, *Engineering News-Record* shares that regret.

Railroad Labor

In urging that decisions of the railroad labor tribunal shall be enforceable, President Harding points out clearly the distinction between private employment and employment affected with so pronounced a public interest as that on the railroads. "No man," says the President, "can be denied his right to labor when and how he chooses, or cease to labor when he so elects, but, since the government assumes to safeguard his interests while employed in an essential public service, the security of society itself demands that his retirement from the service shall not be so timed and related as to effect the destruction of that service." The President is on solid ground in this stand, and there is reason to hope that by this time both medieval railroad executives and predatory labor leaders have come to understand that the day of the "private fight" is over. Surely they must have learned how meager is the net return to either from the waging of industrial warfare. It is hoped that Congress will absorb a measure of the President's courage and enact this principle into law.

Tax-Exempt Securities

In returning to his proposal for a constitutional amendment that would permit restriction of the issuance of tax-exempt securities by governmental units, the President dwells not so much upon the diversion of taxes from the federal treasury as upon the encouragement of unproductive and extravagant public expenditure. Although we are fully mindful of the contribution of some of these state and municipal expenditures toward maintaining activity in the construction industry, we share the President's concern. The prosperity of our people depends primarily upon the normal functioning of productive industry, which is the creator of public and private wealth. Government in itself is not a productive activity. It is, or should be, rather the servant of the community, including productive industry. In the well-ordered community, therefore, government seeks to promote every lawful productive enterprise, whereas the effect of the tax-exempt security has been to dry up the sources from which industry derives its life-blood. No enduring prosperity for the construction industry or for any one else will result from the dissipation of capital in unproductive public improvements while it is needed for the conduct and expansion of productive industry.

The Highways

Competition between the highways and the railways, the President seems to think, exists on an important scale, for he devoted a number of paragraphs to an emphatic statement that subsidized motor carriage should not be permitted to take profitable traffic from the railways.

The President, we fear, has been lending his ear to the old type of railroad manager who seeks his salvation in the throttling of competition rather than in improvement of his own service. It is true that the motor truck has taken business from the railroads but the President does not seem to appreciate that this traffic is largely short-haul less-than-carload business, unprofitable to the railroads. True, there is some competition for business that the railroads would like to have, but the extent of it is not yet sufficiently known to draw intelligent conclusions.

Moreover, experience with motor haulage in competition with the railways does not support, if the interpretation be reasonable, the President's contention that motor haulage would be wasteful if burdened with "its proper and proportionate share of highway construction." We presume that he means not "construction" alone but all highway charges. No motor vehicle advocate that we know of protests against the raising through vehicle taxes of the entire costs of maintenance and reconstruction; first construction is properly

chargeable to general taxes.. In fact, if all of the revenue now collected upon motor vehicles were assigned to road funds, it would aggregate one-half of the total annual expenditure for highway work. The federal excise and other personal property taxes on motor vehicles, however, go into the general treasuries. True, motor vehicle transport bills are higher than railroad freight bills, as the President intimates, but in his easy generalization, he fails to take cognizance of the transfer charges at both ends of rail haul and to place any valuation upon the saving in delivery time.

Of course, it would be too much to expect that in four paragraphs the President could take cognizance of all the factors entering into the relationship of highway and rail transport. But four paragraphs is plenty long enough to permit the enunciation of unsound doctrine—and of that opportunity the President has taken advantage. We think the Congress would proceed detrimentally to the public interest by incorporating in its highway legislation any provisions based on the President's generalizations. Unintelligent curbing of a new agency of public service will prevent it from finding its proper place in the economic system.

The Engineer's Industrial Opportunity

IN HIS valedictory as president of the American Society of Mechanical Engineers, Dean Kimball presented an exceptionally sane and helpful estimate of the engineer's opportunity in the industrial world. One of his ideas embodies in considerable measure the essence of that opportunity. He referred to the new industrial day in which industry is coming more and more to be viewed as humanity in the act of earning a living rather than as a mechanism set up primarily for the production of profits. This conception of business enterprise is, of course, not new. The development that has prompted Dean Kimball's reference to it at this particular juncture is the growing conviction on the part of the general public that this is the proper conception and the only conception for which public opinion should be sponsor. Its special significance to the engineer is that, quite aside from his technical relation to industry, he is in position to help materially in spreading throughout business generally a faith in this fundamental doctrine.

As has been said, the idea of service before profits is not new or revolutionary. For a long time it has dominated the business policies of the shrewdest and most farsighted of our industrial and commercial leaders. It is not a conception of idealism; neither is it *wholly* a counsel of altruism. Rather is it the expression of enlightened self-interest as opposed to blind selfishness. Operating under the complex competitive conditions of modern community life; serving a public of rising standards, of increasing discrimination and of more insistent determination to have what it wants, he prospers most who serves most faithfully. Every business, of course, must render some service if it is to survive, but one will do this grudgingly, its eyes fixed on profits, while another will earn its profits incidentally, its eyes fixed on the service it seeks to render. The first type has had its day and it is nearly spent. The new day will have need and sufferance for the second only. Now this attitude toward an occupation partakes in its essence of the professional, and if the industrial world is to realize the new ideals it has set up for itself most quickly and with minimum disturbance, the professional idea of "service first, then profits" must be sold to American industry just as soon and as universally as is possible.

Provided the engineer can make good the deficiencies mentioned by Dean Kimball there is no reason why he should not be the ideal salesman for this task. He is imbued with the professional instinct, yet he is so close to the administrative problems of industry that he should be able to speak and understand the language of the business man. His analytical skill is equal to that of the lawyer or the economist, yet he is dominated by the constructive instinct as is neither of these. His viewpoint is that of a conservative, respecting that which has proved its worth; tempered, however, by the spirit of the pioneer, ever seeking to adapt to the service of the community the newest of scientific discovery. In every respect the engineer is qualified to undertake the mission of spreading the professional spirit in industry—provided that he will perfect his understanding of economic principles and develop his sympathy with human problems.

Even with the best of intentions, not every engineer will be able to measure up to these requirements. But as Dean Kimball points out, the new day is opening up broader opportunities to those of the profession who are equipped to undertake this task; and if they are to be ready when they are wanted the time to prepare is now.

Sewage-Works Progress at Chicago

THE magnitude and variety of the sewage-works program of the Chicago Sanitary District and its significance to sewage-works engineers and to cities throughout the country is not generally recognized. The seven major projects, so far as yet planned, include activated-sludge plants equipped with a variety of dewatering devices that will provide valuable working-scale data. These data, like so many already gathered by the engineers and chemists of the Sanitary District, promise to be widely useful. Besides Dorr thickeners for use in the settling tanks, following activation, there are in use or will be used on the sludge, at one plant or another, an Oliver vacuum sludge filter, a Berrigan platen press and a Besco-ter-Meer centrifuge for the preliminary, and an Atlas drier for the final, dewatering stage. Both Imhoff tanks and fine screens of the Riensch-Wurl type will throw light on preliminary treatment to lighten the burden on the activated-sludge process.

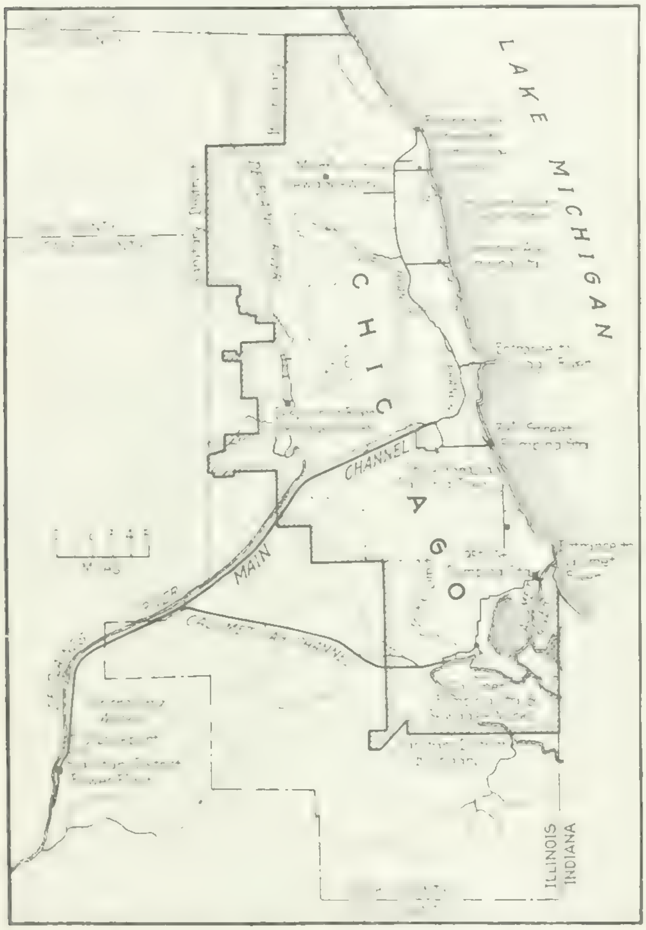
Some of the plants will deal with such troublesome industrial wastes as those from the stockyards and packingtown, from tanneries and from corn product's manufacturing operations. Parts of the program look ahead to a possible large central sludge dewatering plant for the recovery of fertilizing values, and the pumping of sludge from perhaps two or more activated-sludge plants through long pipe lines to the dewatering plant. Besides all this, the various pumping plants include some unique electric-driven pumps that cannot fail to be interesting and suggestive to many engineers, now that sewage pumping is becoming relatively common and electric motive power gaining in favor. From all this it appears that the dozen years to come, like those just past, will see much of interest and value to sewage-works engineers coming from the engineering offices, laboratories, testing plants and sewage-works of the Sanitary District of Chicago.

Sewage-Treatment Progress in Chicago Sanitary District

Program Includes Seven Major Projects — Changes Since Earlier Articles, Sludge-Handling Equipment and Early Operating Experiences Described

By Langdon Pearse
Sanitary Engineer, Sanitary District of Chicago

TWO new large sewage-works have recently been put into service by the Sanitary District of Chicago. A third has been in operation for several years. Each one of these stations is supplied by electrically-driven pumping stations of novel design. In addition a fourth sewage pumping station is operated by float switches with a minimum of attendants. One of the large pump-



CHICAGO SANITARY DISTRICT BOUNDARY AND WORKS

[illegible] parts of 49 other minor civil divisions in Cook County. [illegible] and adjacent territory from Lake Michigan to the Mississippi drainage system. Under the original plan, all the sewage of the district was disposed of by dilution but due to government limits set on the amount of water diverted from the lake and to other causes a treatment program is being carried out. The main and branch channels, pumping stations, existing sewage-works and some of the projected sewage-works are shown on the map.

ing stations and a future station are to be supplied by emergency power from generators driven by Diesel engines. In the smaller pumping stations the pumps handle the sewage without the use of screens. The engineering details of the Calumet, Evanston and Des Plaines pumping stations, together with the general details of the Des Plaines activated-sludge plant and the Calumet treatment works were described in the *Engineering News-Record* as noted in detail later on.

SEWAGE-WORKS OF THE SANITARY DISTRICT OF CHICAGO

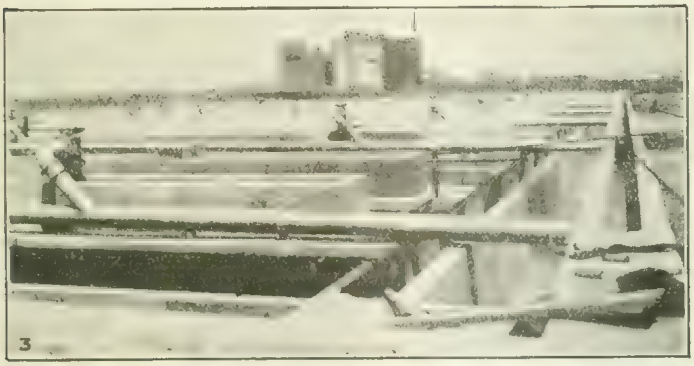
[illegible]	Population Served 1922	1930	[illegible]	[illegible]
Morton Grove	1,127		Dec. 9, 1914	[illegible]
Des Plaines River	40,000		Apr. 1, 1922	[illegible]
Calumet	150,000	225,000	Sept. 22, 1922	[illegible] tank
[illegible]		868	[illegible]	
North Side	......	800,000	Plans under [illegible]	Activated sludge
West Side.......	......	1,430,000	Future	Activated sludge
Southwest.......	......	1,230,000	Distant future	

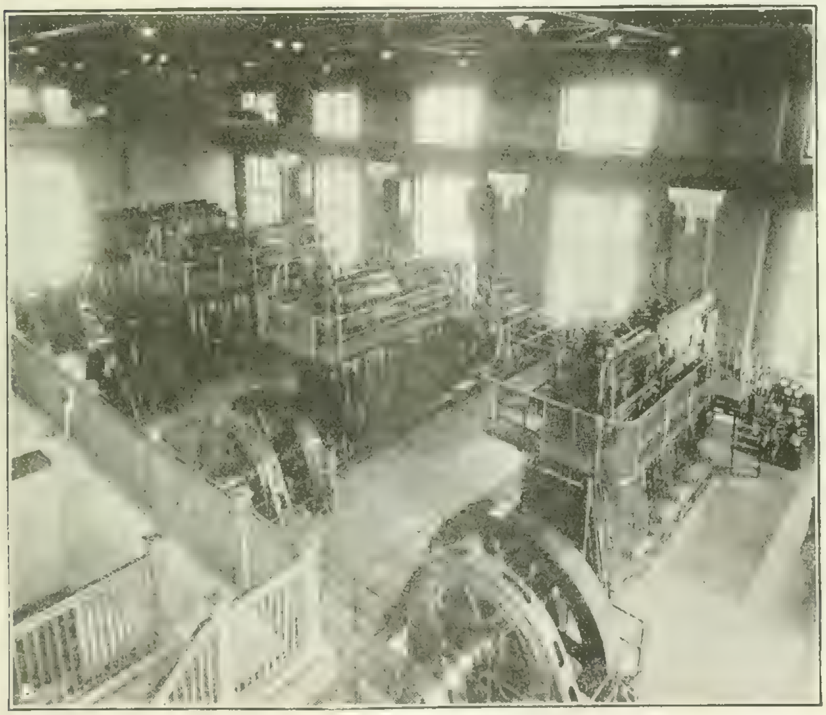
* [illegible] sprinkling filter 0.74 [illegible] activated sludge [illegible] 1.75 [illegible]

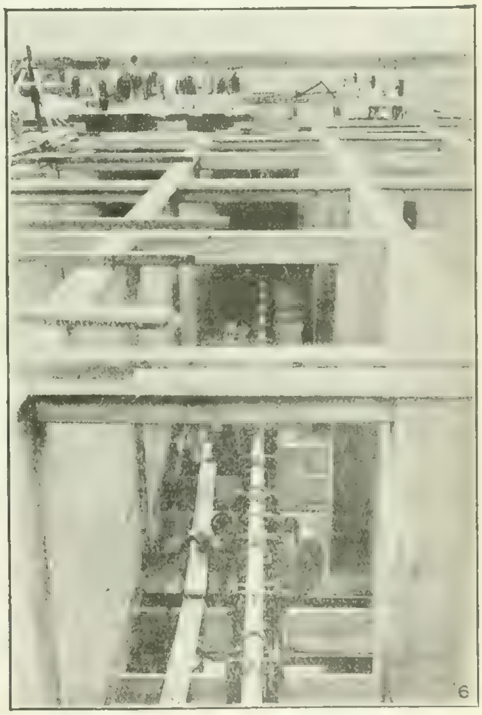
All of these plants are now in operation. It is the purpose of this article to bring information regarding these plants to date with illustrations, noting changes made and such results as have been obtained.

In the sewage-treatment program since 1909, two distinct lines of investigation have been followed, one on domestic sewage, the other on industrial wastes. The importance of the industrial load has been shown by gagings and tests of late years which indicate that the industrial wastes from Packingtown and the corn products and tanning plants are equivalent to wastes from more than 1,500,000 people. The domestic sewage was studied from October, 1909, to January, 1915, in a testing station at the 39th St. pumping plant (see *Engineering News*, March 31, 1910, p. 367). The results have not been published. A testing station operated on the mixed wastes from Packingtown from September, 1912, to September, 1918, indicated that screening followed by the activated-sludge process was the most practicable method of treatment. On the tanning industry wastes, tests have been run on the effluents from a large chrome tannery from December, 1919, to December, 1922. This station will be shut down before the end of 1922. On the corn products industry wastes, tests have been run in co-operation with the Corn Products Refining Company, at Argo, from April, 1921, which will probably be continued until the summer of 1923. Both the Des Plaines River and Calumet sewage-works include experimental features on a considerable scale to aid in planning the larger work ahead.

As the engineering studies developed, the division of the Sanitary District into seven major projects became evident. These are the Calumet, handling the sewage south of 87th St.; North Side, from the north line of the Sanitary District to Fullerton Ave., in the city of Chicago; West Side, Fullerton Ave. south to the Main Channel and west to Harlem Ave.; Southwest, from the Main Channel south to 87th St.; Packingtown, handling locally the industrial wastes from the packinghouses and stockyards in that locality; Corn Products, handling locally the wastes from the Argo factory; and the Des Plaines River works, dealing with the sewage from a group of seven villages on the Des Plaines River north of Riverside. In addition to these major







CALUMET SEWAGE-WORKS AND PUMPING STATION FOR THE SANITARY DISTRICT OF CHICAGO

(1) General view of pumping station. (2) Interior of pumping station. On left 75 sec.-ft. units, vacuum pumps and switchboard. On right 275 sec.-ft. units. (3) Imhoff tanks showing air-lift and sludge piping. Effluent channel at left. (4) Sludge-drying beds. (5) Activated-sludge unit showing piping and ridge-and-valley bottom built inside of Imhoff tank walls. (6) Four 750-hp. stand-by Diesel engines direct-connected to 625-kva. generators. Switchboard on the left.

projects isolated plants have been considered, from time to time, for outlying villages where intercepting sewers would be too expensive at present, plants for single communities or for two or more towns. So far only one small plant has been built, namely for Morton Grove. The intercepting sewer systems and pumping stations have been planned to feed the works suggested.

Calumet Pumping Station—The Calumet pumping station has been in operation since Aug. 1. The changes from the previous description (*Engineering News-Record,* Nov. 4, 1920, p. 872) have been in the rack cleaners, in that the motor runs continuously in one direction, the speed being reduced by gearing and a mechanical reversing device provided for the reversing of the rakes. The pumps prime and work successfully, but have not as yet been closely tested. The final tests

DES PLAINES RIVER ACTIVATED-SLUDGE PLANT
Screen house, blower and pump house at rear. Aerating tanks in middle distance, with pipe gallery next and settling tanks at front.

will involve measuring the discharge through a weir chamber built in the outfall sewer for the purpose.

In the building adjoining the pumping station, connected by an underground passage, are located four 625-kva. Diesel-engine-driven generators. The generators, flywheel and 16-kw. 125-volt exciter are mounted on an extension shaft which is coupled to the engine crankshaft just within the engine frame. This shafting is supported by the engine end bearing and an outboard bearing located between the generator and the exciter. The engines are of 750 brake-horsepower —operated at 180 r.p.m.—of the vertical two-stroke cycle, single acting, crosshead type. Fuel oil is supplied from four 10,000-gal. concrete storage tanks located underground between the two buildings. Raw water taken from the storm-water relief conduit leading to the Calumet River is used for condensing purposes. On tests the engines operated with a fuel consumption less than the following guarantees per horsepower-hour: Full load, 0.47 lb., three-quarter load, 0.49 lb. and one-half load, 0.53 lb. The purpose of this power plant is to furnish standby service in case of a breakdown of the transmission line from the hydro-electric power plant of the district at Lockport, not only to the Calumet station but also to the 95th St. pumping station 7 miles away.

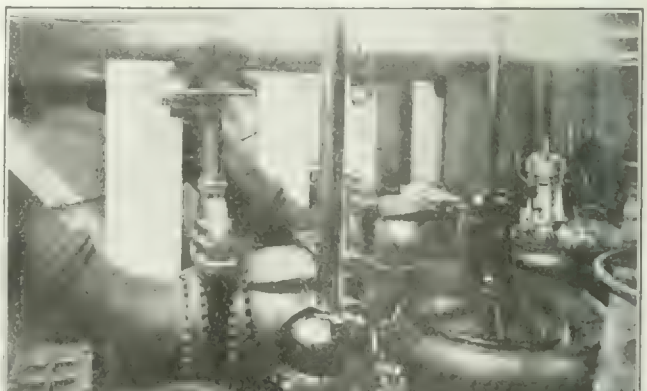
Calumet Works—The Calumet sewage-works, which went into operation Sept. 11, have been built substantially as described in *Engineering News-Record* of June 9, 1921, p. 986. They include Imhoff tanks (convertible into aeration tanks) with sludge-drying beds; two activated-sludge units, with Dorr thickeners in the settling tanks; a sprinkling filter unit with dosing tanks and secondary settling basins. One activated-sludge unit and the sprinkling filter treat settled sewage. The present population tributary to these works is about 150,000.

Since the date of the previous article, just mentioned, bar screens inclined at 45 deg., with 1-in. clear openings, and grit chambers with five passages, have been provided. They are to be equipped with a gantry crane spanning the chambers to hoist buckets containing the grit. In a building housing the pumps and blowers are located electrically-driven pumps which discharge through a Venturi-meter rate controller which can be set automatically to deliver a given amount of settled sewage to the sprinkling filter unit. In addition there will be installed four blowers of the hydro-turbine type to operate against a pressure of 8 lb. per square inch. Two of the blowers will have a capacity of 2,500 cu.ft. per minute each, one of 1,000 and one of 450 cu.ft. per minute. These blowers will be electrically driven by silent chains.

For handling the sludge from the activated-sludge units an Oliver vacuum type sludge filter is to be installed with a cylinder $11\frac{1}{2}$ ft. in diameter by 14-ft. width of face and approximately 495 sq.ft. of filter surface. A centrifuge of the Besco-ter-meer type may also be installed in the same house, together with a 4 x 30-ft. Atlas dryer having a guaranteed evaporation capacity of 2,000 lb. per hour. The intention is to try the centrifuge in the winter on Imhoff sludge as well as on activated sludge to determine its capacity and relative economy as compared with drying the sludge on beds and its subsequent removal by hand.

An administration building is also provided, housing the laboratory, office and store room, together with the Venturi meter in the basement. The sewage flow now averages about 30 sec.-ft., fluctuating between 27 and 37 in dry weather. At the present time one-half the plant is in operation. The other half will be put in operation as soon as the dry-flow sewage from the 95th St. pumping station area can be turned in through an emergency pump.

Des Plaines River Works—After many vicissitudes the Des Plaines River sewage-works went into operation on Aug. 1. The works proper were built substantially as described in *Engineering News-Record* Dec. 9, 1920, p. 1134. This is an activated-sludge plant, with coarse rack screens, a grit chamber, a Riensch-Wurl screen. Some of the settling tanks are fitted with Dorr thickeners. In addition, a press-and-dry house has been provided, including a Simplex plate press with center feed, containing 120 plates each 36 in.



VERTICAL-SHAFT CENTRIFUGAL UNITS OF THRASH-PUMP TYPE, DES PLAINES PLANT

square, chambered to make a 1-in. cake; a Berrigan platen press containing 18 bags working between leaves 6 ft. wide and 8 ft. deep and a centrifuge of the Besco-ter-meer type, not yet erected. The sludge cake will be lifted to the second floor in specially designed buckets. In the basement of the press-and-dry house are arranged two pneumatic ejectors, a centrifugal pump and a stuff pump electrically-driven, each of which may be used to feed sludge to the presses or to the centrifuge. The purpose is to determine whether or not there is any different behavior of the sludge after being handled by such pumps. In the press-and-dry house there is also installed a 4 x 30-ft. Atlas dryer, together

with a screen and a bucket elevator to raise the dried sludge from the first to the second floor. The dryer is fired by an automatic stoker. The sludge is fed to the dryer on the second floor. The apparatus is designed to take wet press cake and mix it with a given amount of dried material so that the material entering the dryer can be maintained at any given degree of moisture. The dryer went into operation early in October. Storage is provided on the second floor of the press-and-dry house for press cake, and also for a limited amount of dried material. It is proposed to operate the dryer continuously for two or three days each week to determine its capacity and behavior and to run the sludge presses as continuously as possible. Arrangements are provided for acidifying and heating the raw sludge.

The dry flow of sewage has varied from 3 to 3½ m.g.d. During storms more than 10 m.g.d. have passed through the fine screen, of which 4 m.g.d. were handled in the plant. The suspended matter in the raw sewage when the plant was first started averaged 200 p.p.m. Following an exceptionally heavy storm, which flushed out the flat sewers tributary, the suspended matter ran as high as 2,000 p.p.m. for a day. The screenings on the $\frac{1}{16}$ x 2-in. slots of the 14-ft. diameter Riensch-Wurl screen have averaged 200 lb. per day, wet, but following the storm more than 2,000 lb. were removed in one day. Occasional applications of kerosene have been found necessary to keep the slots free from grease. So far little grit has been obtained.

In the aeration tanks the sludge built up more rapidly than could be cared for, so that over 40 per cent of sludge was accumulated before pressing began. Consequently a higher rate of air has been used than will probably be necessary later on. From 1½ to 2 cu.ft. of air per gallon of sewage have been used. The filtros plates have given an even distribution. The settling basins of the hopper-bottom type with slopes 2 vertical to 1 horizontal have shown need of some scraping. It is evident that the 2 on 1 slope is not quite steep enough on a large working scale to permit the sludge to slide rapidly to the bottom. The Dorr thickeners have worked well so far. The air lifts are being adjusted.

In the sludge handling the intention is to run the presses as continuously as possible and to make sludge cake. From time to time runs will be made with the dryer and enough sludge accumulated and bagged to supply experiment station work during the coming year. The nitrogen content of the sludge, as shown by one or two analyses, started low, averaging 2½ per cent on a dry basis. This low fertilizer value is probably due to the clay discharged by the flushing of the sewers during storms. It is now more than 3½ per cent.

Although the sewage reaching the plant was at the start very stale and devoid of dissolved oxygen, the plant has been remarkably free from odors.

Morton Grove Works—The Morton Grove plant discharges the effluent into the North Branch of the Chicago River. The plant is located directly across the street from a busy roadhouse, so that an unusual endeavor was made to design a system which would be free from odor. The Imhoff tanks and sludge beds were built in 1917. In 1920 there were added two covered sprinkling filter beds, each 36 x 36 ft. in plan, filled with 1½- to 2-in. crushed limestone to an average depth of 6.2 ft. The beds are dosed by float-operated centrifugal pumps discharging through a system of pipes which distribute the sewage over the surface of the beds through nozzles and splash plates. Overhead distribution was adopted so that in case the pumps stopped in cold weather the pipe system would drain automatically. Two centrifugal pumps are housed alongside the filter, each capable of delivering 125 gal. per minute when running at 1,200 r.p.m. They are float-operated with single-phase motors and automatic oiling. As the splashing of sewage from the nozzles penetrated the brick walls of the building, the inside face of the walls was plastered during this last summer to prevent further moisture travel, two coats of hard waterproofing plaster being used. The dry-weather sewage flow has been from 125 to 250 gal. per minute, according to the amount of ground water. Practically no trouble has been experienced from odors.

AERATION TANK AT DES PLAINES PLANT
Tank 15 ft. deep with ridge-and-valley bottom. Pipe gallery in background.

A plant very similar in design has been prepared for a population of 800 people at Glenview. A tank-and-sprinkling-filter plant has been chosen again on account of the lower cost of electric power for pumping as against the activated-sludge type with the combined cost of air compressing and pumping. The Glenview plant, however, will have an open sprinkling filter as the location is more remote from habitation. The sludge will be removed from the tanks by an airlift, instead of a centrifugal pump, as at Morton Grove.

Evanston Sewage Pumping Station—The Evanston sewage pumping station (*Engineering News-Record* Nov. 4, 1920, p. 872) has been in operation for more than two years. No changes have been made in it except to install an automatic oiling system on the pump steady bearings. Very little difficulty has been experienced with the operation of the trashpumps without screens. During the first few months of operation occasionally 2 x 4- and 2 x 6-in. sticks passed into the run-

ners and stopped the pumps, but they were readily removed. With the completion of the construction work on the tributary system, no further difficulty with timbers has been experienced. At infrequent intervals, however, some floating trash has to be removed from the suction chamber.

Tannery Testing Station—The tannery testing station is located alongside the Griess-Pfleger Tanning Co., in Chicago. This is a large chrome tannery with five sewer outlets. The testing station has been operated from the start with activated sludge, but different preparatory treatments have been tried. Included in the installation have been a fine screen, with holes 0.1 in. in diameter, a Dorr thickener, 19 ft. 10 in. in internal diameter by 7½ ft. deep, four activated-sludge aeration tanks, each 6 ft. wide by 23 ft. long by 11 ft. water depth on the filtration plates with a Dorr thickener for final clarification, 11½ ft. in diameter by 11.4 ft. deep. The various mixtures of tan, beam and soak liquors have been tested, as well as the need of thorough treatment preparatory to aeration. At first the aeration tanks were fed only during the working hours, but since last winter storage has provided a continuous flow. A sprinkling filter, 14 ft. square and 6½ ft. deep, has been operated on settled mixtures, together with cinder beds and sand beds. Great care has been required in operation to avoid caustic alkalinity, which injures the activated sludge. The activated-sludge process has been difficult to control, especially in cold weather. With continuous feeding a period of 12 to 15 hours and air in amount 2.5 to 3.5 cu.ft. per gallon has been used. In summer nitrates may run up to 30 p.p.m. The sprinkling filter has been dosed at a rate of 1 m.g.d. per acre, producing nitrates from 10 to 20 p.p.m. The cinder filter has worked at rates of 300,000 m.g.d. per acre and removes color. Nitrates have run from 20 to 30 p.p.m. All the devices have been supplied with a settled mixture of the three tannery wastes, the suspended matter being reduced from 1,000 to around 350 p.p.m. by the Dorr thickener.

MORTON GROVE SEWAGE-WORKS CHICAGO

Imhoff tank and sludge-drying beds at left. The building covers splash-plate sprinkling filters. Secondary settling tanks in foreground.

Corn Products Testing Station—The testing station at Argo is being operated jointly by the Corn Products Refining Co., J. J. Merrill, chief engineer, and the Sanitary District. Prof. Edward Bartow is consultant for the company. With the exception of a sprinkling filter 14 ft. square and 8 ft. deep, this station has been operated on activated sludge. At present the installation includes (1) two standard aeration tanks, each 6 ft. wide by 23 ft. long by 12 ft. deep, with a 12-ft. diameter Dorr thickener settling tank, which has been run on a 13-hour period with air from 4.5 to 5.0 cu.ft. per gallon; (2) a circulating tank 6 ft. wide by 23 ft. long by 12 ft. deep, with a settling tank 6 ft. square by 12 ft. deep, baffled like an Imhoff tank, which has run on a 13- to 15-hour period, with air from 3.5 to 3.8 cu.ft. per gallon; (3) two Manchester type tanks, each 8 ft. wide by 23 ft. long by 12 ft. deep, with a 12-ft. diameter, Dorr thickener settling tank, which has been run on a 13- to 15-hour period, with air from 3.4 to 3.5 cu.ft. per gallon. The Manchester type of bottom has shown a better effluent than the others, with less air per gallon. The ratio of filtros-plate area to total area has been 1 to 13, as against 1 to 11.5 in the circulating tank and 1 to 5.75 in the standard tank. Tests have been made on sludge pressing, using a plate press and also an American rotary vacuum filter. This work is still in progress. In the original installation two Dorr-Peck double-deck activated-sludge units were included. The results obtained were no better than the standard tank and at times not so good. The use of these tanks was abandoned last winter (see *Engineering News-Record,* Feb. 9, 1922, p. 251).

Future Works—At the present time the engineering staff has practically completed the plans for the new 95th St. pumping station of 750 sec.-ft. capacity in the Calumet district which will be tributary to the Calumet sewage-works. This pumping station will contain three 72-in. pumps and two 30-in. pumps and will be somewhat similar in general design to the Calumet station. It will be electrically driven from Lockport but in emergencies can be operated from the Calumet power plant.

Since the report was made by the engineering commission composed of Messrs. Eddy, Fuller and Hatton (see *Engineering News-Record,* Aug. 24, 1922, p. 324) work has been pushed actively on the design of the North Side treatment works with the result that the plans for the activated-sludge tanks are nearly completed. The details of the power plant, screens and the like have not as yet been completed. In accordance with the recommendation of the engineering commission, the sludge is to be pumped 18 miles to waste land owned by the district and lagooned. This site is in the vicinity of the proposed West Side plant. With the experience in hand of the Des Plaines River and the Calumet Works in handling sludge, the preparation of the sludge from the North Side and West Side will be approached later on.

Illinois River Survey—Twenty years after the opening of the Main Drainage Canal it seemed fitting that an extended investigation should be made of the condition of the flow from Chicago to the Mississippi River over a period of a year. This met the desire of the United States Public Health Service to obtain data to supplement the Ohio River and the Potomac River studies. The field work of a joint survey terminated on Sept 1, and the results are now being compiled. Bacteriological data show markedly the bacterial death rate from Chicago to Peoria and bear out thoroughly the judgment of the United States Supreme Court in the case of Missouri vs. Illinois to the effect that the sewage of Chicago would not affect materially the Mississippi River above the St. Louis water-works. From the data accumulated it is hoped to compile some re-aeration factors and to determine to what extent dilution and

re-aeration are responsible for the remarkable self-purification which goes on in the Illinois River.

The work described has been carried on under the general direction of H. P. Ramey, acting chief engineer of the Sanitary District of Chicago, who succeeded A. W. Dilling, chief engineer, upon his retirement in July. The work was begun under George M. Wisner and continued by E. J. Kelly, Mr. Dilling's predecessor. The engineering staff working on the developments include the writer, sanitary engineer; Julius R. Hall, principal assistant engineer; S. Moreell, Jr., structural engineer; L. C. Whittemore, assistant sanitary engineer; I. P. Kane and O. L. Eltinge, assistant engineers; H. I. Steffa, mechanical engineer; I. T. Roberts, electrical engineer; and F. W. Mohlman, chemist. A. B. Wood of New Orleans, La., has been the consulting engineer on the pump layouts. In the co-operative work the United States Public Health Service has been represented by Surgeon W. H. Frost in charge and J. K. Hoskins, sanitary engineer.

The Engineer and the Demand for Industrial Leaders

Dean Kimball, Retiring President of the A.S.M.E., Weighs Qualifications of Engineer for Industrial Management

By Dexter S. Kimball
Dean, College of Engineering, Cornell University

Extracts from address as retiring president, A.S.M.E., delivered at Annual Meeting, New York, Dec. 4, 1922.

The benefits that have accrued to all classes in modern civilization are beyond question and are more apparent when comparison is made either with older forms of civilization, or even with existing handicraft nations. The general level of physical comfort and education as seen in modern nations is unquestionably higher than has ever before been attained. Nevertheless, no single class of people is satisfied with its position in the nation, and there is a deep feeling of unrest and discontent among those workers who actually produce the comforts of life.

This charge that modern civilization is a failure or at least no improvement upon former civilizations, is or should be of peculiar interest to the engineer, using this term in its widest sense to include all industrial workers who use the scientific method. For modern civilization is largely what he has made it, and the civilization of the future will be largely what he wishes it to be. It is too much, of course, to claim that the engineer, unaided, can solve these difficult problems, but it is undoubtedly true that if he will direct his energies to the problem of the distribution of wealth as earnestly as he has devoted them to its production, he can make a contribution to industrial economics that will be exceedingly helpful. The engineer alone has a direct and personal knowledge of the industrial machine.

Furthermore, it should be noted that the efforts of the engineer are no longer confined to the design and actual production of commodities. The principles of mass production that have so greatly reduced the cost of commodities he has now quite fully developed. The wide application of the principles of mass production has been made possible by mass financing, the work of the financier. The engineer, in turn, is now developing the principles of mass management, and his contributions to the philosophy of management are already noteworthy. I believe most business men would be surprised to know to what a large extent the methods of the engineer have invaded their chosen field, and there can be little doubt but that the near future will see the engineering type of manager a predominant figure.

It will be freely conceded that the preparation of the engineer for these new duties is far from adequate, and two of his shortcomings stand out conspicuously. The first is his lack of knowledge of the economic principles of industry and commerce. This need in the equipment of the engineer is now fully recognized, and in a fair way to be remedied. All first-class engineering colleges now prescribe more or less economic study and students of engineering recognize this study as a necessary part of their mental equipment.

Another important weakness in the mental processes of the engineer is his lack of knowledge of human nature and, worse still, his lack of sympathy with human problems. He is by nature a constructive individualist and usually impatient to obtain results; and, as a consequence, impatient of any obstruction, human or physical, that stands in the way.

Over against these weaknesses must be placed certain inherent qualities that strengthen his claim to industrial leadership. He is, as a class, essentially honest. His entire training and professional experience are such as to demand honesty of thought and purpose in all of his transactions.

The engineer also often occupies a strategic position in industry which is of great importance in controversial matters. As the designer and planner of industrial enterprises he stands between capital and labor, and he is, not infrequently, better informed of the real difficulties at issue.

And last, but most important, the engineer has command of the scientific method of attacking problems. With this he has practically solved the problem of production and is now rapidly rebuilding the field of administration. Is it reasonable to suppose that he cannot make a great contribution to the problem of the distribution of wealth if he attacks this problem in the same wholehearted manner?

Need for New Leadership—Thinking men who know industry agree that we should have a new form of industrial leadership, but the source of this new leadership does not seem to be clear. And it should be noted that future industrial leadership will be closely associated with political leadership, so closely are the problems of industry linked with political administration. The first form of national leadership was the military type, the rule of the strong man. This extreme form of leadership still prevails in some countries. In modern democracies military rule has been succeeded by what may be termed legal government. Today our social, political and industrial activities are governed by a very comprehensive code of legal regulations that rest upon precedent and upon the opinions of eminent jurists sometimes affirmed and reaffirmed many times. The legal method and the legal mind, however, are for the most part backward looking in their processes.

There remain for consideration two other types of mind from which a new industrial leadership may come; namely, the business or financial type, and the scientific type. The business type of mind with the aid and counsel of the legal and engineering fraternities has built up modern industry as we now see it. There can be little doubt as to the ability of this type of mind to plan and direct the larger aspects of industry along existing lines. One weakness lies in its apparent inability to appreciate or rather to acknowledge that a new industrial day has dawned in which industry is being viewed more and more as the support of human life and not as a means of producing private, corporate, or state profits. Another weakness is its lack of technical knowledge of modern industry. As industry becomes more and more complex, the business man is compelled to depend more and more upon the engineer for advice and knowledge. It is this very phase of modern industry that is rapidly forcing the rôle of industrial manager upon the engineer.

No one would presume to say that the engineer alone can solve the industrial riddle, but it is clear that he can make a very great contribution to the solution. But it becomes increasingly clear that hope of a solution rests with the two groups just discussed. The National Department of Education has for some time been advocating strongly that engineering students be taught more of the fundamentals of business and that young men preparing for the field of business and commerce be instructed in some of the outstanding features of engineering. And it may be that we shall yet develop a combination of these two fields that will produce the new type of industrial leader.

Building the North Platte Branch; Union Pacific R. R.

Tracklaying Train Has Locomotive Crane to Place Rails—Small Station Layouts—Line Serves Irrigated District

AN IMPORTANT railway extension built in 1921-1922 is the North Platte branch of the Union Pacific R.R., which is a land development or settlement project, progress on which was interrupted by the World War. It is a continuation of a line, which, starting at O'Fallons, Neb., follows up the North Platte river 152 miles to Haig, Neb. This point was reached in 1914. The new 42-mile extension, running westward from the river, as shown in Fig. 1, was commenced in 1921 in order to provide railway transportation for a 50,000-acre district which had been put under irrigation by the U. S. Reclamation Service. For convenience of construction and accounting the line was divided into three sections; 14 miles west to the Nebraska-Wyoming state line, 15 miles west to Cherry Creek and then 13 miles north and eastward down the valley of that creek.

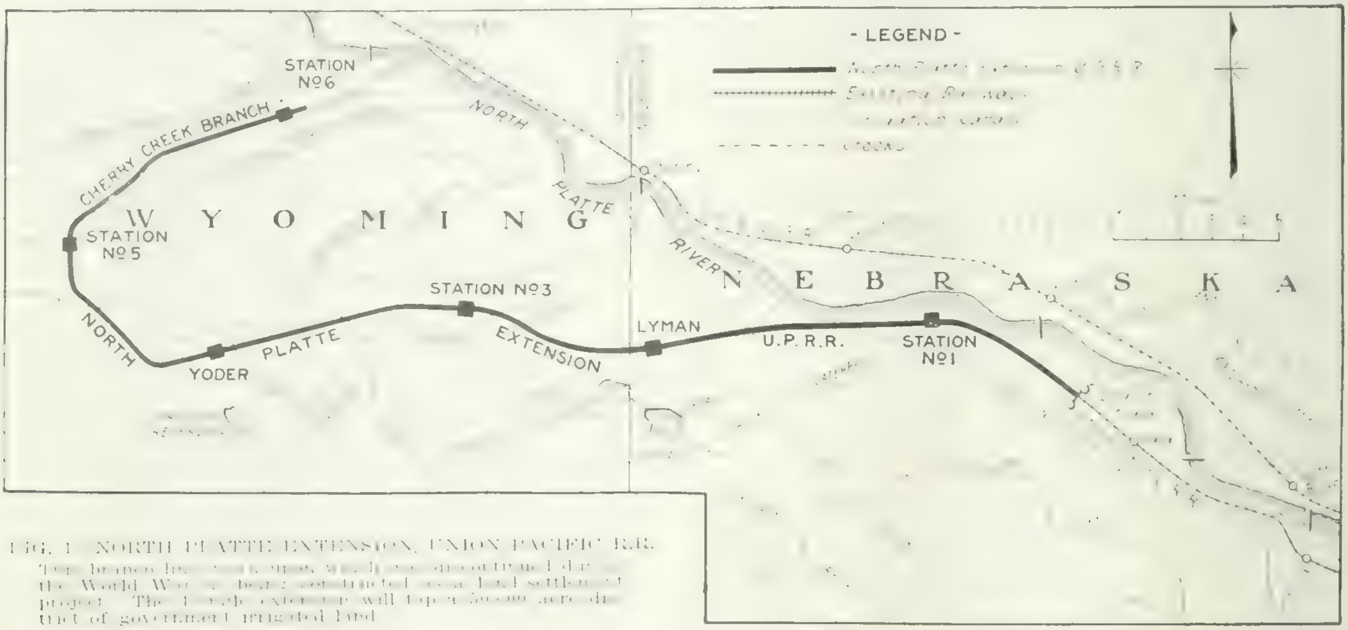


FIG. 1—NORTH PLATTE EXTENSION, UNION PACIFIC R.R.

Grading and Structures—The line is in the rolling prairie country of a semi-arid region and has maximum grades of 0.6 per cent in both directions. Its sharpest curves are of 3 deg. Elevations above sea level are 3,926 ft. at Haig; 4,250 ft. at Yoder, 27 miles farther on; and 4,155 ft. at Station No. 6 (the present end of the line). Earthwork averages 27,000 cu.yd. per mile and is largely clay and loam, but with some solid rock. Excavating machinery includes four steam shovels, six elevating graders and a number of fresno scrapers with teams. Material for fills is 47 per cent from cuts and 53 per cent from borrow pits. Temporary trestles for dump-car trains were used in making the heaviest fills, the haul being about ½-mile and the 4-yd. cars being dumped by hand. The remainder of the fills were built with dump wagons and scrapers.

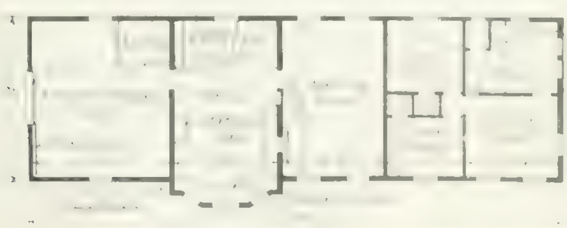


FIG. 2—COMBINED STATION AND [illegible] HOUSE

Four through girder bridges with spans of 50 to 110 ft. on concrete substructures are required for irrigation canals and drainage ditches. Twenty trestles averaging 55 ft. in length and 10 ft. in height are built with creosoted piles and open decks of untreated Oregon fir. Culverts and small concrete bridges average seven per mile. Stations for new town sites are frame buildings with living rooms for the station agent, as shown in Fig. 2. The typical layout of tracks and buildings at these small stations is shown in Fig. 3. Fairly good water for the engines is obtained from wells. The nearest engine terminal and repair shop is at North Platte, Neb.

Tracklaying Methods—In tracklaying, a locomotive crane is used. At the material yard a second crane loads rails and ties onto flat-cars for the tracklaying train, which is taken to the front by a locomotive. The crane is at the head of the train with the rail cars next, then a car of fastenings and after that the cars of ties.

On reaching the front, ties are unloaded into wagons to be hauled ahead and distributed on the grade. Eight wagons are usually employed to keep the ties distributed ahead and the force for handling ties consists of eight teamsters and thirteen laborers. The rails are taken by the crane from the cars behind it and delivered onto the ties. To handle the rails, there are three men on the cars and twelve men on the ground. Behind the train is a force of about 65 men for backspiking, lining and bolting. In addition to the above usually about twenty-five men are required in the material yard to load material.

Since the tracklaying is done intermittently, no high records have been made, but the maximum progress has been 4,400 ft. per 9-hour day with a force of about 100 men. All tracks are laid with 90-lb. rails of the Union Pacific R.R. standard section, using No. 10 frogs in main tracks and No. 9 at all other points. Both

FIG. 3—TYPICAL STATION LAYOUT AT SMALL TOWNS

Oregon fir sawed ties and Wyoming pine hewed ties are used, all treated with zinc-chloride. Tracks are ballasted with cinders, averaging 1,000 cu.yd. per mile. Passing sidings 3,000 ft. long are provided at intervals of about seven miles.

Motor trucks and the contractor's trains moved supplies from the base at Haig to the head of steel. The Utah Construction Co. has the general contract for grading, bridging and tracklaying. Stations are built and water facilities provided by the railway company's forces. The field force consists of three engineering parties to look after the grading and tracklaying and a fourth or floating party which looks after the bridge and culvert work. These parties live in camps. All the work is under the supervision of R. L. Huntley, chief engineer of the Union Pacific System.

Load Curve Charts Help Save Lost Time in Construction

For One-Purpose Machines Time Principal Factor —Multi-Purpose Machines Require Maximum Adaptability

JUSTIFICATION for the continued use of high-priced construction equipment in a declining labor and machinery market has led the Omaha (Neb.) Metropolitan Utilities District to study the load curve of its heavy equipment bought at high prices. Homer V. Knouse, assistant superintendent and purchasing agent, related as follows the results of the district's experience in a paper presented recently before the Iowa Section of the American Water Works Association:

The solution of the lost-time problem is intensive operation, or an improvement of the load curve, to the end that the overhead charges may be spread over a larger number of units. Fig. 1 represents the load curve of a wheel-type trenching machine having a maximum capacity of a trench 24 in. wide by 6 ft. deep. The white areas above the line represent lengths of trench excavated and the shaded areas below show time in hours the machine was out for repairs, inspection and general oiling. The white areas below the line represent time in hours of moving from job to job. The machine should not be penalized as fully as this curve would indicate, for it is undoubtedly true that it could have increased the total amount excavated had it been possible for the pipe-laying gang to keep up with it. This fact was noticeable where short lines were laid, when the time required for the connection was great in proportion to the time required to lay straight pipe. As a consequence the operator would spend time repairing or overhauling, which might quite as well have been devoted to digging had there been the work to do.

Fig. 2 shows performance curves used for day-to-day check on the efficiency of the machine operation. A factor or index number for the machine operator's score is obtained by dividing the sum of digging hours plus moving hours by the total hours the machine is in service, digging, moving and repairing. Idle time is not considered in this curve, inasmuch as the operator is not responsible for the time when there is no work provided for the machine. The "General Foreman's Score," checks the total time of digging, moving and repairing to total working hours and is an index of the degree to which work was provided for the machine. The third curve is a combination of the first two, and represents the value of the machine to the district. By decreasing repair time and increasing digging time, it will be possible for the operator to increase his score. Since digging time is figured by measuring the amount of trench opened and dividing by an allowance of 100 ft. per hour, it is not unreasonable to expect that a score of between 90 and 100 can be obtained by the operator. While the machine is capable of digging 138 ft. per hour, an allowance for "digging in," raising over services, cleaning buckets, oiling, greasing and adjustments, makes 100 ft. per hour for the entire day a reasonable average to expect.

The general foreman will be able, by better co-ordination of his work, to reduce the idle time and obtain a higher score. Pipe-laying gangs can be directed to follow the machine as may be necessary to keep their part of the work as closely behind the trenching machine as possible, and when numerous or difficult connections are necessary, extra gangs can be used advantageously to keep the progress at a maximum. By using this system of records the men responsible for the various factors are able to visualize the progress of their work and it is the hope that the increase in operating efficiency will decrease the unit cost of trenching for from 20 to 30 per cent.

The excavator is essentially a one-purpose machine, but in the construction department of utilities there are many operations which, although rather dissimilar, may often be performed by a single piece of equipment. A back-filler now in use by this department has had its load curve greatly benefited by adapting it to several uses. In addition to being a rapid back-filler it has been used as follows: For unloading cast-iron pipe from cars the costs were reduced 60 per cent. With bottom-dump buckets deep excavations may be handled more cheaply and the work speeded up as compared with hand methods. For erecting reinforcing steel and forms in building work the back-filler made a satisfactory traveling crane. For pouring concrete in column forms a special mast and bucket made the handling of the work a simple matter.

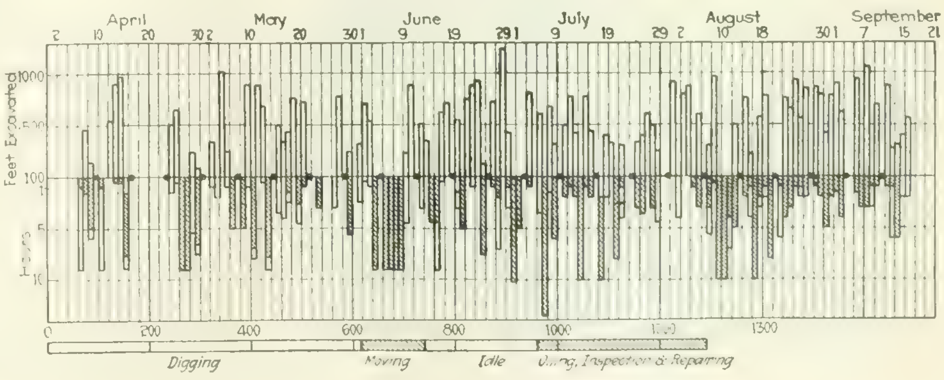


FIG. 1—YEARLY LOAD CURVE OF EXCAVATOR

The district has in service a small gasoline-driven dragline which has proved useful for excavating trenches for large size pipe, for handling pipe while laying, for unloading sand and stone, for unloading and bunkering coal and as a back-filler.

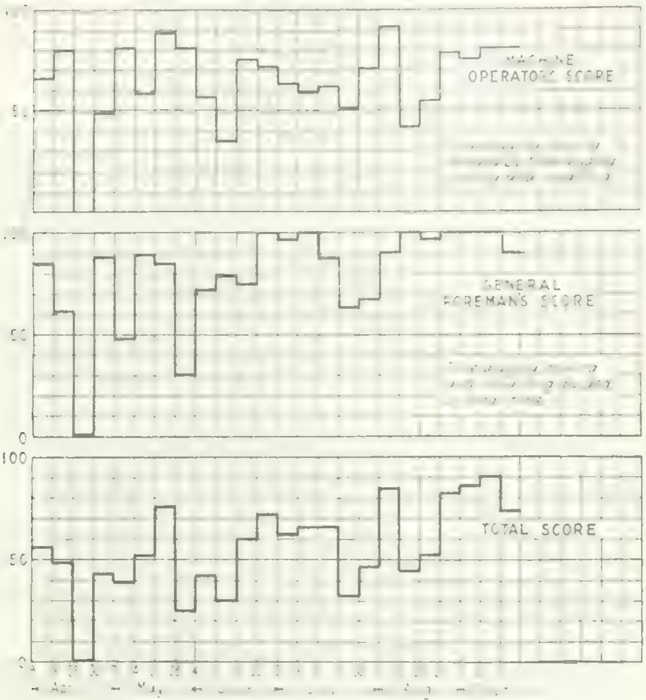


FIG. 2—DAILY PERFORMANCE CURVES OF EXCAVATOR

An air compressor was placed in service about July 1 and while cost data are not available in sufficient detail to be published, it is felt that its purchase was a wise move.

The compressor was delivered on a steel truck, but it soon became evident that the racking due to trailing behind a truck over rough pavements would cause material damage. In consequence it was decided to mount the unit on the chassis of an old truck which had been retired from service. The first plan contemplated the use of the chassis as a trailer. As the mounting progressed, it became evident that with minor changes the unit could be propelled by the engine of the compressor. The space formerly occupied by the engine has been utilized as a tool box, and all necessary equipment can be carried to handle the various classes of work without the necessity of providing a truck to aid in moving from job to job.

The compressor has been used in connection with a paving breaker to cut paving for the installation of water and

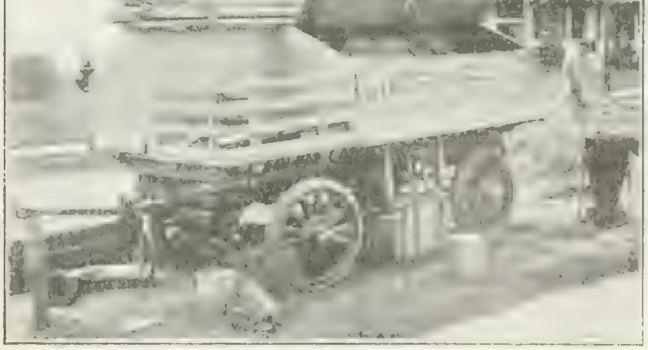


FIG. [illegible]

FIG. 4—AIR COMPRESSOR ON OLD TRUCK CHASSIS
Engine of compressor drives the truck. The space occupied [illegible] engine is used as a tool box.

gas mains. This paving breaker is a heavy non-rotating air hammer, using $1\frac{1}{4}$-in. moil-point steel and is very effective in breaking concrete base. A chisel point tool is used for cutting and lifting sheet asphalt, or asphaltic concrete, and the moil point is used for raising brick.

A foundry tamper to which was added a larger foot has been found effective in tamping re-filled material in trenches. One man with this tool is able to do the work of six men with hand tampers, and do it better.

A jackhamer drill, for use in cutting holes in walls and slabs and for the removal of old foundations, is a valuable addition to the equipment. Chipping hammers are useful in many places. When used in connection with a cement gun a large field of use is opened to the compressor. Undoubtedly many more uses will be found for the compressor as particular conditions arise, and it should be possible to get for it an attractive load curve.

The writer uses a dispatcher to order the movements of all trucks, and has found that not only is there less idle time, but that material is delivered to the job more nearly at the time it is needed. Gangs can be moved when ready and a truck is always available at some point in the city to handle emergencies.

The trailer shown in Fig. 3 was designed to make rapid transit of repair tools possible without the necessity of loading and unloading a truck whenever a move was necessary. Since this item of labor was avoided, it was possible to equip the trailer with tools to meet practically all emergencies. By the use of a spring-cushioned, rubber-tired trailer, the truck travels easily at its normal speed, whereas with the steel-tired wagon trailer, speeds of more than four or five miles per hour would soon wreck the running gear, rack the body and so mix up the contents of the wagon that tools would be damaged and rendered inaccessible.

An item of automobile expense that is generally overlooked is that of unnecessary mileage. The speed of a car makes the long way to a job seem of small importance, allows a return for forgotten tools to be made easily and makes careless routing a matter that is almost impossible to detect. Probably 15 to 25 per cent of auto mileage can be eliminated by a consideration of these items.

Summarized, the elements which should be considered when endeavoring to improve a load curve, are as follows: (1) With a one-purpose machine, it should be so designed as to give maximum hours of useful work with minimum time out for repairs. (2) Multi-purpose machines should be designed so as to be adaptable to the maximum number of uses spread as nearly over the entire year as possible. (3) Co-related work should be so organized that the equipment is able to work all possible hours. (4) Supervision should be such that duplication of trips of trucks and possible "empty" or unnecessary mileages are avoided and that no work or men are kept waiting.

Building a 6,500 Hp. Water Power Plant in New England

Work on Searsburg Development of the Deerfield River Involved Earth Dam and 4-Mile Wood Stave Pipe Line

By J. Arthur Garrod
General Superintendent, Aberthaw Construction Co., Boston, Mass.

At Searsburg, Vt., the New England Power Co., through its subsidiary, the Power Construction Co. of Worcester, Mass., recently completed another unit in its already extensive power development of the Deerfield River. The project includes a large earth dam, wood-stave conduit nearly four miles long, power house and surge tank, located on the upper reaches of the Deerfield River west of Brattleboro, Vt., and approximately ten miles above the Massachusetts state line.

Fig. 1 shows the general location of the development, also profiles, from which it will be noted that the wood-stave conduit runs from the dam with a pitch of only 25 ft. in the full length of 20,000 ft. to the power house site where the water drops 185 ft. through a steel penstock to the wheel in the power house. Where the penstock and wood-stave conduit join a concrete Y affords a connection to the steel surge tank.

The nearest railroad to the development is the Hoosac Tunnel & Wilmington R.R., which runs north from the Boston & Maine R.R. at Hoosac Tunnel, Mass., and terminates at Wilmington, Vt., about four miles from the power house site of the new development. On this railroad about two miles below Wilmington is a station called Mountain Mills, which is the headquarters of the operating division of the New England Power Co. From Mountain Mills a discontinued narrow-gage logging railroad follows the river to the site of the new development.

One of the first operations was the repair and strengthening of this narrow-gage railroad as far as the dam and its removal from the flooded area above the dam. The material yard for construction tools and supplies was, therefore, located at Mountain Mills and the materials were moved to the location over this narrow-gage railroad, or over a very good country road which also follows the course of the river, and which also had to be located outside of the flooded area above the dam.

The river valley at Searsburg is fairly narrow and the river banks are quite precipitous, in some cases approaching a 1 to 1 slope. The ground is largely clay with big boulders and nests of boulders which have

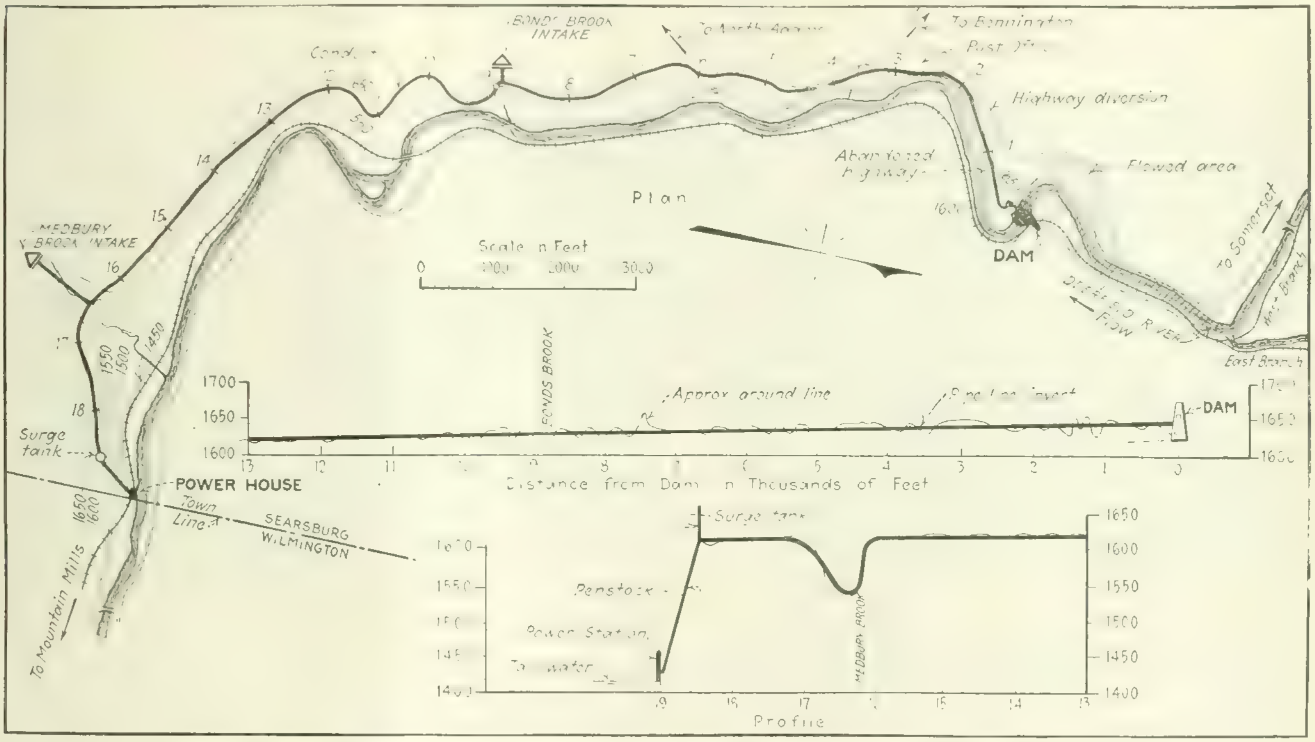


FIG. 1 PLAN AND PROFILE OF THE SEARSBURG HYDRO-ELECTRIC DEVELOPMENT

apparently been old stream beds. At the site selected for the dam a ledge on the west side of the river afforded excellent opportunity for a temporary bypass and subsequent permanent intake and spillway in solid rock.

The dam itself presents no unusual features. It is a simple earth structure slightly more than 50 ft. high in the middle of the stream with a base approximately 240 ft. wide and a crest 20 ft. wide. The total length of the dam, including spillway, is about 550 ft. The earth section, however, is only slightly more than 200 ft. The 55,000 cu.yd. of earth fill required for the dam was obtained from borrow pits opened in the easterly hillside mostly above the dam approximately a quarter of a mile away. This fill, which was a combination of clay and gravel, was excavated with $1\frac{1}{2}$-yd. steam shovel, full revolving type, and was brought to the dam site in trains of four yard dump cars drawn by 30-in. gage locomotives. Two trains of cars were operated continuously and it was found possible to take the output of the $1\frac{1}{2}$-yd. shovel practically continuously.

The first work at the dam was the construction of a temporary bypass. The ledge at the west bank of the river was blasted out and a concrete wall constructed 10 ft. thick at the base and in height and width following the section of the drain. This wall formed the abutment for the fill as well as forming part of the permanent spillway. Buttresses extended into the fill to prevent leakage along the wall. No cofferdam other than the deposit of earth was required to divert the stream through the temporary bypass, although some rocks from the excavation were placed from a low trestle at the upstream edge of the fill to serve as a partial breakwater.

Building the Dam—The plan of operation was to place the earth fill by dumping from temporary wood trestles placed about 100 ft. apart and constructed of local timber. When the fill had reached a height of about 15 ft. dumping was suspended and the bed of the river between the two lines of fill cleared of boulders and river silt, leaving the undisturbed hardpan clay bottom of the river bed exposed. Dumping was then resumed and as the fill was deposited in the middle of the dam the fine material was washed to the center by two fire streams playing continuously. This formed the core of the dam. This core was carried well into the east bank of the river. The sluicing resulted in a pond being formed in the middle of the dam which thoroughly puddled the fill as it was placed. The two fire streams were supplied with water from this pond by a two-stage electrically-driven pump located on a raft in the pond. Make-up water was supplied from up-river by a 6-in. single-stage pump. The pond in the central portion of the dam was discontinued when the grade of the spillway was reached—approximately 15 ft. below the crest.

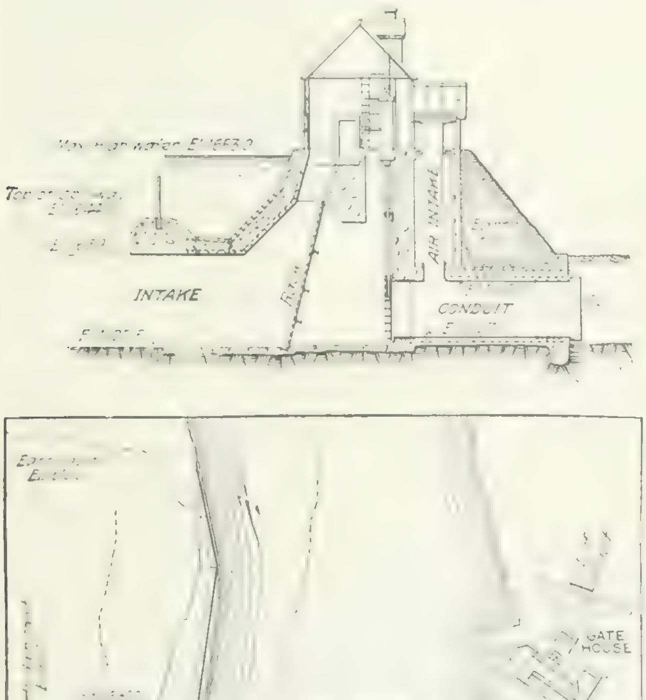


FIG. 2. INTAKE AND SPILLWAY STRUCTURE

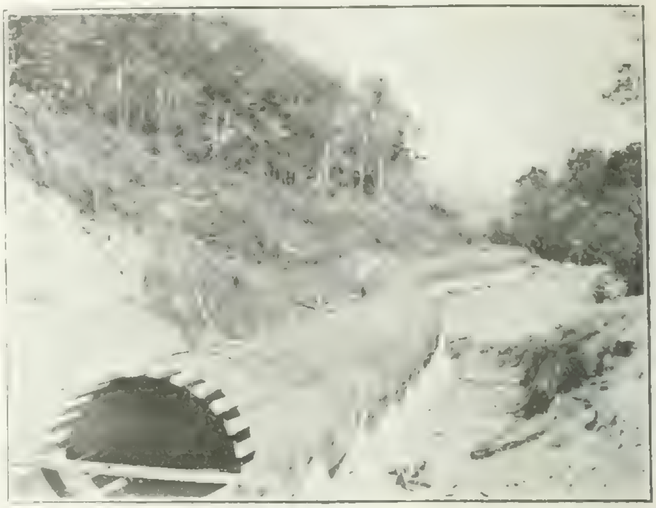


FIG. 3. WOOD-STAVE PIPE UNDER CONSTRUCTION

Pipe is 8 ft. in diameter and line is nearly 4 miles long, constituting the largest installation of this type in New England.

When the fill had reached the height of the top of the trestles the upper work of the trestles was removed and the track jacked up as the fill rose. To take care of the settlement of the fill an over-slope of about 10 per cent was placed. The flood line above the dam included about 20 acres of land, about 14 acres of which had to be cleared.

Wood-Stave Pipe—The largest single item in the contract, and the one which involved the most difficulty from a construction viewpoint, was the building of the berm or bench for the wood-stave conduit and the placing of the conduit itself. The only practical location for the conduit was on the slope of the river bank. The river winds more or less and as previously stated the bank is quite precipitous and heavily wooded. Where the bank curved sharply, studies were made of the possibility of tunneling through rather than curving the conduit around the hillside, but the uncertain nature of the excavation, with the probability of encountering boulders and ledge if the conduit were directed through a tunnel, showed economy in favor of the hillside location.

Following the location of the conduit a clearing gang went ahead and cut down the trees and brush in a swath approximately 100 ft. wide, this width being considered necessary to afford proper fire protection to the wood pipe. This clearing approximated thirty-five acres.

A force of men called the prospecting gang followed the clearing gang. It was the duty of this crew to determine as closely as possible the exact nature of the digging which the steam shovels would be called upon to handle, and to remove as far as possible any obstacles. The gang dug test pits, drilled test holes and also did considerable blasting. To carry out this preliminary work effectively a narrow berm was cleared by hand on practically the center line of the pipe to

allow travel and to provide a space in which to run the water line for the steam shovels.

Two 1-yd. steam shovels were used in excavation of the berm. These shovels came by rail to Mountain Mills, where they were transferred to the narrow-gage rails and transported to the site. They were assembled at the foot of the hill near where they were to cut in and it was necessary to build temporary roads to get them up the bank. Shovel No. 1 was cut in at Medbury Brook about 2,000 ft. upstream from the surge tank at an elevation about 150 ft. above the highway at this point. This shovel worked back to the surge tank, after which it returned and worked continuously upstream until it reached the point where shovel No. 2 had started. The excavation by shovel No. 1 totaled 29,000 cu.yd. of earth and 5,600 cu.yd. of rock.

Shovel No. 2 was cut in at approximately a halfway point of the berm and worked upstream to the dam, removing in all about 48,000 cu.yd. of earth and approximately 1,500 cu.yd. of rock.

The difficult nature of the digging is well indicated by the fact that the shovels, which operated day and night, often advanced only 40 ft. in 24 hours, with an average for a full month's work of about 110 ft. in 24 hours. All of this excavation was in the hillside and, for the most part, the excavated material was simply dropped over the low side of the slope by the shovel. At some points, however, spurs of the hills ran out flat, and in these cases it was necessary to move some of the excavated material by teams. Many fingers of ledge were uncovered as the shovels progressed and had to be blasted out. This excavation averaged about 4.3 cubic yards per foot of conduit.

Details of Pipe—The 8-ft. wood-stave conduit is the only wood penstock of appreciable length in New England. This was furnished and erected by the Continental Pipe Manufacturing Co. The contract called for 1,600,000 board feet of Douglas fir staves 2½ in. thick, average length 14 ft., as well as some 600 tons of ¾-in. steel bands and 70 tons of malleable cast shoes. This material was all unloaded, stored and placed on the berm by the general contractor. Fifty-seven staves completed the conduit circumference. Accordingly, staves were placed on the berm in piles of 114 staves each, all of one length, as near as possible at exact points. This was done not only to eliminate handling, but to prevent damage through excessive handling. The ends of the staves were slotted to receive steel tongues, about 11 tons of which were used.

The concrete cradles supporting the conduit were supplied by the general contractor. These cradles were in two pieces and were cast in molds at Mountain Mills and transported by rail and team to the berm where they were distributed along the conduit line. Of these precast cradles 2,090 were used, while about 100 were cast in place. All were placed on reinforced-concrete foundations.

Where the conduit crossed brooks or ravines wood trestles were erected with the assistance of the steam shovels, a total of about 900 ft. of such trestle being necessary. Where Medbury Brook and Bond Brook entered the river through deep cuts, siphons were placed in the conduit line. At these brooks, also. 24-in. wood pipe intakes were cut into the main conduit. The shortest allowable radius for wood conduit was 300 ft. Where sharp curves occurred special steel bends were provided, six of these being installed at different points, radii varying from 40 deg. to 90 deg. Where the conduit line crossed the Bennington Road is was necessary to blast out the ledge and build a special flat section of conduit in concrete, the road passing over this.

FIG. 4—RETAINING WALL AT WEST END OF DAM SHOWING TRESTLES FROM WHICH EARTH WAS DUMPED

Spillway—Fig. 2 shows a plan and cross-section of the intake and spillway structure at the dam. This was all built in solid rock, and, including the temporary bypass, necessitated the removal of more than 6,000 cu.yd. of rock as well as about 1,500 cu.yd. of preliminary stripping. The mechanical equipment at the dam consists of two 6 x 8-in. cast-iron sluice gates, one of which controls the water entering the conduit, the other being used to bypass the water down the river bed, thus aiding in the flood control. These gates are operated by oil cylinders 16 in. in diameter, pressure for which is supplied by a 30 gal. electrically driven triplex pump. The normal operating pressure for the cylinders is about 200 lb. per sq.in.

The downstream end of the conduit terminates in a concrete Y, one branch of which is connected to the surge tank and the other to the steel penstock which drops to the power house.

The surge tank is of the Johnson differential type

50 ft. in diameter and 35 ft. high, the vertical steel section being set in the concrete of the foundation without a steel base. This tank is partially protected from freezing by a wooden housing. Nearly one thousand yards of earth and rock were removed at this point for the surge tank foundation, while the foundation itself required more than 600 cu.yd. of concrete.

The penstock is 6 ft. 6 in. in diameter, approximately 500 ft. long, of steel plate varying in thickness from $\frac{5}{16}$ in. at the concrete Y to $\frac{9}{16}$ in. where it enters the power house. The steep slope at this point was fairly clear and little preparation was necessary for the penstock line other than the construction of the supporting concrete blocks.

Power Equipment—The power house is a concrete and brick structure 34x41 ft. with a gunite roof slab on a steel frame. The equipment consists of a 5,000 kva., 4,500 kw., 360 r.p.m. General Electric generator with the necessary auxiliary switchboards, transformers, oil switches, lightning arresters, etc. The generator is driven by a 6,200-hp. vertical turbine with cast steel spiral case built by the I. P. Morris Department of the William Cramp & Sons Ship and Engine Building Co. At the turbine inlet there is a Wellman-Seaver-Morgan Co. balanced plunger hydraulic valve, by means of which water can be shut off from the unit.

This development not only adds materially to the amount of power developed by the New England Power Co., but is also of considerable value as further controlling the Deerfield River, which was already extensively developed below the Searsburg location.

The general contract for the work was handled by Aberthaw Construction Company, of Boston, under the direction of the Power Construction Co., of Worcester.

Publicity of the Right Kind for Water-Works Properties

Extracts From a Paper by Dow R. Gwinn, President and Manager, Terre Haute Water Co., Presented to the Iowa Section, American Water Works Association

SOME operators take their publicity matter to the editor when they should see the advertising manager. They fail to distinguish the difference between news and advertising matter. An operator, who would resent the suggestion that he furnish service free of charge, should keep that idea in mind when he goes to the newspaper office with copy. A newspaper must charge for advertising matter. Therefore, when you wish to acquaint the public with facts about the water-works business, see the advertising manager and make a contract for space.

Plenty of time should be taken in the preparation of copy. If a series of advertisements are to be used, it is advisable to start in with one of a historical character. Prepare a second with some of the difficulties of a practical character that have been overcome. The third insertion could give a description of the present system. Somewhere through the series the name of the engineer or engineers should be given, the trouble in financing the enterprise and the names of those who bore the responsibility of getting the works started.

It is a mistake to try to tell too much in one issue of the paper. In most cases 5 in., three columns wide, is sufficient space, with at least two insertions of each story or talk. Change copy weekly. Contract for space on the editorial page if it is used for advertisements. It is advisable to complete copy for the entire series before beginning publication.

The public should be taken into the confidence of the water-works operator; it is poor policy for the public to get the idea that the operator is covering up something. Let the public know what you are doing. If you contemplate important improvements, take space in the newspaper and state what you are about to do, whom you have engaged to plan the work, the standing of the engineer and what he has done in other cities. If an application is to be made for an increase in rates, space should be bought for making the announcement and full particulars should be given so that the public will be able to judge as to the reasonableness of the claim for higher rates.

After or during the publication of a series of advertisements (call them "water talks" if you please), an effort should be made to get the public to visit the pumping station and other portions of the plant. Incidentally, the grounds around the station should be made attractive and pleasing. Our grounds are desirable for picnics and we invite the public to use them.

During the past summer the Rotarians, the Kiwanis Club and the Exchange Club served noonday luncheon on our grounds; the Lions and their wives served supper. We have tables (trestles and boards) sufficient for 140 people; our men set the tables, cover them with white paper (it comes in rolls), put on the glasses, forks and spoons. The caterer, who is engaged and paid by the club using the grounds, furnishes the food, plates and paper napkins. We furnish the water, coffee and sometimes small bottles of milk. In this way the live wires of the city, the men who are doing things, visit our plant, see what we have and, judging by many comments, go away with a good impression of the local water-works plant. Of course, the newspaper men are present and the luncheons are duly written up, usually with some reference to the water-works. It is always favorable publicity.

We have an unusually fine tennis court which may be reserved by telephone, no charge being made. The finals of tennis tournaments are played on the water-works court.

The record of fatal typhoid cases in Terre Haute since 1909 has dropped from 60 to 5 per 100,000 population. In the same period the number of water consumers has increased from 5,200 to 9,000. A drawing 8½ x 11 in. was made showing these facts graphically. For three years we have prepared these drawings and have about 400 blueprints from the tracings. These prints have been mailed to a selected list of names, including the state health officials, members of the Public Utility Commission, local officials, physicians, nurses, college and school principals and all members of the Rotary Club.

The writer is of the opinion that the best form of advertising is through the public press, but there are occasions when a personal letter, multigraphed with typewritten address, is effective. A special letter was sent recently to real estate men advising them that the price of cast-iron pipe was extremely high; that money was dear and hard to get and that a survey showed over 2,500 vacant lots on the lines of existing water mains. Blueprints of the survey were inclosed. We also enclosed an extract from Mr. Brigham's article in the *Atlantic Monthly* for March, 1921, to the effect that the United States Housing Corporation could have built houses where utilities were already installed much more quickly and cheaply than in new locations, that the cost of improved vacant lots in the city was less than the improved acreage plus the great cost of utilities.

California Forest Fire Losses

According to a preliminary estimate made by the U. S. Department of Agriculture fire losses in California national forests during the past season amounted to $134,000. Fires burned over a total of 290,800 acres, of which 192,000 acres were government land. Some of the watersheds in the state were severely damaged through destruction of their forest covers. Lightning set 25 per cent of the fires. The effective fire detection and suppression organization of the U. S. Forest Service made possible extinguishment of 80 per cent of the fires before they had covered 10-acre areas.

Remove Subaqueous Ledge Above Rapid Transit Tunnel

Special Precautions Safeguard New York Subway Tubes During Channel Improvement—Fire Blasts Are Made Between Trains and Close Inspection Is Maintained

BY COL. EDWARD BURR
Corps of Engineers, U. S. A.
Officer-in-Charge First New York Engineer District

THE improvement of East River as now carried on by the United States contemplates a channel 40 ft. deep at mean low water with a standard width of 1,000 ft., narrowed at points where topographical conditions make it necessary for reasons of excessive cost. The estimated cost of the improvement under existing general cost conditions is about $72,000,000, this high cost being due to the large yardage of submarine ledge to be removed in strong currents and congested traffic.

Among the items of work is the removal of a ledge shoal which was approximately centered over the Old Slip-Clark St. tubes of the rapid transit system operated by the Interborough Rapid Transit Co. This shoal had a least depth to ledge rock of about 31 ft. at mean low water and an area of about 105,000 sq.ft. that was less than 40 ft. deep. The quantities involved were 9,544 cu.yd. of ledge rock to 40 ft. depth and 15,406 cu.yd. to 42 ft., with average depths of cut of 2.5 and 4.5 ft. respectively, payment being made at full contract price for material removed between 40 and 42 ft. The quantities of dredgeable material to be removed were 4,314 and 6,425 cu.yd. to 40 and 42 ft., respectively.

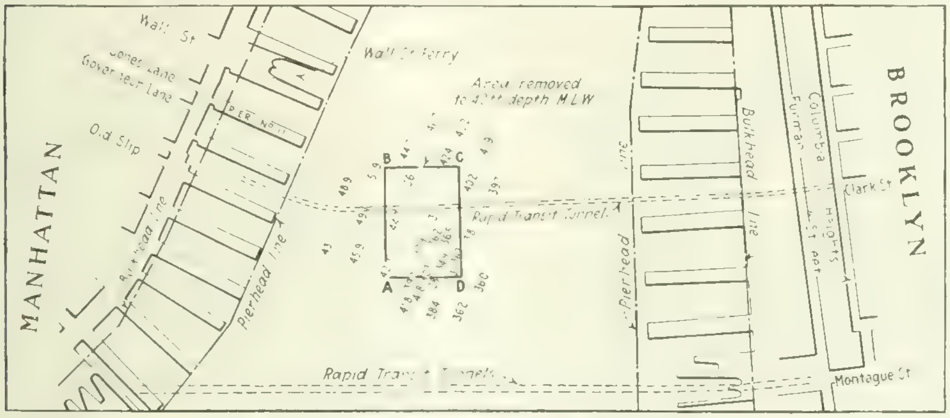


FIG. 1—LOCATION OF AREA EXCAVATED
The seismograph was installed in a cross passage between the tubes under the easterly edge of the area to be removed.

After customary advertisement a contract was entered into with the New Jersey Shipbuilding and Dredging Co. on Sept. 2, 1919, the work being due for completion on Nov. 24, 1921. Dredgeable material having first been removed, the contractor began drilling and blasting in November 1920, but his plant was seriously injured by collision after but three days operation. Drilling and dredging operations, either separately or jointly, have continued since that time with interruptions and delays resulting from collisions by passing traffic, more or less serious, and the work is now completed excepting for the removal of a few high points which have been developed by sweeping and which may be broken rock.

Proximity of Tunnels—This contract, in addition to the normal difficulties found in removing ledge to 40 ft. depth (45 ft. at m.h.w.) in the traffic and tide currents of East River, presented special problems resulting from the existence directly under the highest point of the reef of twin rapid-transit tubes 66.2 ft. below m.l.w. measured to the iron lining. It was essential to conduct blasting without damage to the tubes, undue delays to traffic and even without alarming passengers, bearing in mind a serious tunnel accident in Brooklyn a few years earlier. These ends were all attained and the public was not aware of the execution of the work until its completion.

On the other hand, for economic reasons, it was desirable and necessary also that blasting should result in breaking up the ledge into condition suitable for effective dredging, with the minimum of high points of unbroken ledge and consequent costly re-drilling, drilling, and blasting operations representing from 70 to 80 per cent of the total cost of a successful contract. The adjustment of these conflicting elements of the contract was the special problem to be solved and, so far as concerned the conduct of blasting, adjustments were a continuous process so long as blasting was necessary.

The ledge under the lower section of East River includes schist, gneiss and granodiorite of varying composition and hardness, from quartz seams to disintegrated surface rock. The records made during the driving of the tubes had been destroyed by fire but it was learned generally that this ledge was unusually hard and free from fissures. From other sources, including a geologic examination of the entire East River area by Dr. Charles P. Berkey of Columbia University, it was learned also that the rock was Fordham gneiss of characteristic type, with dip of nearly 90 deg. towards the west and a strike nearly parallel to the long axis of the contract area.

The best practice among contractors for ledge removal in the East River channel in recent years is based upon drill holes 5 to 7 in. in diameter, spaced 10 ft. centers and driven to 10 ft. below grade, with the object of breaking out the ledge so as to leave no points above grade and thereby require redrilling which, if extensive, largely increases costs. Layout of holes and similar matters are determined by the types of drilling plant as affected by tide currents.

Provisions for Safety—After consultation with the engineers of the Public Service Commission, the specifications, in addition to bringing out the existence of the tubes, carried special provisions, calling attention to the tunnel traffic, prohibiting blasting between 7 and

10 a.m. and 4 and 8 p.m. in order to avoid unnecessary interruption to that traffic, and requiring that the exact moment of blasting should be governed by a system of signals to be adopted by agreement between the contractor and the Public Service Commission. Also as a precautionary measure, they prohibited the drilling of holes more than 7 ft. below grade, i.e. deeper than 47 ft. below m.l.w. In other respects the specifications were the standard for such work. Early in the contract a system of inspections, reports and studies was developed to meet the special conditions, to furnish needed information to all concerned, and to permit of effective control of the next steps as required for safety and avoidance of delays.

The circumstances of the work required the development of reliable means of prompt inter-communication between the contractor's plant and the train dispatcher's office at Wall Street station. The responsibility for all necessary arrangements rested with the contractor but cordial co-operation between him, the Transit Construction Commission (T.C.C.) (subsequently the Transit Commission), the Interborough Rapid Transit Co. (I.R.T.) and the District Engineer (D.E.) led to successful methods without friction.

Direct telephone connection was attempted through a cable extending from the end of Pier 11 on the Manhattan shore to a barge moored near the contractor's drill boat, the attachment of the cable to the latter being impracticable for various reasons. The cable was installed but owing to cable and other troubles this method was found so unreliable that it was abandoned before blasting began. Resort was then had to visual signals between the drill boat and a shore station, with wire connections thence to the dispatcher's office. After using for a few days Old Slip police station, the shore station was subsequently established at the outer end of Pier 11. In each case communication with the dispatcher's office was by telephone but a buzzer system was soon installed between Pier 11 and the dispatcher's office and served successfully for the greater part of the work. For day signals between the drill boat and Pier 11 a red flag with square white center was adopted, and for night signals three lights, red, white and green on a vertical line.

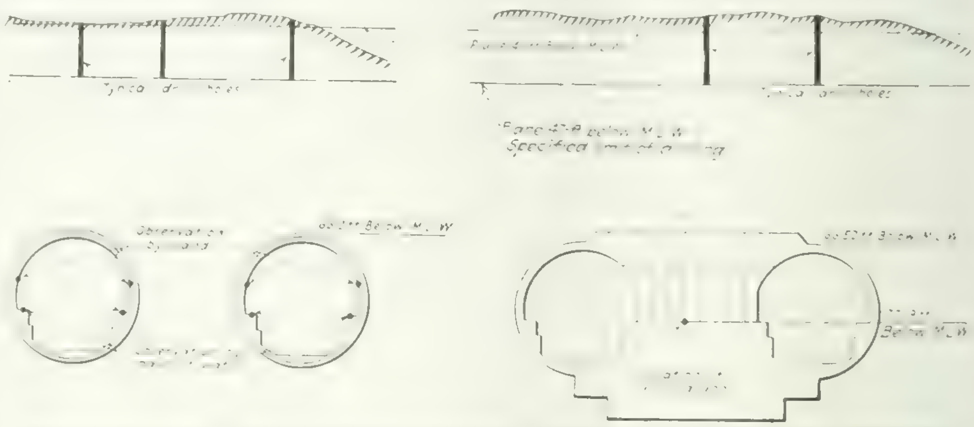


FIG. 2 TYPICAL CROSS SECTIONS SHOWING POSITION OF TUBES WITH RESPECT TO ROCK SURFACE

The cross-section to the left is typical of conditions under nearly all of the area of excavation and shows the points at which observations were taken by hand and by pail of water.
That to the right is a special section at the cross-passage in which the seismograph was installed. This lies under the easterly edge of the area excavated as indicated in Fig. 1.

Inspection Procedure—Drilling and blasting were conducted at first on a 16-hr. basis, but for most of the work on a 24-hr. basis. When the blasting had reached a stage to justify it, the routine was as follows. After each blast the contractor furnished information as to the approximate time of next blast. This could be done with fair accuracy based on periods of no firing and the time of slack water which, when practicable, was used for firing because of the necessity for moving the drill boat from above the holes before firing and back into position after firing. At the specified time the following force reported: At Pier 11, one I.R.T. signalman, one T.C.C. and one U. S. inspector; at Wall Street station, one T.C.C., one I.R.T. and one U. S. inspector. A U. S. inspector was at all time on duty on the drill boat. The contractor sent an inspector to the Wall Street group at times only.

When ready to fire the drill boat hoisted its signal (flag or lights) and the signalman (I.R.T.) answered by waving a red flag or red light. The signalman sent one long ring on buzzer to dispatcher who answered with one long ring on buzzer. The tunnel inspectors took the next train for their posts in the tunnel and on arrival there the I.R.T. inspector notified the dispatcher of their readiness. Meanwhile the dispatcher cleared the tubes of traffic and then sent one ring on telephone to the inspector in the tunnel as a ready signal and two long rings on buzzer to the signalman on Pier 11, who answered with two long rings and hoisted his signal (flag or lights), indicating that tubes were clear and blast could be fired. The drill boat fired the blast and lowered its signal to show that blasting was completed. The signalman at Pier 11 lowered his signal and gave the "all over" signal, three rings on buzzer to dispatcher who replied with three rings. Tunnel inspectors noted the effect of blasting and when satisfied that it was safe to start traffic, notified the dispatcher by telephone and he started the trains. The tunnel inspectors took the next train to Wall Street station and reported to their respective offices by telephone of the effect of blasting. The U. S. inspector also submitted a detailed report on the prescribed form giving all the details of each blast.

All signalling was done by employees of the contractor and I.R.T., who were the responsible parties, the U. S. and T. C. C. inspectors being merely observers. Normally the interval from the time tunnel was reported "cleared" to the time dispatcher was notified that it was "O. K." was between two and three minutes, and delay to traffic seldom occurred or was of short duration. The basic control of blasting was that no firing was permissible excepting while the signals were up on both the drill boat and Pier 11, and that these signals when hoisted, remained up until blasting was completed. For communication not possible through these signals and for prompt transmission of instructions the contractor maintained a motor launch at Pier 11.

Devices for Observing Vibration—Accurate and entirely reliable means for determining the amplitude of vibrations on the tube structures were lacking, but some

measures was necessary to gage the varying effects of blasting. Although these were distinctly noticeable through the report or noise of the detonation or through the vibration or jar observed by personal contact (through hands or feet) with the tube structure, they had no physical effect upon it. Inexperienced observers usually will construe a sharp report or noise as indicating a marked physical vibration.

All of the following means were regularly used: (a) An improvised seismograph installed by the T. C. C. in the cross-passage between the tubes, located under the easterly edge of the ledge area to be removed. This instrument recorded the amplitude of both horizontal and vertical vibrations but was not always reliable. Moreover it was relatively distant from the point of most intense shock during the critical period of blasting directly over or immediately adjacent to the tubes. (b) A pail, partially filled with water, with a light float carrying a vertical pointer that indicated the amount of disturbance of the water surface on a horizontal scale supported above the rim of the pail. This primitive method lacked sensitiveness, but, used at the point of maximum intensity, it gave indications for shocks smaller than those physically affecting the tubes, and was reliable. (c) By holding the hand against the tube wall in direct line with the blast. This method was merely a check on others but was of value. (d) Observation of incandescent light filaments, through dark glasses. This was an additional check, which was used after the filament in one tunnel lamp had been broken by concussion. (e) A thorough examination of the tubes after each blast, in the vicinity of the blast, noting effects such as dislodgment of dust or of other light encrustations.

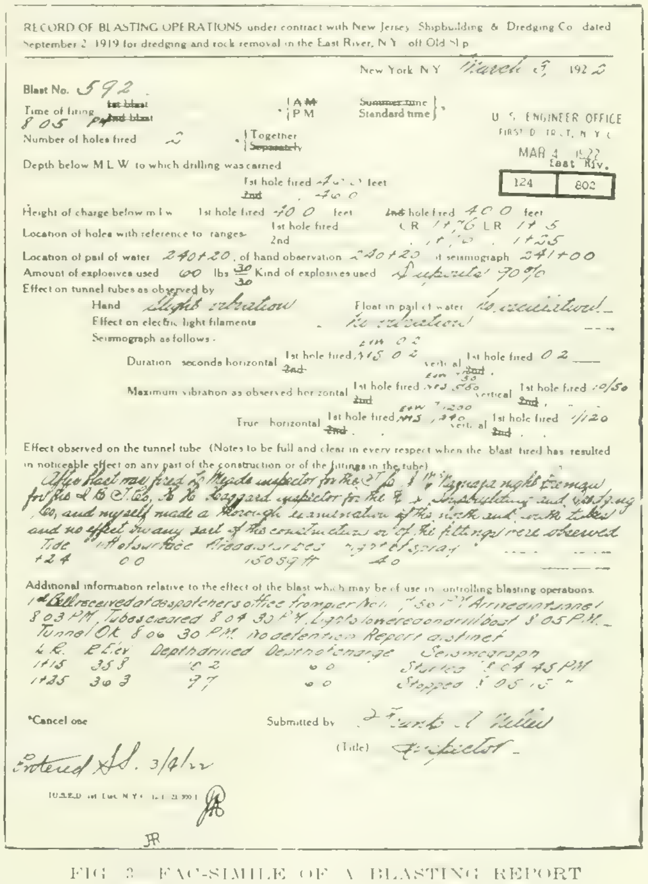
Tests (b), (c), and (d) were developed by the contracting officers' organization and, though crude, were of value in indicating measurably severe shocks, insufficient to cause material damage to the tubes.

Sequence of Operations—For administrative reasons the contract area was divided into four sections by lines nearly parallel to the axis of the tubes. Section 2 was 125 ft. wide, with the two tubes occupying a width of about 50 ft. near its center. Blasting was begun at the end of the area most remote from the tubes and carried forward to the boundary of Section 2. It was then started at the other end and brought up to Section 2, thus leaving the work nearest to and over the tubes until there was available all the experience gained as the blasting progressed.

The drilling plant consisted of a boat carrying three drills for drilling three holes at a setting. After loading the holes, the boat was hauled off, the blast fired and the boat hauled back to its next location as established by shore ranges. The explosive was Dupont's 90 per cent blasting gelatin, loaded in tin canisters or tubes, and three holes were fired at a blast.

Blasting Practice—When blasting was begun, at a distance of about 275 ft. from the nearest tube, no restrictions were placed upon the normal practice of the contractor who used for three holes a total charge varying generally between 100 and 150 lb. and a few charges more than 150 lb. and as high as 200 lb. During this period there were experienced some of the more severe shocks to the nearest tube, but these effects were so irregular that their prediction was difficult or impossible and they were a most unsatisfactory basis for determining the size of the charge. By the time the work had approached to 40 ft. horizontally from the line of the nearest tube, the necessity for close regulation of the total charge for each blast had become evident and it was progressively reduced from 80 or 100 lb. to 30 lb., in the area directly over the tubes where the least distance from the bottom of the hole to the tube lining was as little as 18 feet.

For effective blasting, the concentration of this charge in one hole was necessary, and the firing of but one hole in a blast was permitted. It was found that on 10-ft. centers the firing of one hole would generally detonate the second and the contractor resorted to drilling on 20-ft. centers, using the two outside drills of his plant, and fired the two holes separately at a few seconds interval, thus obtaining the maximum drilling capacity for each setting of his drill boat. It was necessary at times to use part of the charge as a surface blast over the hole even though the use of such charges produced more pronounced effects on the tubes than equal amounts loaded in the drilled holes.


RECORD OF BLASTING OPERATIONS under contract with New Jersey Shipbuilding & Dredging Co dated September 2 1919 for dredging and rock removal in the East River, N Y off Old Slip

New York N Y March 3 1922

U. S. ENGINEER OFFICE
FIRST DISTRICT, N Y C
MAR 4 1922
East Riv.

124	802

Blast No. 592

Time of firing ~~1st blast~~ ~~2nd blast~~ 8 05 PM — ~~A M~~ P M — ~~Summer time~~ Standard time*

Number of holes fired 2 — *Together ~~Separately~~

Depth below M L W to which drilling was carried — 1st hole fired 40 feet — ~~2nd~~ 40

Height of charge below m l w 1st hole fired 40 feet ~~2nd~~ hole fired 40 feet

Location of holes with reference to ranges — 1st hole fired C R 1+76 L R 1+15 — 2nd 1+25

Location of pail of water 240+20, of hand observation 240+20, of seismograph 241+00

Amount of explosives used 60 lbs 30/30 Kind of explosives used Dupont 90%

Effect on tunnel tubes as observed by

Hand: Slight vibration — Float in pail of water: No vibration

Effect on electric light filaments: No vibration

Seismograph as follows:

Duration seconds horizontal 1st hole fired 0 2 ~~2nd~~ — vertical 1st hole fired 0 2 ~~2nd~~

Maximum vibration as observed horizontal 1st hole fired ~~2nd~~ — vertical 1st hole fired 10/50 ~~2nd~~

True horizontal 1st hole fired ~~2nd~~ — vertical 1st hole fired 1/120 ~~2nd~~

Effect observed on the tunnel tube (Notes to be full and clear in every respect when the blast fired has resulted in noticeable effect on any part of the construction or of the fittings in the tube)

After blast was fired [illegible] inspector for the [illegible], [illegible] inspector for the N. J. Shipbuilding and Dredging Co., and myself made a thorough examination of the north and south tubes and no effect on any part of the construction or of the fittings were observed

Additional information relative to the effect of the blast which may be of use in controlling blasting operations.

Tunnel OK 8 06 30 PM. No detention. Report as timed

L.R.	Elev	Depth drilled	Dept of charge	Seismograph
1+15	35 3	42	40	Started 8 04 45 PM
1+25	30 3	77	40	Stopped 8 05 15 "

*Cancel one

Submitted by [illegible]

(Title) Inspector

Entered [illegible] 3/4/22

FIG. 3. FAC-SIMILE OF A BLASTING REPORT

Shortly after blasting was commenced, an examination of the tubes was made jointly by representatives of all parties interested and a full record made of conditions then existing. While the blasting generally was effective in breaking the ledge into condition suitable for dredging with little re-drilling, no effects of any consequence resulted to the tubes, which were in no wise damaged, a combined result that was most satisfactory.

Personnel—The work was done under the direction of Colonel Edward Burr, Corps of Engineers, U. S. Army, in charge of the First New York Engineer District. J. H. Rostock, assistant engineer, had direct supervision of contract operations. Much of the success was due to painstaking services of the inspectors and to the accuracy of their observations and reports.

Volumes at Jack-Arch Groins

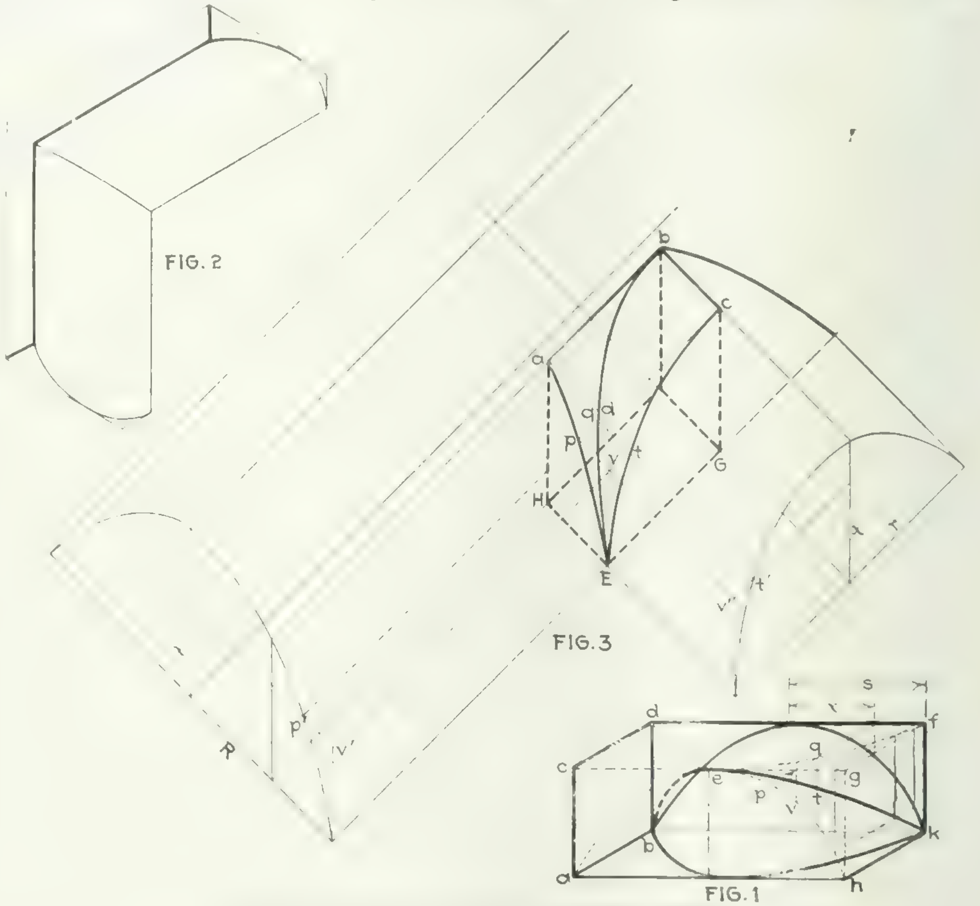
By George Paaswell
Construction Engineer, New York City

A PROBLEM of frequent occurrence is that of determining the volume at the groin of two intersecting arches. Referring to the figure, the required volume may be found as follows: Compute the volume of the two intersecting arches separately, carrying the length of arch (Fig. 1) to the planes *acgh* and *cdfg* respectively. There has been included two times, then, the volume of the two curvilinear pyramids *abcd* — *e* and *gfkh* — *e*. These are equal figures. It is necessary to deduct from the sum of the two arch volumes the volumes of the two pyramids. The following analysis covers the computation of this latter volume.

By referring to Fig. 3, it is seen that the intersection in Figs. 1 and 2 is a special case of the more general intersection of two cylinders. The process of finding the volume is the same in the general case and the same method is employed of deducting the volume of the common pyramidal figures.

Exact Solution and Tables—In Fig. 1, a typical section of the pyramid is the rectangle *pqvt*. Denote the radii of the two arches by r and R respectively, r being the smaller radius. The sides of the rectangle are the two circular offsets, *pq* and *pv*. The method of finding the curve of intersection *bek* of the two cylinders is indicated in the figure. The offsets are computed from the common edge *cg*. The circular offset from a tangent is

$$R - \sqrt{R^2 - x^2}$$



COMPUTING THE VOLUME AT ARCH GROINS

Taking the thickness of the rectangle as the infinitesimal dx, the total volume of the two equal pyramids is given by the integral

$$V = 2\int (R - \sqrt{R^2 - x^2})(r - \sqrt{r^2 - x^2})\,dx$$

Multiplying the two factors, the integral is broken up into four simpler ones, thus

$$V = 2Rr\int dx - 2R\int \sqrt{r^2 - x^2}\,dx$$
$$- 2r\int \sqrt{R^2 - x^2}\,dx + 2\int \sqrt{(R^2 - x^2)(r^2 - x^2)}\,dx$$

The first three of these may be integrated by elementary methods, but the last leads to elliptic integrals. Upon denoting by k the ratio r/R of the smaller radius to the larger, and by t the ratio s/r of the half span of arch to the smaller radius, the volume is finally found to have the form

$$V = KR^3$$

where

$$K = \Big[k^2t\Big\{2 - \sqrt{1 - t^2} - \sqrt{1 - k^2t^2} + \tfrac{2}{3}\sqrt{(1 - t^2)(1 - k^2t^2)}\Big\} - k(\sin^{-1}kt + k\sin^{-1}t) + \tfrac{2}{3}(1 + k^2)E - \tfrac{2}{3}(1 - k^2)F\Big]$$

In this expression E and F are elliptic integrals of order two and one respectively. They are defined by the integrals

$$E = \int \sqrt{\frac{1 - k^2x^2}{1 - x^2}}\,dx \qquad F = \int \frac{dx}{\sqrt{(1 - x^2)(1 - k^2x^2)}}$$

In order to evaluate these integrals, in the absence of proper tables it was necessary to expand the integrals into series and integrate term by term.

Table I gives the values of K for a range of values of k and t. It must be remembered that r is the smaller radius.

Approximate Solution—An approximate expression for the volume may be found, using a parabolic equation for the arch in place of the true circular. This method is based upon the following equation for the offset:

$$y = x^2/2r$$

The total volume is then given by

$$V = 2\int \frac{x^4}{4rR}\,dx$$

Upon integration and substitution of k and t, the volume becomes

$$V = LR^3$$

where $$L \qquad k't^{\cdot}\ 10$$

A study of this expression indicates that it gives results within a reasonable limit of error when both k and t lie between 0 and $\frac{1}{2}$.

TABLE I—VALUES OF

k/t	0.2	0.4	0.6	0.8	1.0
0.2	0	0	0.00001	0.00001	0.00003
0.4	0	0.00003	0.00014	0.00048	0.00109
0.6	0.00001	0.00022	0.00111	0.00359	0.00899
0.8	0.00007	0.00099	0.00486	0.01689	0.04408
1.0	0.00022	0.00262	0.01915	0.06531	0.19174

Volume in Terms of Rise and Span—Quite often the arch is defined by its rise and span rather than by the radius and span. If the rise of an arch with radius R is denoted by h, and that of the arch with radius r by m, then, from simple geometry

$$R = \frac{s^2 + h^2}{2h};\ r = \frac{s^2 + m^2}{2m}$$

If the ratio h/m is denoted by u and the ratio of m/s by v, then the values of k and t may be expressed directly in terms of u and v, and the foregoing table used to find the volume when the rise ratios and span to rise ratio are known. Thus

$$\frac{r}{R} = k = u\,\frac{1 + u^2v^2}{1 + u^2}$$

and

$$t = s/r = \frac{2v}{1 + v^2}$$

TABLE II—VALUES OF

u/v	0.2	0.4	0.6	0.8	1.0
0.2	0.19	0.38	0.45	0.50	0.52
0.4	0.19	0.36	0.47	0.54	0.58
0.6	0.20	0.36	0.50	0.60	0.68
0.8	0.20	0.36	0.54	0.69	0.84
1.0	0.20	0.40	0.60	0.80	1.00

Table II gives the value of k in terms of u and v and Table III the values of t in terms of v.

TABLE III—VALUES OF t

	t		t
0.1	0.2	0.6	0.88
0.2	0.38	0.7	0.94
0.3	0.55	0.8	0.98
0.4	0.69	0.9	0.99
0.5	0.80	1.0	1.00

When the angle of intersection of the two arches, or of the two cylinders is not a right angle, the foregoing formulas may be applied with a slight correction. The element of volume is now a lamina with face a parallelogram. The sides still have the lengths as determined before, and if the acute angle of intersection is ϕ, then the element of volume becomes,

$$\sin\phi \left\{ r - \sqrt{r^2 - x^2} \right\} \left\{ R - \sqrt{R^2 - x^2} \right\} dx$$

and the final formula takes the form $V = KR^{\cdot}\sin\phi$.

Lumber Varieties by States

Arkansas is the leading lumber state in the production of red gum, hickory, ash and sycamore, according to information compiled by the National Lumber Manufacturers Association. California leads in redwood, white fir and sugar pines. Louisiana is first in yellow pine, Colorado in lodgepole pine, Idaho in larch, Indiana in beech, Maine in balsam fir, Michigan in maple, Minnesota in white pine, Mississippi in cottonwood, Missouri in walnut, Oregon in western yellow pine, Tennessee in oak, Washington in Douglas fir, spruce and cedar, West Virginia in chestnut and yellow cedar, and Wisconsin in hemlock, birch, elm and basswood.

I.C.C. Reviews Status of Tests of Automatic Train Control

THE present status of the Interstate Commerce Commission's study of automatic train-control is summarized in its annual report, covering the period from Nov. 1, 1921, to Oct. 31, 1922. The various devices for train-control and their success in practical use are discussed as follows:

IN OUR last annual report we stated that arrangements had been made by our bureau of safety and a joint committee of the American Railway Association for observations under service conditions of three automatic train-control devices of the intermittent electrical contact type.

These observations, made during the period from May, 1921, to March 31, 1922, disclosed that 148.8 miles of road, 276.6 miles of track, 142 engines, 276 indication points, and 275 signals were equipped. The engines travelled 721,581 miles in the equipped zones, and the total number of operations observed was 659,875. The tests demonstrated that automatic train-control devices observed have been developed to the point where now they are practicable under actual service conditions; that they perform their intended functions and that, when properly installed and maintained, they increase the safety of train operation. During the tests some features undesirable from an operating standpoint were disclosed, but these can be corrected as the devices are installed and utilized more extensively.

I.C.C. Requirement—In June, 1922, we adopted specifications and requirements for the installation of automatic train-stop or train-control devices and ordered 49 carriers to install upon a full passenger-locomotive division, included within designated portions of their respective lines, a device in accordance with these requirements. We have not recommended any particular device or any particular type. The specifications are drawn so as to establish fundamental safety requisites, leaving to the carriers the selection of any device which will meet the requirements.

The act requires that such order be issued and published at least two years before the date specified for its fulfillment. The carriers requested additional time within which to make further tests and we allowed a further period of six months. In view of the additional time granted, the years of study and experimentation already devoted to the subject of automatic train-control, and the growing need therefor, it is expected that our order will be complied with promptly. Under our order the installation must be com-

Try Induction Devices—In addition to devices of the ramp type, a number of roads are now installing induction devices for test purposes. These are non-contact devices which depend upon the effects produced upon apparatus on the locomotive by magnets, or inert elements, placed between or outside the running rails. They are, like ramp-type devices, intermittent in their action; that is, impulses are transmitted to the locomotive from roadside apparatus only at certain selected points. Devices of intermittent type are generally devices to compel obedience to stop indications of fixed wayside signals or, where speed control features are incorporated, to compel obedience to caution indications of such signals by automatically bringing the train down to a predetermined safe speed.

The need for automatic train-control devices has been further emphasized since Jan. 1, 1922, by our investigation of six serious train accidents resulting from non-obedience to automatic block signals. These accidents resulted in the death of 50 persons and injury to 488 others.

Carrier Pigeons Aid Forest Fire Fighters

The U. S. Forest Service is experimenting with carrier pigeons as aids in fire fighting. In a recent test a pigeon was dispatched to headquarters from the scene of a fire, but before the relief party was organized a second pigeon reported the fire under control and assistance needless.

Changes in Mattamuskeet Drainage District, North Carolina

Project Refinanced, Levees Repaired, Canals Dredged, Pumps Overhauled and Railway Built for Better Transportation

By John R. Wilbanks
Consulting Engineer, The R. L. Dollings Co., Columbus, Ohio

THE bed of Lake Mattamuskeet is a shallow basin in Hyde County, N. C., lying between Albemarle and Pamlico Sounds, about fourteen miles long and six miles wide, containing 48,830 acres. The elevation varies from sea level to —3.9 and the soil is very fertile. (See U. S. Department of Agriculture Bulletin, "Soil Survey of the Lake Mattamuskeet Area, North Carolina," by W. Edward Hearn; May 16, 1910, p. 1.) The lands surrounding the lake have been in cultivation for more than two hundred years and in but few places is the elevation as great as 10 ft. above sea level. The first effort to drain this lake dates back to 1773 but no progress of consequence was made until about 1908 when both State and Government officials, appreciating the value of the property, used the resources at their command to aid private enterprise to develop the property. The technical features of the project were described in *Engineering News*, March 1, 1917, p. 346, with editorial comment on p. 365 of the same issue, while on March 29, 1917, p. 529, there appeared a letter by J. W. Dappert, criticizing the work. This article will review the recent history of the project and outline some extensive repairs and deferred maintenance work, and also the construction of 35 miles of railway to afford the district better transportation facilities. The total amount of water to be removed is about 8,300,000,000 cu.ft. per year and estimating that evaporation and plant growth will take up 40 of the 60 in. of annual rainfall, the pumping plant should handle the remainder in 54 days.

The writer first became acquainted with the project in the Fall of 1918 when he visited New Holland as a representative of financial interests who were contemplating the acquisition of the holdings of The New Hollands Farms, Inc., which company owned the 48,850 acres of land constituting the lake bed.

Refinancing and Reconstruction—It is easy to look back over work already begun or completed and pick flaws or offer criticism. The drainage of Lake Mattamuskeet would have been an ideal private enterprise with a boundary canal and levee surrounding only the lake bed proper and with a pumping plant of half the capacity of the present one. However, the district was already established and the problem to be solved was whether or not the plan could be successfully completed. A thorough investigation disclosed that the original layout had been well considered, and the improvements which had been made were with the idea of permanency. Perhaps the prime cause of delays and misfortunes was the fact that the project was inadequately financed and the various efforts poorly co-ordinated. The consequence was that in 1918 the lake was again full of water and the canals which had been dug were about 85 per cent filled with silt. The levees were leaking badly and the pumping plant had not been kept in good repair. Transportation facilities for an enterprise of this magnitude were entirely inadequate. The maintenance tax assessed was insufficient and in general the entire work had to be refinanced. Continuance of the enterprise was warranted by the fertility of the soil, the delightful climate, nearness to market and demand for the products.

PANORAMIC VIEW OF NEW HOLLAND TOWNSHIP AND PART OF MAIN CANALS
The view taken was from the top of a 125-ft. water tank and covers an arc of 180 degrees. Since the

The present owners of the property began work in the latter part of 1919. The pumping plant was put in first class condition, the levees were repaired and a 35-mile standard-gage railway (New Holland, Higginsport & Mount Vernon R.R.) was built from New Holland directly across the lake connecting with the Norfolk Southern R.R. at Venona, N. C.

This railroad was located for the purpose of providing all of Hyde and a part of Washington Counties with the most direct outlet for truck and similar produce to eastern markets. Nine miles of the line is on the lake bed, where a good foundation was secured; about five miles was across a savannah of black muck, where the track was laid on a mat of poles and later ballasted with sand, while the remainder is across lands which have already been reclaimed by gravity drainage districts. The section of the Inland Waterway connecting Albemarle and Pamlico Sounds crosses this railroad about halfway between Wenona and New Holland and its completion will aid materially in the transportation need of the community in general. The Foundation Co. of New York City was the contractor for the railroad. A gasoline truck and trailer was put in service on the railroad for the purpose of accommodating passengers, mail and express. It made one round trip daily and its performance was remarkably reliable and economical but the business soon outgrew its capacity although it now serves as an auxiliary and is very

effective equipment for any short line railroad to own.

The present dredging equipment consists of one 12-in. hydraulic dredge and two 1-cu.yd. gasoline dredges. Water has been maintained at from 5 to 7 ft. below sea level without difficulty and, as severe weather conditions have existed since the work was completed, if there are any reasons why the district cannot be maintained they are not apparent at the present time.

Model Town—The town of New Holland is being built with modern cottages and equipped with sewers, waterworks and electric lights. It is proposed to sell the land to experienced truck farmers in small tracts and give them time to demonstrate that they can earn money on their land to pay for it, providing their efforts are constant and well directed. Farming is not a business in which people get rich quickly, and while it has been pretty thoroughly demonstrated that the soil in this district will produce more per acre at a less expense of either money or effort than any known similar soil, there is still considerable knowledge to be gathered concerning the most profitable crops to plant and how to market them to best advantage.

Community planning and developing must "feel its way" in a practical manner for several years to come, but the development will be rapid, as there is no grubbing or clearing to do. Ownership of land after all is only a chance and its moral value depends upon the use which is made of it. The continued success of the enterprise depends upon getting experienced settlers on the land and providing them with a direct market for their products.

Since the draining of the lake has been accomplished the company has been grading roads, putting in small lateral ditches, planting various crops and in general getting the property in shape for settlers to begin actual farming on their arrival.

The only comtemplated changes in the original plan are the possible gravity diversion of some of the rainfall on lands above sea level, and perhaps a change in design, but not purpose, of the various townsites.

Both "dry land" and floating dredges can be used to advantage in maintenance at the present time, but an electrically-driven hydraulic dredge of light draught, getting its power from the pumping plant, will no doubt be the most suitable for permanent use.

The new work was done under the supervision of the Service Department of The R. L. Dollings Co., Columbus, Ohio, of which Dwight Harrison is general manager and the writer is consulting engineer. K. L. Ponzer, New Holland, N. C., is chief engineer of the North Carolina Farms Co. The Board of Drainage Commissioners consists of D. H. Kirwan, S. S. Marshall, and the writer.

OF MATTAMUSKEET DRAINAGE DISTRICT, HYDE COUNTY, NORTH CAROLINA
view was taken a number of streets have been constructed and additional buildings have been erected

GASOLINE MOTOR CAR AND TRAILER
The equipment made a round trip of 70 miles daily with success until its capacity was outgrown. It still serves as an auxiliary.

Desired Data on Multiple Arch Bridges

Facts on which to base the design of concrete multiple arch bridges are meager, especially for structures having relatively tall piers. The Engineering Foundation states that some months ago A. C. Janni proposed that it organize a co-operative study of such structures, involving tests of experimental arches and piers built for the purpose. The Foundation sought the counsel of the Advisory Committee on Civil Engineering Research, which reports that it believes the study to be important and desirable but extensive and probably very costly. If support for the project should develop and it should be undertaken, a natural beginning would be observations on existing bridges. Private parties have attempted some measurements on a large bridge of this character. In another bridge, preparation was made for observations, and some measurements may have been taken. There may be other cases. Engineers who have knowledge of such data are requested to inform the Foundation, at 29 West 39th St., New York. Expressions of opinion as to the usefulness of the proposed investigation and information about existing bridges on which observations could be made would also be helpful; also information about deformations and stresses in such structures caused by shrinkage of the concrete, temperature and moisture changes, settlement of foundations, and effect of removal of forms. These factors may be more important than loads.

Financing the California State Highway System

Commission Estimates $135,000,000 Additional Funds Required — Seven Recommendations Made—Traffic Control Urged

[illegible], who has just retired as State Highway Engineer of California.

WHILE the great activity in highway construction during the past two years has given the state the service of a large new mileage of improved road, it has also brought California face to face with the problem of refinancing its highway system.

Money Needed—How great an amount of money could be advantageously spent upon California's road system is indicated by the mileage now in the system and the character and cost of the portion that has been improved as compared with the mileage yet to be improved. The figures are as follows:

[illegible]	[illegible]
[illegible]	[illegible]
Mileage still to be improved (exclusive of graded roads included in the improved mileage above, but some of which are yet to be paved or otherwise further improved)	3,900

The following tabulation shows the mileage of bond issue roads constructed or improved:

	Miles
[illegible]	[illegible]
[illegible]	61
[illegible]	16
[illegible]	[illegible]
Asphalt surface on concrete base	108
[illegible]	[illegible]
Total	[illegible]

The cost of the completed bond issue roads has averaged approximately $20,000 per mile. The average cost per mile of improving the remaining roads in the California state highway system, however, will probably be not less than $25,000 and may be considerably more than this amount, depending entirely upon the class of improvement adopted.

Most of the work to date on the system has been in the valley or hill sections of the state where the grading was comparatively light and pavement costs were relatively low, due to close proximity to rail facilities. By far, the greater part of the grading yet to be done is in mountainous country.

At $25,000 per mile the cost of improving 3,900 miles will amount to very nearly $100,000,000, but this amount does not represent the total expenditures that must be made on California's highway system. It represents simply an estimate of the cost of improving to average specifications of past years the unimproved portions of the present state highway system, and the reconstructing of the old county-built macadam roads in Los Angeles, San Joaquin, Sacramento and several other counties, which have become a part of the state highway system.

To this must be added the cost of widening and thickening approximately 1,200 miles of the present system and the elimination of grade crossings. These two latter items will cost about $35,000,000 additional.

Work in sight at the present time will, therefore, cost not less than $135,000,000 to complete.

It should be noted that the above statement includes only items involving capital expenditures. Money for maintenance must be provided outside of this sum.

Methods of Financing—Three methods of financing highway construction have been analyzed: (1) Construction on a pay-as-you-go plan, (2) construction on a bonding or deferred payment plan, (3) construction on a plan based in part on direct payments and in part on bonds. As a result of a careful study of these plans the commission has reached certain definite conclusions relative to highway financing. These may be summarized as follows:

1. The demand for roads is so insistent that the public will not be content to await their construction on the slow process of pay-as-you-go plan. Correlated with this is the demonstrable proposition that improved roads pay their own way with a handsome return on the investment and hence an investment in good roads is a paying venture for the people of the state.

2. While another bond issue appears to be imperative, the users of the roads should be asked to bear a larger share of the highway burden than has been placed upon them in the past.

3. Future bond issues should not contemplate providing funds for the completion of the entire system. The public should realize that the completion of the state highway system is many years in the future and that as California grows, its road system must grow with it. Disappointment can only follow any bond issue which the people are asked to vote with the promise that it will be the last one.

4. The preferable method is to ascertain the amount of work that can be economically and efficiently undertaken by the California Highway Commission in any one year, and under normal building conditions. With this ascertained, the work should then be financed for a period of not less than five years.

5. Such a plan would require a rigid budgeting of the funds of a bond issue. Some financial flexibility is absolutely necessary in the conduct of the work. This can be secured if federal funds are left unbudgeted.

6. The gasoline tax and an increase and equalization of the motor vehicle fees offer a practical and fair method for imposing a larger share of highway costs upon highway users.

7. The legislature should definitely and rigidly refuse to designate roads as state highways unless at the same time finances for their improvement and maintenance are provided; nor should any roads be included in a bond issue except upon definite allotment for their construction.

Traffic Regulation—No less important but somewhat less perplexing than the question of highway finances is that of the traffic regulation on the roads.

It is the opinion of the Highway Commission that the present maximum weight of 30,000 lb. permitted upon the state highways should be decreased to a maximum permissible gross weight of 22,000 lb. This latter weight will permit the operation of the five-ton truck and its load.

Experience has demonstrated that the mere passage of a regulatory law is useless unless machinery is set up for its enforcement. The Highway Commission recommends the establishment of an adequate force of state motor police to enforce traffic laws on state highways. It is the opinion of the Commission that such officers should operate under the direction of the Highway Commission for the reason that the body charged with the responsibility of maintaining highways should be vested also with power to adequately protect them.

The Commission would also recommend that there be written into the law of California by the next legislature the so-called "Maryland Plan."

This plan has been found the most effective method yet devised for stopping overloading, inasmuch as under it the operator of a truck found with an overload can be forced to remove it before proceeding farther on the highway. Once forced to leave a portion of his load by the roadside, there to incur the risk of damage through the elements or loss by theft, and the further expense of sending a truck back for a small cargo, operators are careful to avoid future overloading. Recommendations for traffic regulation may be summarized as follows:

1. The maximum permissible weight on state highways should not exceed 22,000 lb.

2. An adequate force of state motor police should be authorized for the enforcement of traffic laws on state highways.

3. The police should be under the authority of the State Highway Commission, the body responsible for the protection and maintenance of highways.

4. Where portable scales reveal that a truck is overloaded, traffic officers should be authorized to demand the removal of the excess load before the truck proceeds on the highway; the so-called Maryland plan.

Concrete Bridge a Continuous Beam on Hinged Piers

War-Time Structure for French Steel Plant Also Has Approach of Novel Box Retaining-Wall Type

DURING the war there was built at a steel mill at Saint-Chamond, France, a long reinforced-concrete viaduct of exceptional novelty in design. Only in a recent issue of *Le Genie Civil* has there appeared any description of the structure, and from that description there has been prepared the following account:

The viaduct carries the service railroad of the plant across a valley which is traversed by other tracks on grade and filled with buildings. Because of the restrictions of both line and grade, the latter to gain clearance and to provide safe travel for the service trains, it was necessary to lay out the new viaduct on a slight curve, to spot its piers at odd intervals and to provide a minimum depth to the spans. In order to answer these requirements and at the same time take care of expansion, reduce breaking stresses and effect economies in reinforcement, it was decided to make the main crossing a continuous beam carried on hinged piers and abutments. The approach is a series of concrete cells filled with earth.

As shown in Fig. 1, the total structure is 764 ft. long, of which 62 ft. is a small approach single span, 283 ft. at one end and 31 ft. at the other end retaining wall, and 390 ft. the continuous-beam viaduct. The viaduct comprises seven spans, varying from 89 ft. to 94 ft. In section, as shown in Fig. 3, the girder is 6.6 ft. wide and 7.2 ft. deep with 6-ft. 2-in. cantilevered brackets. It is reinforced with a number of small rods at the bottom, together with a series of longitudinal spirals in the lower part of the section and with the usual cantilever reinforcement for the bracket. It carries in its center a 4.9 ft. gage track (1½ m.). Vertical reinforcement consists of diagonal stirrups as shown. Each span is corbeled at the supports and extra reinforcement in that section is provided by spirals as shown in Fig. 3.

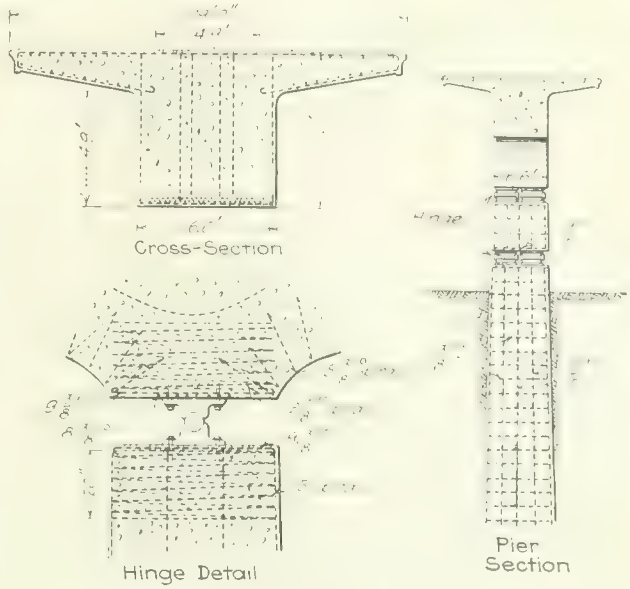


FIG. 3—DETAILS OF MAIN GIRDER AND HINGED PIER

This pier consists of a solid section through its spread bottom to a point just above the earth surface. Between this pier and the beam supports there is an intermediate pier with hinges both above and below, as shown in the section in Fig. 3. These hinges are of steel on steel pins. One pier in the middle of the viaduct is an abutment pier, much wider than the others and carries only one hinge. It will be noted, however, that the abutments are both two-hinged.

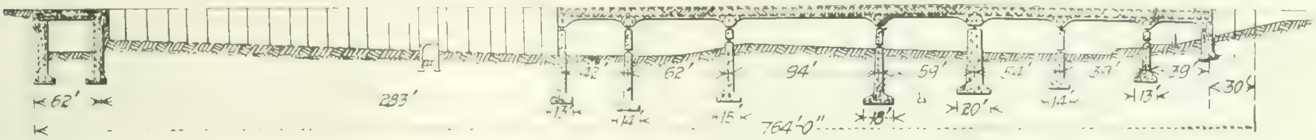


FIG. 1—LONGITUDINAL SECTION THROUGH NOVEL FRENCH CONCRETE BRIDGE

Main structure a continuous beam on piers which are double hinged, except anchor pier which has only one hinge. Approach is box retaining wall and small bridge at left end is solid slab with pivot support.

The retaining wall is made up of a number of cells of details as shown in Fig. 2. There are walls of varying thickness, but averaging around 8 in., sloped slightly inward and with cantilever brackets outward at the top. They have a spread footing at the bottom and are cross-braced with 6-in. walls. This section was built on an old slag fill of a number of years' standing.

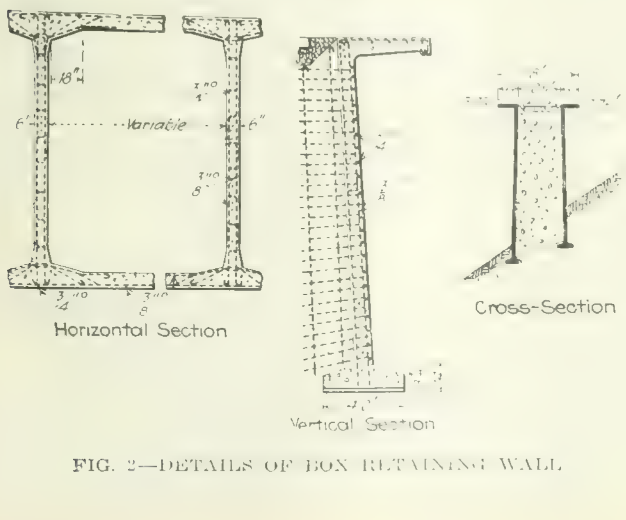


FIG. 2—DETAILS OF BOX RETAINING WALL

The bridge is designed for very heavy loads. According to the statement in *Le Genie Civil* it has to resist a speed of 12 km. per hour (9 miles per hour), two types of load: one, a locomotive of 50 metric tons pulling a special car of 200 metric tons load, with four axles of 1.1 m. to 1.75 meters, and a total length of 5.5 meters; the other, the same locomotive followed by an indefinite number of cars of 65 metric tons each. Special attention is paid to wind stresses and braking stresses. After the construction the bridge was tested to the full design load with quite satisfactory results. It was found, for instance, in the longest span (95 ft.), where there should have been a theoretical deflection, considering the tension in the concrete, of 8.25 mm. and of 11.25 mm. without considering the tension, that the observed deflection was 9.9 mm.

Fundamentals of Highway Department Organization

Address Before the Association of State Highway Officials Urges Leadership—Ability to Sell Highway Improvement to the Public Is Paramount

BY A. R. HIRST
State Highway Engineer of Wisconsin

IF WE investigate American highway history we find practically without exception that those states which have made distinguished successes of their highway work, have done so because the work was controlled by a body or person permitted to function over a series of years without political dictation or interference. Conversely, we find, almost without exception, that in states where a new governor invariably means a new highway administration highway progress has been slow and unsatisfactory.

In a work where length of service, experience and knowledge of past history is as essential as it is in the highway field, the control of the work should not be subject to instant change with every political change, but should be as far removed from the domain of politics as it is possible to place it and yet make the administration of highway matters properly responsive to the taxpayers.

The body acting as the board of directors of a state's highway work should be a long term body, appointed from time to time by successive governors, so that no single governor, unless elected over a term of years, could control the state highway department. This body should consist of a practically non-paid state highway commission composed of high class men serving because of their interest in highway work, and in public service, and not because of the emoluments. It has been found possible in every state which has tried it, to find strong men to serve and serve well on the highway board of directors, provided too much of their time is not required.

The state highway body should act as a board of directors, determining the principal policies, and selecting and employing the executive officer and holding him responsible for the success of the work. In this way the executive officer is removed one place from direct contact with politics, and is free to prosecute the work of highway construction and maintenance without political embarrassment.

Manager of the Enterprise—Every effective organization has a head—a single head. Most enterprises have boards of directors, or the equivalent, but in the final analysis, every enterprise has one man who is held responsible for the success of the enterprise.

This must also be true of highway work. The enterprise must have a single manager or executive. Whether this executive or manager is appointed by the governor, elected by the people, or appointed by a board or commission, is immaterial as long as longevity of service is insured to the successful manager. Length of service as a reward for good work is made much more sure for the manager who is appointed by a board or commission, in turn appointed by the governor, than in any other way. The history of highway departments demonstrates that this is true. We believe that the states will not be well organized to perform their highway functions until this plan of organization is universal.

Whether the appointee should be a highway engineer, or a high class professional or business man not an engineer, is debatable. I am enough of an engineer to believe that when there is the uniting of the proper qualifications in an engineer, he makes the ideal manager of a state highway enterprise. But the combination of the proper business and managerial ability with the proper amount of engineering ability is not universal in engineers, and the present American tendency to appoint a non-engineer as the executive controlling the general phases of the work, while a chief engineer is employed to have charge of the engineering, may be the solution in many cases.

High Points in Mr. Hirst's Address

There are some 15,000 highway engineers, not including the thousands of county and municipal officials, who need to know something of highway problems.

All of these men have received their training in the last 30 years and infinitely the greater number of them in the past 10 years.

One of the chief problems of highway administration is to organize these men into permanent, efficient, loyal bodies for highway development.

Each state organization should consist of a non-paid highway commission, acting as a board of directors.

A single executive should direct the work, and whether this manager is appointed by the governor or the commission or elected by the people is immaterial as long as longevity of service is assured the successful manager.

Essentially the problem of building the American highway system is not a problem of engineering but a problem of handling people in detail and in mass.

In selecting men for highway work look first for personality and second for technical knowledge.

To secure and retain clean-cut, energetic and progressive men it is necessary to pay salaries adequate to the work.

Unless a state highway department can sell and does sell its ideas and its ideals to the people, it fails to perform its greatest function.

It is undoubtedly a good solution wherever a big man, not an engineer, and who realizes he is not an engineer, is employed as the manager. But in too many cases the moment a successful lawyer, farmer, or business man steps into the chief highway chair, he becomes an expert highway engineer in the twinkling of an eye, and rules the roost from top to bottom, without having the necessary background, education or engineering qualifications to do so.

However, an effective state highway board or commission can regulate the division of responsibility as between the instruments which they believe it advisable to employ. If the board or commission realizes the line which must be drawn between the executive management of the enterprise and the control of the engineering phases of it, the work will succeed regardless of whether the man at the head is a good highway engineer or a good general executive.

The Subordinates—The field of highway engineering, due to the romance of it and the fact that it has become within a decade probably the largest employer of civil engineering talent in America, has attracted a very high class of young men. These young men, not knowing very much about the political situation overhead, have come into the game with pride and enthusiasm. They want to make good, they are capable of making good, and they will make good, if those of us who are responsible for the conditions under which they work can create the right kind of organizations for them to function and expand in.

These young men—our successors—have had, most of them, better training than we had. They enter the field after many of the elementary problems have been met and overcome, and they should become better highway engineers than any of us have been able to become. Two much stress, however, has been placed upon the importance of engineering knowledge and training as a preliminary to work in the special field of highway engineering. Universities and colleges can produce scientists, but God only can produce men of natural adaptability and brains.

Essentially the business of building the American high-

way system is not a problem of engineering, but a problem of handling people in detail and in mass. Humanness is the big factor in the game. The ability to impress one's own viewpoint while not insulting the man who holds another is a prerequisite. We must deal in county highway work with county boards and with the residents of the county; in state highway work with the legislature and with the whole people of a state. No matter how profound our learning, how inclusive our experience, or how well founded our conclusions, if we cannot put our ideas and ideals across and get the support of the legislatures and of the people of the unit of government which employs us results cannot follow.

It is my conviction after a highway experience of twenty years that the first thing to be sought in employing a highway man is personality and likeability. There will of course need to be down in the lower registers scientists without number, but these are not the men who will leave their impress upon the highway thought or upon the highway progress of America. In selecting men for service in highway departments look first, for personality and second, for knowledge. Personality without knowledge is of little avail, because the American people are quick to see through pretense and bombast in their employees. But, on the other hand, knowledge without personality, except in those positions close to the bottom, is just as useless. Highway executives should not lose sight of the human equation, which is the only factor that really counts.

In all times to come, the administrative highway official will have to get the funds for his program out of the people through their legislative bodies. He must be an advertiser and a seller of his goods. He must be a promoter of parts, able to get out a prospectus and to make a sale, and he is selling not one person but millions of them. We want in this field young men of education, of promise, of courage,—men who really belong. The half-dead-and-alive ones, who would not know a football yell from a cradle song, belong behind the drafting desk, pushing a right line pen or chaperoning a planimeter around cross-sections.

The Matter of Salaries — We have stated that we need clean-cut, energetic, up-and-coming organizations. The only way to insure these is to pay salaries adequate to the work. There has been a considerable increase in the salaries paid by American highway departments. The proper standards have not yet been reached, but if the next five years show the same progress that the last five years have recorded, proper salary scales will have been established.

The great difficulty in establishing proper salary scales in the average state is that the whole scale of public salaries is too low. When the governor of a state receives a salary of $5,000 a year, it is hard to convince the people of the state that the head of any state department should receive more than the governor. However, it is being done in many of the American states, and it must be established in more of them if real success in the highway program of the state is to be secured. The salary paid the executive head of a highway department is supremely important because his scale dictates the scale of all below him—well paid head, well paid department, and vice versa.

The highway field is a highly competitive one. There are a number of allied and supplementary branches which appeal to the engineer as profitable and attractive. If the state highway departments are to hold their best young men they must convince them that they have at least as much to offer as have other branches of the business.

The only other large employer of civil engineers has been the railroads. Their scale of salaries has been comparatively low, but they have kept a very high class personnel in their engineering forces, simply because there were positions higher up, well paid and even magnificently paid, to which the young engineer could aspire.

We must establish approximately the same conditions in the highway engineering field if we expect to hold the best of our young men. If the higher positions, paying the money, are always to be held by politicians and political appointees, we are going to create a very discouraging situation for the up and comers down below.

One discouraging factor in the situation is, that many fine men interested in highways who have made their stake in other enterprises, are entering the highway field and accepting without protest any salary offered them simply because the salary they obtain from their highway work is not a factor in their personal situation. They wish to perform a public service and are willing to do so at any salary because they have made their stake.

We are very glad to see them enter the work. They should realize, however, that while highway work may be the plaything of a few years to them and means nothing as to their financial success in life, the highway field is the field of life performance for thousands of other men who expect not only to make a decent living out of it, but hope finally to amass a reasonable competence for old age.

Selling the Ideas—All of us must sell our ideas and our ideals to the national and state legislatures. The county highway administrator must sell his ideas and ideals to the county board. These are delicate and important tasks.

Unfortunately about three-fourths of the political campaigns of America are carried on, with all participants pledging themselves to economy and efficiency in the operations of whatever unit of government they aspire to represent. The conception of the great majority of these men as to economy and efficiency is that it will be best promoted by cutting down on the amounts spent for overhead. They believe, almost without exception, that the body politic will function much better if some of the members are amputated. Consolidation of departments, and elimination of departments has a public appeal, only second in effectiveness to promised curtailment in the funds appropriate to operate those departments which are to be allowed to continue to exist.

Economy and efficiency are considered sister words to lack of expenditure for overhead. The reduction of fifty thousand dollars in the cost of operating a well managed state highway department is hailed as a master stroke of economy when, as a matter of fact, it is usually the very acme of wastefulness, leading to abuse and looseness in the expenditure of the vast highway funds available.

The average state legislature or the average county board would not deliberately cripple or make less efficient any branch of the state and county service, but it has so long been in the blood of the American people that the less public servants they have, the better their pocketbooks are protected, that it is difficult to eradicate the idea.

The national bill for rural highways now totals approximately $750,000,000 a year. The expenditures of many of the larger states for rural highways are over $20,000,000 per annum. Those large states which have not reached this total will soon approach it. In the expenditure of sums of such staggering magnitude only the best talent should be employed. Where it does not exist it must be made. The state which first gets and keeps a highway organization, composed from top to bottom of men with knowledge, brains, experience, energy and foresight is going to get the cheapest highway service, regardless of the amount of money spent in operating its highway departments.

Unfortunately, too many highway officials despise work with the legislatures and with the county boards. They consider it beneath the dignity of their profession to mix with politicians. But as long as the American government is organized on a political basis just as long will state, county and city employees have to do business with politicians. That, of course, means as long as the American government shall endure.

The American politician is not, in general, either vicious, ignorant, or unpatriotic. He, however, changes often, and he cannot know the highway situation in our state as we should know it. It is one of our duties to help him to know it, and the dodging of that duty and responsibility makes impossible the performance of the service which we should give our people. A state highway department is not a real department unless it can make definite proposals for legislation, help to frame those proposals into bills, and then help to pass those bills. The department which takes what it gets, gets little. Neither do the people of this state get real highway progress or service.

From Job and Office

Hints That Cut Costs and Time *For the Contractor and the Engineer*

Plotting Transit Lines by Natural Tangents and Cotangents

By Francis R. Molther
Brooklyn, New York

With the object of employing a system of the greatest expediency reconcilable to sufficient accuracy, the following method of plotting long transit lines was developed on a recent railway location job in Colombia. The general method consisted in plotting all courses by the employment of the natural tangent or cotangent of the angle deflected by each course from a predetermined meridian.

The meridian should be laid off on the sheet in the most desirable manner, as indicated by the size of the sheet or the space available for the map, and the general direction of the survey. Normals should then be erected or dropped from this meridian as required by the length of the courses to be plotted, and the general deflection of the courses to the right or left of the meridian.

Then, at some convenient decimal scale, a distance to be considered unity should be measured to the left of the intersection of the meridian with the normal, along the line of the meridian, to give a base point for locating the azimuth of all courses measured by tangents on that normal. The tangent of the first course should now be laid off at the same scale along the normal to the meridian, up from the meridian if the deflection of the course to be plotted is left, or down if the deflection is right.

Any number of courses may be laid off on this normal, their length only determining when it may be desirable to move up to another normal. For reference, the points on the normal located by so measuring these tangents may be numbered 1, 2 and 3, etc. for the first, second and third courses.

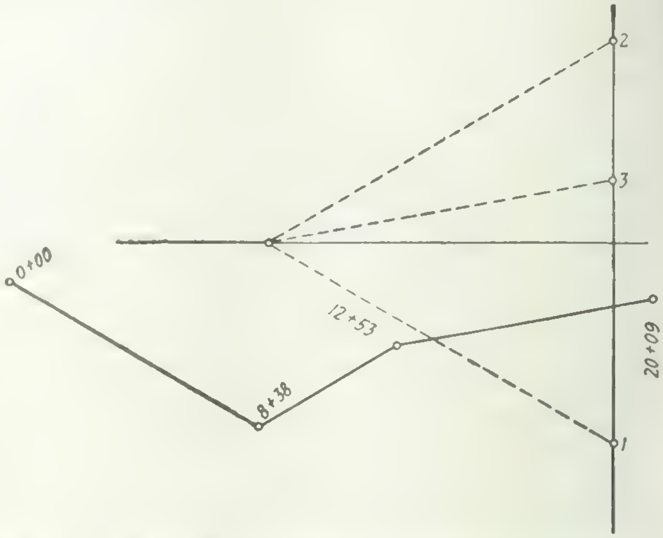


FIG. 1—LAYING OFF TANGENTS ON NORMAL TO MERIDIAN

Selecting some convenient point for the first hub the direction of a line through the base point and point 1 should be paralleled over, by means of triangles or parallel rulers, to pass through the point selected for the first hub. This line is the true direction of the first course, with reference to the meridian, and its length may now be measured at the scale selected for the map, locating the second hub. Repeating this process will locate all of the courses. Figure 1 shows the plotting of the survey line at this stage, complete to Hub 3 (Sta. 20 + 09).

Where deflection angles greater than 45 deg. are encountered, the natural cotangent of the angle must be employed, laying it off along the meridian, and measuring the distance unity on the normal. Deflections greater than 90 deg. must have that angle subtracted from them, and the tangent or cotangent of the angle remaining employed inversely for deflections of less than 90 deg. That is, where natural tangents are laid off on the normal and the meridian base point employed for angles less than 45 deg. when the angle is between 90 deg. and 135 deg. (less than 45 deg. when 90 deg. are subtracted), the tangent will be measured on the meridian and the base-points on the normals employed. Figure 2 presents a chart and sketch indicating the proper position for laying off and determining deflections of angles from 0 deg. to 180 deg.

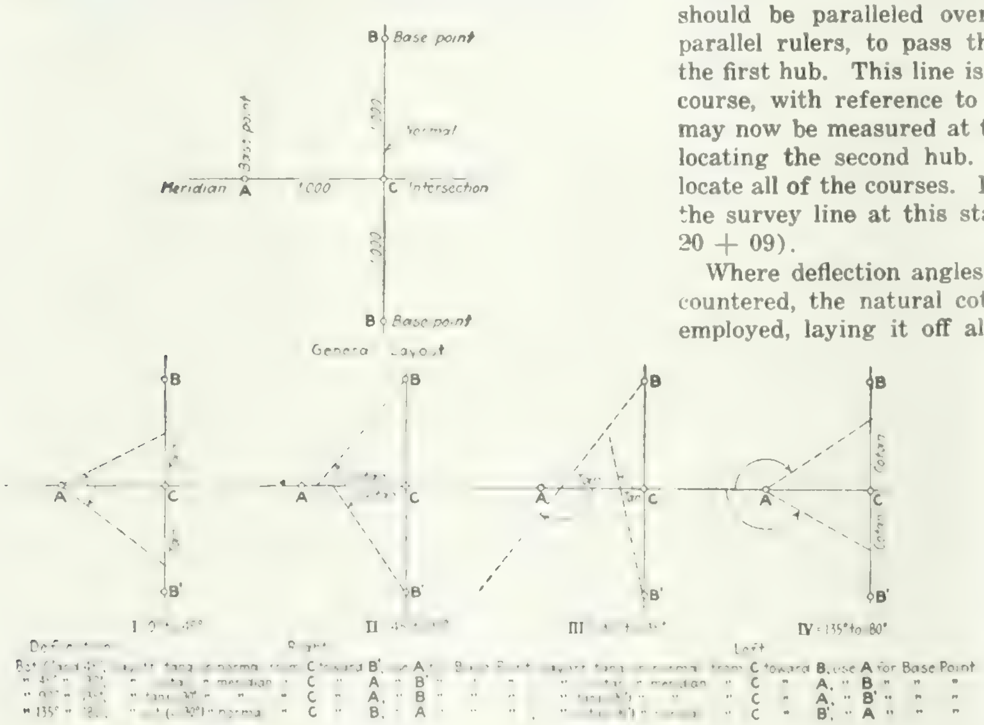


FIG. 2—PLOTTING ANY COURSE FOR DEFLECTIONS FROM 0 DEG. TO 180 DEG.

The occasion for which the writer adopted this method of plotting was for the drawing of the detail maps for a railway survey in Colombia, some 300 km.

in length, and generally northeast in direction, but with sharp breaks of several kilometers required by various developments in directions nearly normal to the general direction of the line. The line was completed with about 5,000 stations. The courses between each two hubs varied in length from 4 m. to 7 km. depending upon topography.

The great number of stations to be plotted recommended the use of some system more rapid than computation of latitudes and departures. At the same time a method as accurate as the use of co-ordinates was required.

The application of the general method outlined above was first to determine by means of a small scale chart, the meridional components of each course. The latitudes and departures of those hubs which were at the points of sharp changes in direction were then determined, and plotted at 1:10,000 scale. A meridian was now fitted through this skeleton of the survey, with the object of planning to incorporate as much of the survey in a single stretch as possible.

This first sketch also indicated the last hub which could be contained on this sheet, and the next step was to refer all the courses, between that hub and the first one accommodated on the sheet, to the selected meridian. This was done in the transit book. This computation was checked before proceeding, by subtracting like deflections, and adding unlike deflections, to arrive at the original deflection at the hub as contained in the notes. Incidentally, this check also afforded a further check on the transit notes, and caught several compensating errors occurring in pairs on the same page that had prevented the original check of the page. To these data in the transit book, was added the natural tangent or cotangent of each deflection, or the deflection less 90 deg. where required, as explained previously.

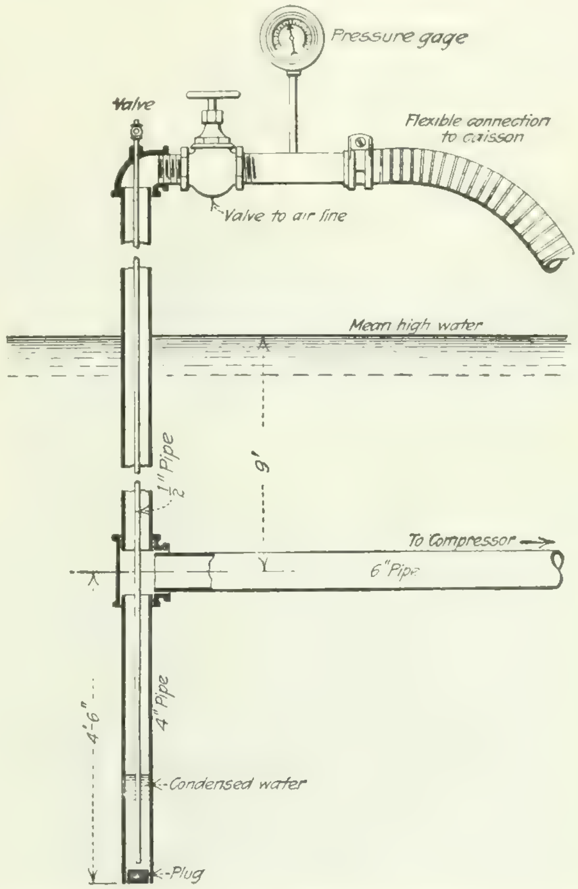
The scale for all detail maps was 1 : 2,000 (metric), drawn on rolls 48 in. wide, making the sheets as long as the undulations of the survey would permit. A straight line was carefully drawn down the middle of the sheet, and assumed to be the same azimuth as that selected for a meridian from the preliminary sketch made by approximate latitudes and departures. On this line normals were erected every 500 m. at the same scale (1 : 2,000) as that to be used for the map. On each normal, employing that section of the meridian between each pair of normals where necessary, the tangents or cotangents on one page (usually 12 to 13 courses) were measured. Occasionally the length of all the courses on one page would prove so short, that the same normal, and section of meridian, would be employed twice, or the courses would prove so long as to recommend skipping several normals before measuring the tangents and cotangents of the next page. The location of the first hub having been determined by the preliminary sketch, the courses, were now paralleled over to the respective hub where each started, and the length of each course scaled. As each course was paralleled, before its length was measured, the true deflection at the hub was checked with a protractor, which with a little practice could be read to 5 min. As each page of the transit book was mapped, the plotting of the distances was checked back.

This method is claimed to offer equal accuracy with that of latitudes and departures, when the advantage of the above opportunities for checking deflections and distances is employed.

Blowing Out Condensed Water in Air Line

WHEN the caisson for the Camden pier of the Philadelphia-Camden suspension bridge was being sunk the temperature of compressed air was so high as delivered to the caisson that the line had to be sunk in water in order to cool the air. At times the temperature would attain 150 deg. F., making work unbearable. Accordingly, the 6-in. compressed air line was set about 9 ft. below mean high water. The length of the line from the compressor to the caisson was about 1,400 ft., 500 of that amount being submerged.

Though air was cooled sufficiently in this fashion water condensed in the line, creating another difficulty.



CONDENSED WATER BLOWN FROM SUBMERGED AIR LINE

Inasmuch as the line was submerged the "blowing out" of the line could not be accomplished in the usual fashion. A simple device, illustrated herewith, was conceived by the man in charge of compressed air work to "blow out" the line.

At the caisson end of the line instead of a 90-deg. bend being put in the pipe to bring it from the water a sleeve was inserted and a 4-in. pipe run both ways The stub end, which projected farther into the water, was plugged. Through it and the pipe which projected from the water and to which was attached the flexible connection running to the caisson, a ½-in. pipe was run, being well packed where it projected from the 4-in. pipe. A blow-off valve was fitted into the ½-in. pipe.

When the water condensed it collected in the stub pipe. When it was apparent that sufficient water had condensed to void the pipe, the valve in the ½-in. line was opened and the air pressure in the air line forced the water out.

High Viaduct Moved 75 Feet Laterally

By Edward Godfrey
Structural Engineer, Robert W. Hunt & Co., Pittsburgh, Pa.

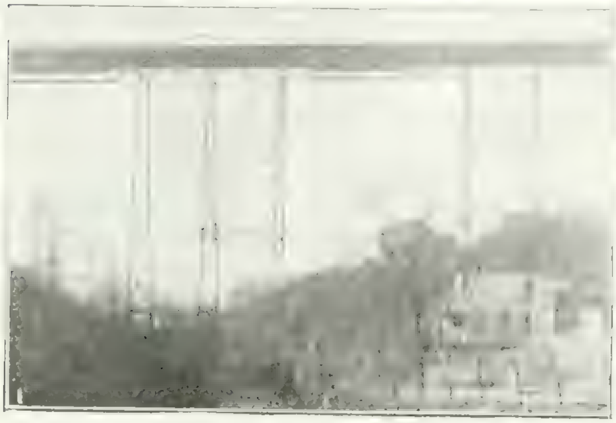
A SPECTACULAR engineering feat was performed in Pittsburgh recently when a high viaduct 740 ft. long was moved sideways bodily a distance of 75 ft. to make room for the building of a reinforced-concrete arch bridge.

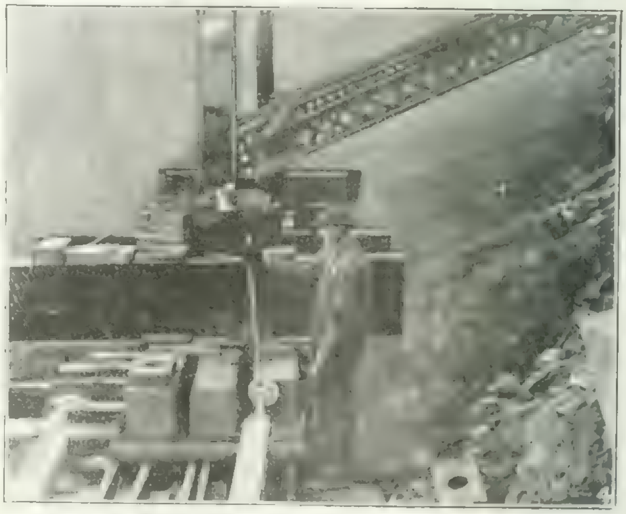
The viaduct is located on the line of the Pittsburgh Railways Co. to Bellevue, a borough adjoining Pittsburgh. It spans the deep hollow of Jacks Run; in its highest portion its floor is about 150 ft. above the bottom of the hollow. It was built about 28 years ago and has since carried the trolley tracks and a highway.

Some years ago the lattice girders supporting the floor system were reinforced because of rusting and heavier trolley loads. Before the work of moving the bridge was undertaken, the writer made an examination and discovered that the top flanges of the stringers were very badly rusted away, and further reinforcement was needed. The floor system was, therefore, strengthened by the addition of floor beams at the mid-panel points.

Because of the great height of the structure, the question of the overturning effect of wind was one of the main features that required attention preparatory to moving. It was dealt with not so much by theory or calculation as by the history of the bridge. Examination of the anchor bolts and bases of the posts showed that the bolts penetrated only the base plates, so that their value was only that of tension on the rivets connecting the angles with the shafts of the posts, and in addition that these bolts (which subsequent operations revealed were good, long bolts, well bedded in the stone caps) were practically devoid of nuts. What nuts had been put on were not drawn up. Some of them lacked three inches of being in contact with the plates. This was a very general condition, being true in particular of the highest towers. In view of the evident uselessness of the anchor bolts and the fact that the bridge had weathered the storms of more than a quarter of a century without any evidence of negative reaction on the bases of the posts, it was considered safe to cut it free for one day while it was being moved, without loading down the columns.

The viaduct is carried on thirteen bents. The spans in the towers are 30 ft.; other spans vary from 48 to 96 ft. The trusses are 8 ft. deep and are of the Warren type, with vertical posts at floor beams. This arrangement afforded opportunity to introduce the extra floorbeams at the upper panel points where the diagonals meet.





JACKS RUN VIADUCT PLACED ON ROLLERS AND MOVED TO A NEW SITE ALONGSIDE

Fig. 1—Highest part of [illegible] Fig. [illegible] [illegible] transfer the load to the rollers.

Fig. 2—Clamping [illegible] pier cap stone used [illegible] Fig. [illegible] Screw jack [illegible] the tower-leg blocking

FROM JOB AND OFFICE

Hints That Cut Costs and Time

FROM JOB AND OFFICE

For Contractor and Engineer

While preparations were being made for moving the bridge, new concrete pedestals were constructed on the new site of the bridge, and abutments were built up of cribbing and earth fill. The trolley tracks were laid on these abutments so that cars could be run on the bridge as soon as it was moved.

The accompanying views show some details of the moving arrangements. The support of two of the posts may be seen in Fig. 2. In the case of the post on the right, large I-beams were bolted on the side of the top stone of the pedestal. These beams were then jacked up and the second stone was broken up and removed, permitting the placing of needle beams under the heavy I-beams and under the cap stone, wedged against the cap stone. In all cases direct bearing of the stones under the posts was secured, either through needle beams or through timbers placed directly under the stones. The base at the left in Fig. 2 was handled somewhat differently. The second stone in the pedestal was picked up by means of I-beams and the one below this was broken out. The heavy I-beams as well as the needle beams were used to carry load to the rollers. Under both of these posts the load was delivered to channels laid flatwise, bearing on the rollers. Fig. 3 shows a case where timbers and channels laid flatwise were placed under the stone.

How the timbers and channels were placed is made clearer by Fig. 4, which also shows how the bridge was moved by jacks. Not much force was required to push the bridge along. In fact, after the work was started it was found that one end of the bridge and an intermediate bent needed no urging but moved along with the rest of the bridge, and no jacks were used at these points.

The rollers moved on rails supported on timber cribbing which rested on sills laid on the earth. The posts shown in Fig. 2 had double sets of rollers and double tracks, those shown in Figs. 3 and 4 had single tracks.

Several lines of electric conduit carried by the bridge were taken care of during the moving of the bridge by flexible connections, to maintain service.

The anchor bolts were burned off just before starting to move the bridge.

About six weeks of preparation were required before the bridge was ready to be moved. It was anticipated that one day would be required for the 75 ft. shift. Moving was begun on the morning of Nov. 24, and the bridge was in its new position about 9 or 10 o'clock at night. Cars were run over the bridge on regular schedule the next morning shortly after 10 o'clock; the delay was due to the fact that some truss reinforcement and shoring had to be done that morning at the extreme ends of the bridge, which required several hours of daylight.

Transit observations for alignment and level during the moving of the bridge showed very little deviation. The writer examined the steel, particularly at points over bents, and no fresh paint cracks could be discerned, showing that the steelwork was not racked in the process.

Foot traffic was not interrupted during the moving of the bridge. A large number of people walked across for the novelty of the thing.

When the viaduct was in its new position, brickwork was built up between the concrete pedestals and the masonry blocks that had been carried over with the several posts.

The moving was handled by the John Eichleay, Jr., Co. Ernest W. Niederberger is their engineer. W. C. Boyd is engineer and J. S. Martin structural engineer for the Pittsburgh Railways Co.; W. C. Wymer had charge of the instrument work; the writer was consulting engineer for the company as structural engineer for Robert W. Hunt & Co.

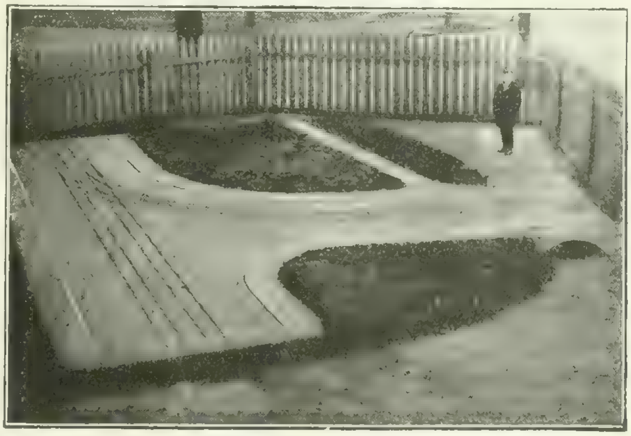
Almost 100 truckloads of equipment, including 300 jack screws, 400 steel rollers, a mile of railroad rails, 150,000 ft. of timber and cribbing and 100 tons of steel I-beams were used in executing the job.

Model Constructed to Clarify Contested Points in Street Intersection

By F. S. Besson

Major, Corps of Engineers, U. S. Army, Assistant to the Engineer Commissioner, District of Columbia

IN EXCEPTIONAL cases considerable expense is justified in constructing models to make sure that the best possible street intersections are obtained. The figure herewith illustrates a model of the new Georgetown bridge approach at its intersection with one of the city streets in the District of Columbia. The street is on a 3½ per cent down grade and the bridge approach on a 3 per cent up grade. The model, which is on a one-eighth scale, was necessary in order to co-ordinate the three interests involved: bridge, railway, and highway. Several other schemes were at first considered, all requiring a large bridge approach area with expensive track construction separated from the vehicular roadway, because prior to the construction of the model it was not evident to all that a satisfactory simple turnout, as illustrated, from the highway to the bridge, could be effected.



ONE-EIGHTH SIZE MODEL OF STREET INTERSECTION

The model was built mostly of sand containing some cement to depict clearly the possibilities of securing an easy railway turnout from the Georgetown Bridge approach to an intersecting street.

The model was constructed with sand, the curbs and rails of light flexible strips of wood nailed to stakes driven true to grade. The surface was given some degree of permanency by mixing cement with the sand.

[The above will be incorporated in a book soon to be published by Major Besson on the design of city streets —EDITOR.]

Costs of Installing Corrugated Pipe

Contractors and engineers are often confronted with the problem of deciding which of several types of culvert is to be constructed. Often the choice lies with that material which will give the lowest cost and the greatest serviceability. Data upon enough actual installations from which reliable costs can be ascertained will give to the contractor or engineer knowledge upon which a decision may be based. For that reason the article below has been prepared.—EDITOR.

IN A STUDY of several hundred thousand installations of corrugated iron culverts constructed in the state of California during the past ten years valuable figures have been made available for the cost of installing, both including and excluding the cost of pipe itself. The study covered installations in all sorts of terrain, from the most accessible flat valley to the most inaccessible broken sierras. Data were secured as well on all those diameters most widely employed—from 8 in. to 48 in. for costs including purchase price of pipe; and from 10 in. to 36 in., inclusive, for costs of installations only.

Fig. 1 shows the standard construction employed by the California Highway Commission. The design is the result of ten years' continuous use of corrugated pipe both under unpaved and hard-surfaced highways. Use of the pipe is about evenly divided between these two classes. About half a million feet of corrugated pipe have been laid along 2,500 miles of California highways, or an average of 200 lin.ft. to the mile.

Tables I and II show how the cost of installing corrugated pipe has varied from 1912 to 1921, a comparison which is graphically indicated in Fig. 2. Table I lists costs on jobs on which the contractor's bid included the purchase price of the pipe, Table II omitting that price.

The lowest installation costs were obtained in 1916, a fact which may be explained by the general low level of all costs and by the facility with which such installations were able to be made after four years of practice.

Contractors and engineers will perhaps be interested in comparing these unit costs with those obtained in

FROM JOB AND OFFICE

Hints That Cut Costs and Time

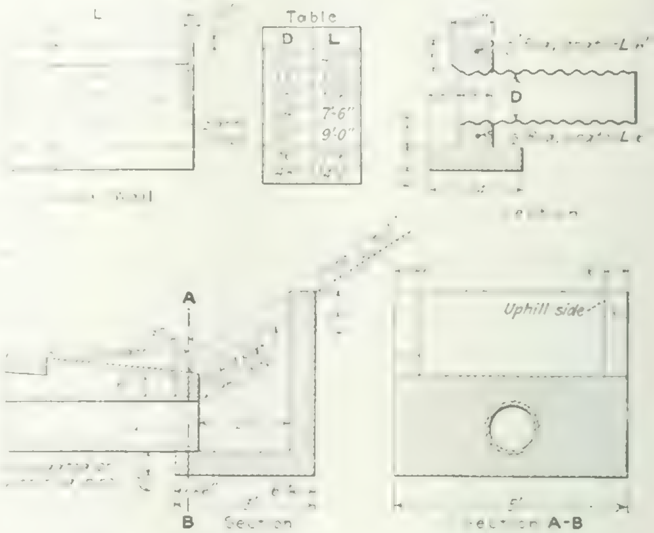


FIG. 1—STANDARD CULVERT INSTALLATION

TABLE I—COSTS PER FOOT OF INSTALLING CORRUGATED METAL PIPE

[illegible]

Size	8-in.		[illegible]		10-in.		12-in.		15-in.		18-in.		21-in.		24-in.		[illegible]		36-in.		42-in.		48-in.	
Year	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost
1912							6,716	1 68	[illegible]	1 65	[illegible]	1 84	26	4 70	1,062	2 38	419	3.24	139	3.77	6	5.00	225	6 00
1913					200	1 00	7,820	1 47			4,385	1 76			3,928	2 30	611	2.45	226	4.03			24	4 07
1914	320	2 42					30	2 66	13	1.34					468	1 78			79	2.90			22	5 23
1915					20	1.70													[illegible]	3.01				
1916	26	0 82	30	0 73			84	1 44																
1917	40	1 04					38	2 21			90	3 09	10	2.31	54	2.59	58	3.59	10	3.91				
1918							48	1 44			102	2 25												
1919															26	3.73			[illegible]	6 08				
1920																	80	4 78						
1921							1,916	2 89	148	[illegible]					450	4 60	34	7.00	44	7 90				
Total	386	2 16	30	0 73	220	1 07	16,652	1 72	669	1 95	6,369	1 81	36	4 04	5,988	2 45	1,202	3.06	708	4 20	6	5 00	271	5 77

TABLE II—COSTS PER FOOT OF INSTALLING CORRUGATED METAL PIPE

Not including purchase price of pipe

Size	10-in.		[illegible]		15-in.		[illegible]		21-in.		24-in.		30-in.		36-in.	
Year	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost
1912																
1913			1,896	0 65			342	0 85			110	[illegible]	106	1 15		
1914	70	0.50	56,315	0 64	3,391	0 66	[illegible]	0 76	224	0 68	[illegible]	0 89	[illegible]	[illegible]	1,723	1 02
1915			18,690	0 56	1,870	0 58	10,104	0 68	340	[illegible]	[illegible]	0 87	[illegible]	1 25	832	1 28
1916			2,349	0 40	614	0 44	1,866	0 55	40	0.60	1,224	0 82	138	0 92		
1917			25,246	0 67	[illegible]	0 82	16,287	0 89			10,360	[illegible]	1,288	[illegible]	759	1 02
1918			8,363	0 75	[illegible]	[illegible]	4 890	[illegible]			3,679	1 12	[illegible]	1 08	108	1 59
1919			20,486	[illegible]	[illegible]	1 11	12,273	[illegible]			9,230	1 57	744	1 96	493	2 36
1920			3,407	1 07			2,216	[illegible]			1,440	1 63	[illegible]	2 55		
1921			24,113	[illegible]	2,922	1 08	[illegible]	1 35			7,327	[illegible]	2,228	2 06	711	[illegible]
Total	70	0 50	160,865	0 77	16,047	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10,455	[illegible]	[illegible]	1 26

FROM JOB AND OFFICE

For Contractor and Engineer

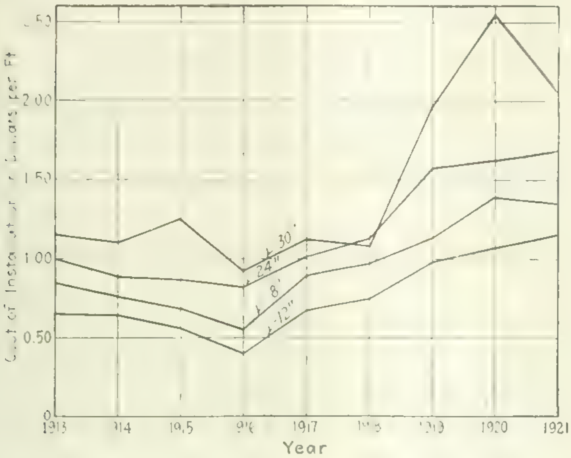


FIG. 2—UNIT PRICE FLUCTUATION ON FOUR PIPE SIZES

other representative states. The following figures have been compiled for Connecticut, Colorado and Oregon, in each of which states the highway commission employs large amounts of corrugated pipe. The costs include the purchase price of the pipe in each case.

UNIT COSTS FOR CORRUGATED METAL PIPE, INSTALLED

Connecticut[1]		*Colorado*[2]		*Oregon*[1]	
Size, In.	Cost, per Lin. Ft.	Size, In.	Cost, per Lin. Ft.	Size, In.	Cost, Per Lin. Ft.
14	$2.00	12	$2.257	12	$1.90
18	2.50	15	2.547	18	2.75
24	3.50	18	2.92	24	3.75
30	4.50	21	3.395	30	5.00
36	6.00	24	3.759	36	6.50
		30	4.715		
		36	5.802		

[1] Unit costs covering 1921 installations.
[2] Average unit costs covering first half of 1921.

Setting Slope Stakes

BY A. O. BOSSHARD

Resident Engineer, Iowa State Highway Commission, Centerville, Iowa

I NOTICED the article in the issue of *Engineering News-Record*, Sept. 21, p. 490, by J. F. Webb, referring to an article by Paul McComb in your Aug. 24 issue, p. 303, regarding the use of a hand level, special rod and tape for setting slope stakes. I have developed a special rod, like Mr. Webb's, with a belt graduated from zero to 10 each way, on which I set off the center cut or fill. Then, any other point than center gives the cut or fill direct at that point, so that the only computations necessary are the slope distances, using an ordinary tape. With a specially marked tape, for $1\frac{1}{2}:1$ slopes, which are standard here, this could be eliminated. In turning up or down, you merely have to take a shot at any convenient point, and reset the rod for that point. It is usually handier for the levelman to go out, and the rodman to hold the rod at center, and record.

In using this rod with a wye-level (which we usually do here as the Iowa commission prefers that we do not use the hand level), we set the centerline cut or fill at the height of instrument. For the rod moving out the zero would be above the eye height for a cut, and for the level moving, would be below. I have found this rod very handy, especially with rather inexperienced help.

Use of Motor Cars in Railway Work

IN A committee report recently submitted at the annual convention of the American Railway Bridge & Building Association, held in Cincinnati, considerable information was set forth concerning the use of motor cars in railway construction, particularly in bridge and building work. Many novel uses are being made of the motor car as a construction aid, the following extract from the committee report being typical.

The Chicago Great Western Ry. recently replaced the floor in a tunnel ½ mile long with concrete. Motor cars were used exclusively to haul the excavated earth and concrete. The cars used for hauling the excavation were side-dump cars of a capacity of 3 cu.yd. and the cars for handling concrete were bottom-dump cars holding 2 cu.yd. The mixer was set on a platform slightly elevated at the tunnel entrance. The concrete was run directly into the hopper car and hauled into the tunnel by a large air-cooled motor car. The arrangement worked out to the entire satisfaction of the management and effected a marked saving over other methods.

The Chicago Great Western also uses motor cars to pull weed cutters and to haul trailers carrying as many as forty men, or loaded with rails and material.

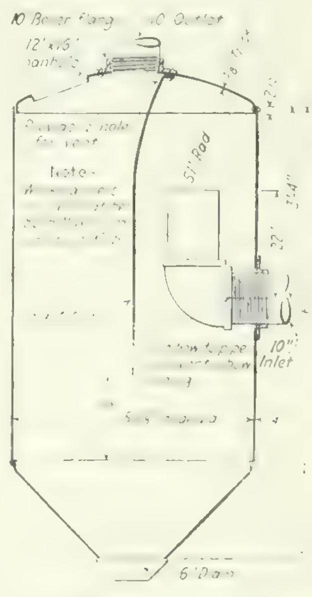
Sand Catcher Clears Cistern Water Pumped for Industrial Uses

BY C. C. BROWN

California & Hawaiian Sugar Refining Co., Crockett, Calif.

IN THE plant of a California industrial concern where use is made of large quantities of water, some trouble was experienced in the presence of sand in the lines. The amount of water pumped amounts to more than 3 m.g. per 24 hours. Water is taken from a cistern and from storage tanks and handled through two 1,300-g.p.m. centrifugal pumps with 200-ft. head. The water passes from the pumps through eight sand filters and thence through an 8-in. line to the house distribution pipes. Some time ago sand was noticed throughout the house. It did considerable damage to lines, bearings, meters and other apparatus. In order to remove the sand the sand catcher shown in the accompanying illustration was devised and installed in the 8-in. line just after it left the filters.

The sand catcher consists of a steel shell ¼ in. in thickness and of an internal diameter of 51⅛ in. It is 6 ft. 3½ in. long with a curved top and a conical bottom. The water is led in through the side in an 8-in. pipe which terminates inside the drum in an 8-in. elbow and nipple. A baffle is installed as shown so that water cannot bypass to the outlet. The 8-in. outlet is at the top of the drum as is also a 12-in. x 16-in. manhole. A 6-in. drain valve is fitted into the conical bottom so that the trapped sand can be flushed away when necessary.



SAND CATCHER HANDLES 3 M.G. PER 24 HR.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Temperature Changes in Arch Dams

Sir—In the article by Fred A. Noetzli on "Arch Dam Temperature Changes and Deflection Measurements," given in *Engineering News-Record*, Nov. 30, 1922, p. 930, there appears formula (1), quoted from my paper on "The Circular Arch Under Normal Loads." This formula has been revised since publication, and the corrected formula will appear in the current issue of "Transactions," Am. Soc. C. E., p. 281. In brief form, it is,

$$D = c\ (ret_o),$$

where,

D = crown deflection in feet, positive when toward center,
r = radius of center line in feet,
e = coefficient of expansion = 0.0000055 (say),
t_o = change in arch temperature in Fahrenheit degrees, + for a rise, — for a fall of temperature.

The coefficient c is given numerically, for a hingeless arch, by Table 4, and, for an arch with "hinged ends," by Table 5, of the writer's paper quoted.

On solving the formula for t_o,

$$t_o = \frac{D}{cre}$$

which should replace Eq. (1) of Mr. Noetzli's article.

On applying this formula to a few of the horizontal arches supposed cut from the Salmon Creek Dam, the data being taken from the table given on p. 931 of Mr. Noetzli's article cited, it is found that the numerical values of the temperature changes are somewhat less than those given in the table. Mr. Noetzli recognizes that the method proposed by him for ascertaining mean temperature change in any horizontal arch of a dam is only applicable in the case of cracked cantilevers, which offer no resistance to the expansion (or contraction) of the arch under a rise (or fall) of temperature, for the formulas refer only to a free arch.

When the dam remains intact, or the supposed cantilevers are not cracked, the method falls. The solution will then have to be for combined arch and cantilever action.

Chapel Hill, N. C., WILLIAM CAIN.
Dec. 2, 1922.

Sir—Since writing my article "Temperature Changes in Arch Dams," some temperature measurements made on a slender arch dam in Switzerland have come to me.

In the "Bulletin Technique de la Suisse Romande," Lausanne, 1922, (Étude sur les Barrages Arqués), A. Stucky describes the design and construction of a most remarkable arch dam on the river La Jogne in Switzerland. This structure is about 175 ft. high, and it was designed scientifically for combined cantilever and arch action, rib-shortening and temperature stresses.

During construction of the dam some 30 thermo-couples were placed in the masonry at various elevations of the structure, and after the chemical heat due to the setting of the cement had been lost or compensated for, the following annual range of temperature was observed:

Depth Below Crest, Ft.	Yearly Temperature Variation, Deg. Fahr.
3	43°
33	36°
66	[illegible]
98	11
164	4

These figures which represent actual measurements, seem to confirm, to a certain extent, the reliability of the figures of Table I for the temperature variations in the Salmon Creek Dam as calculated from deflection measurements.

San Francisco, Calif., FRED A. NOETZLI.
Nov. 28, 1922.

Urges Constructive Criticism

Sir—In *Engineering News-Record* of Nov. 30, p. 947, appears a letter by George Rae of Portland, Ore., concerning the reinforcement of a highway swing span in Oregon. Mr. Rae proceeds to tell us wherein the other fellows erred, but does not state what he would have done if in their positions. That is not constructive.

Most of us are aware that the linear expansion of structural steel is about three times that of structural timber such as fir. Nevertheless many combination spans of steel and timber have been successfully built and used in the past. I know of several such spans where the top chord is of timber and the bottom chord of steel, and these have served for a good many years. It is true that the combination is not exactly an ideal one.

The complete details of the alleged "doubtful bridge reinforcement" are not at hand. It appears that if the rivets in the bottom chord were backed out, in order to insert the bolts for attaching the thrust blocks, there would be no weakening of chord in tension; whether new holes were drilled is not stated. The timber reinforcement of the bottom chord doubtless has been effective in preventing further buckling of the chord, and should stiffen up the members even if the thrust blocks were removed. The two 14 x 14-in. timbers at least serve to reduce the slenderness ratio of component parts of chord when in compression, with span swinging free.

Permanent reinforcement of structural steel would probably have required several months for delivery and erection. In an emergency, such as I judge this was, something effective had to be done even if only of a temporary nature. Presumably, the two county officials, and not Mr. Rae, were bearing the responsibility; and they no doubt used their best judgment in the matter.

The added dead-load due to the asphalt paving caused a shortening of the bottom chord as well as the lengthening of the top chord; and the latter was probably aggravated by heat from the sun's rays. In the writer's experience this same sort of thing has happened in timber Howe truss draw spans. Turnbuckle adjustment of hog-bars and shimming or a runoff at the ends are a practicable means of solution; also, additional hog-bars over a gallows-frame at center of span might well be placed.

The last sentence in Mr. Rae's letter is a decidedly inconsistent conclusion. If the aforesaid county officials are incompetent the registration board should refuse to renew their certificates. Otherwise, it seems that unfair criticism of other men's work should be stopped. I am interested in the ethics, as well as the engineering, involved in this case, else I would not have taken the pains of replying to Mr. Rae's letter.

H. A. GERST,
Registered Professional Engineer.
Asst. Bridge Engr., Great Northern Ry.

St. Paul, Dec. 2.

Painting Galvanized Sheets; Why Galvanize?

Sir—Referring to the letter of F. H. Thomson, on "Painting Galvanized Sheets," in your issue of Nov. 2, p. 759: It has often been a wonder to us why it was necessary to galvanize iron sheets when used for roofing purposes, as it becomes necessary to paint these sheets in a comparatively short time after being exposed to the weather, and unless a special paint is used (such as manufactured by us under the name of No. 625 Galvanized Iron Primer) or unless a special wash is applied before ordinary paint is used, the paint is very apt to peel off. Under the circumstances, it seems an unnecessary expense to galvanize under the present commercial practice, as the painting of the black metal will give just as good results as painting over the galvanized iron surface. The only advantage that we can see is in the transportation of the metal sheets, which, of course, would become rusted when not galvanized unless protected from the weather; but this same protection would be obtained at a lower cost by the application of a shop coat of paint in place of galvanizing.

However, if it continues to be the practice to galvanize in a commercial way, and therefore it becomes necessary to

paint, first-class results can be obtained by using a special galvanized iron primer instead of incurring the extra labor of neutralizing the galvanized iron surface before the application of an ordinary paint, and we will be very glad to furnish further information to any interested party. We do not favor allowing the galvanized surface to weather for a period of six to nine months, or until corrosion starts, as the usual tendency is to allow this weathering to proceed too long, and corrosion has started too vigorously before the application of paint. As it is usually necessary to paint in six to nine months, the material had better be painted when erected and thoroughly protected at that time.

CHEESMAN-ELLIOT CO., INC.,
F. P. CHEESMAN,
President.

Brooklyn, Dec. 5.

Data Used for Storm Sewer Design at Milwaukee, Wis.

Sir—Referring to that portion of J. R. Hendry's article in *Engineering News-Record*, Nov. 2, p. 745, which relates to the basic data adopted for the design of Detroit's storm-water drainage system, the writer takes this opportunity to show the marked degree of similarity existing between these data and those used for similar purposes in Milwaukee and its vicinity.

The accompanying curve (Fig. 1), which is based upon the United States Weather Bureau records, 1905 to 1921, covers a period of seventeen years and was prepared by the writer during May of the present year primarily for use in connection with the investigation and development of drainage areas in the Metropolitan territory in close proximity to the city of Milwaukee, and also for general use in connection with storm-sewer development within the city. The various points on the curve will be seen to conform quite closely to those derived from the use of Mr. Hendry's mathematical expression showing the assumed relation between duration and intensity $i = 136/(t+20)$. See dotted line, Fig. 1.

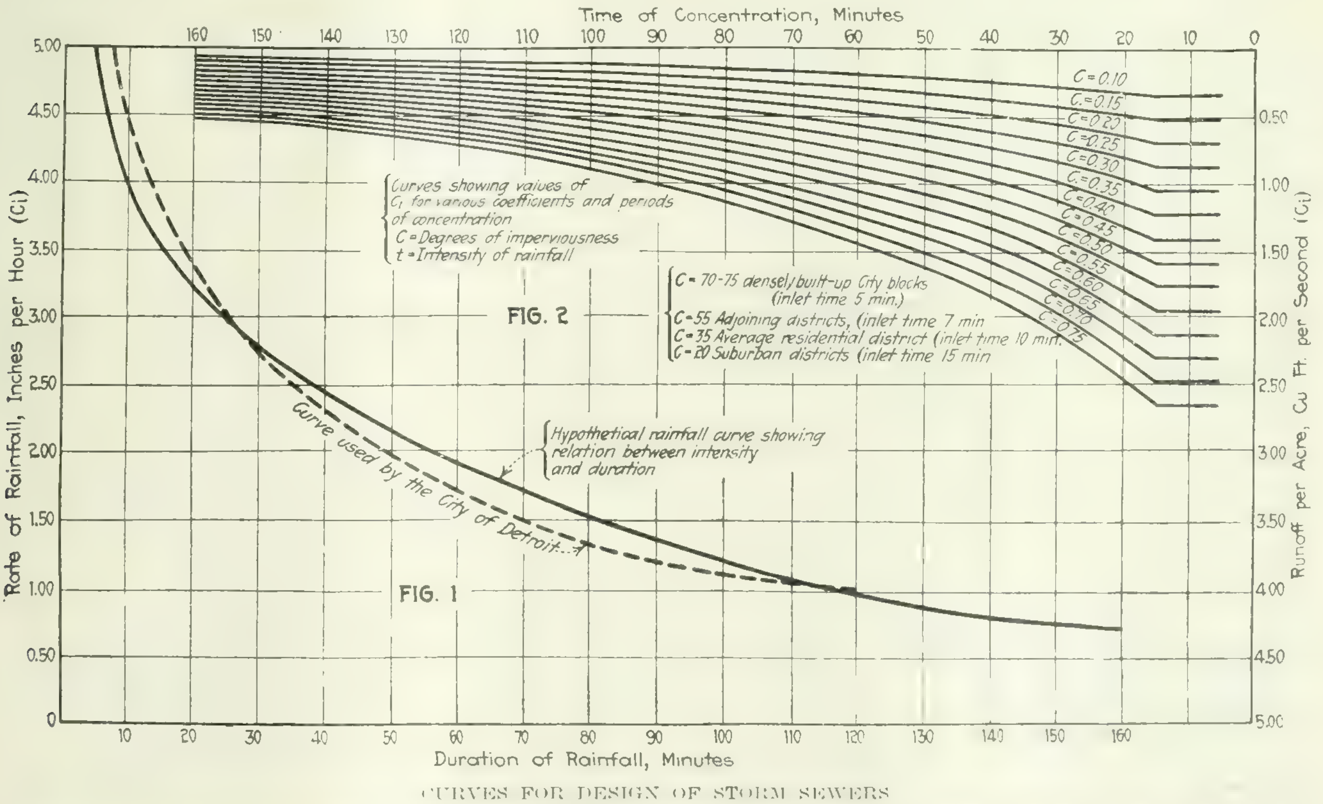
While in reality there is no apparent reason why any mathematical law should govern the relation between duration and intensity, and for this reason no formula was prepared by the writer, the formula affords a convenient method for computing intensities when the curve itself is not available.

For all practical purposes Mr. Hendry's formula will produce results sufficiently close to suggest its use in lieu of the Milwaukee rainfall curve. Studies of present day tendencies toward home building in the residential portions of Milwaukee appear to indicate that a runoff coefficient of 0.35 is well on the side of safety. Accordingly it has been adopted for use in connection with storm-sewer design for the average residential district. It should be noted that this factor, too, is in close agreement with the figure used by Mr. Hendry.

It has been found convenient to construct a secondary set of curves (Fig. 2) which show rates of runoff corresponding to rates of rainfall for various runoff coefficients. These curves give direct readings in second-feet per acre for the time of concentration and the coefficient of runoff under consideration. In referring to the secondary curves it will be noted that a flat rate of runoff is assumed to obtain during the maximum allowable period of concentration at the most remote inlet, and also that the time of concentration at the inlet is assumed to decrease as the value of the runoff coefficient is increased. The reason for the use of this method is, that the use of high rates of rainfall corresponding to the short periods of duration results in sewer sizes at the beginning or upstream end of a system, which, in the light of past experience, appear to be considerably larger than are actually required. It is at the beginning of a system, as the writer views the situation, where a reduction in the indicated quantity is possibly more reasonably warranted than at some point or points farther down the line. This statement is not made, however, in criticism of Mr. Hendry's method of effecting reduction in quantity by applying the indicated runoff for a fifty-minute concentration period to the accumulated area above the point in consideration. On the contrary the writer is inclined to believe that this method is logically permissible, especially in view of the fact that storms of maximum intensity for short duration periods are localized and confined to limited areas.

DARWIN W. TOWNSEND,
Engineer of Designs, Milwaukee Sewerage Commission.

Milwaukee, Wis., Dec. 7.



CURVES FOR DESIGN OF STORM SEWERS

Based on rainfall data for Milwaukee and vicinity obtained from the records of the United States Weather Bureau, 1905 to 1921.

Ventilation, Body Temperature and Health

Sir—We should all heartily agree with most of the statements made in the letter by F. W. Harris in your issue of Dec. 7, p. 989, headed "Sanitation, Ventilation, and Vaccination." Regarding the subject of ventilation, it seems that we, including some of those who ought to guide us in health matters, hardly yet fully understand or at least appreciate all the facts relating to it. Mr. Harris very properly says that the object of ventilation is to supply fresh air and to maintain the proper temperature. There is a surprising ignorance among people at large regarding fresh air and ventilating, particularly as to proper temperature. I believe that we more often suffer illness, including colds, and sometimes even deaths, starting from a temperature cause than from any other single source.

Fresh air is air that has a definite mixture of nitrogen (76), oxygen (23), carbon dioxide (0.0005), and small amounts of argon, ozone, ammonia, organic and mineral matter. We know how far a deviation from the relative quantities is permissible, to cause first discomfort, then illness, and finally death. Our momentary judgment regarding comfort and healthfulness is guided by our senses, chiefly by odors, temperature, and slightly by humidity. We cannot accurately measure these sensations, except by thermometers and hydrometers, but our nostrils and our skin are generally sufficient informers.

I cannot forget the impression made upon me when a boy on entering a small shoemaker shop to have my shoes repaired. It was winter and cold outside. A family of about six lived in a small room. I was fairly stunned, as the air was thick, and its odor intensely disagreeable. "Why don't you open the window and get some fresh air?" "Why that would make us all sick by letting out the heat, and coal is too expensive." "But you will all get sick in this air." "None of us has ever been sick for years," the chorus replied. For the first time in my life did I realize that proper temperature might be of more importance than the popular idea of fresh air.

Since then I have made a number of observations along these lines and found that our general education along them might be much improved. We often have our rooms too hot or we expose ourselves to a cold temperature, with our skin and clothes improperly conditioned.

A few years ago, when wintry weather was setting in, our papers reported much bronchitis, influenza, and pneumonia, and most people one met had colds. Posters were put up in the street cars and elsewhere, urging people to open their windows wide at night to keep off those diseases. Unfortunately it was a cold winter and the death rate from such cases, usually starting with a cold, ran very high.

There can be no doubt that the air, particularly, in our large cities, can be kept as pure as we can get it. But it is of still greater importance to our personal comfort and health to have the temperature conditions next our bodies such that they keep us in good health. The chief reasons for this greater importance are the frequent and great changes of air temperature (daily, seasonal, indoors and outdoors), to which the body must continually adjust itself.

Blood temperature is about 99 deg. F., or a trifle less. A few degrees above will cause fever and a few more death; a few degrees below 99 will cause a chill and a few more death. It is therefore highly important that we maintain our normal blood temperature as nearly as practicable, because inside of our bodies a variation of comparatively few degrees from the normal may be fatal.

In cold climates nature provides animals with furs and men wear suitable clothing to produce a non-heat-conducting covering around the body, thus preventing an excessive loss of heat, as engineers do by covering steam pipes. On the other hand physical exercise and rubbing of the skin mechanically produces heat within the body, and thus raises the blood temperature.

We have therefore acquired some knowledge of the means to protect ourselves under existing conditions from sinning against the infallible natural laws of temperature. But we could go much further in this acquisition and prevent many cases of sickness and death produced by temperature causes alone, if our instructors would spread more information among us, first, about the importance of maintaining our bodies always at the proper blood temperature, and secondly, by pointing out in detail the ways in which we could best do this at home and out of doors and both in summer and in winter.

In other words, we should consider our body to be a "heat engine," and treat it as rationally as we do a st_am-engine and realize that prevention of mishaps is better than their cure.

New York City, Dec. 10.

RUDOLPH HERING, Consulting Engineer.

Mechanical Amusement Devices Are Safe

Sir—In a recent issue of your magazine appeared an article criticizing the mechanical amusement devices as operated in parks and fairs and advocating the complete abolition of these devices. It is apparent that the writer of your article was misinformed. It is not true that this business originated with the Chicago world's fair. There were scores of patents on such devices fifty years ago. There were merry-go-rounds in France more than a century ago. There have been mechanical Rides at Coney Island for fifty years. Several manufacturers in America alone have been building these devices for thirty to forty years.

From the accident standpoint these Rides are safer than any other means of human locomotion. Several manufacturers report having built hundreds of Rides in forty years which have carried from thirty to one hundred million passengers without serious accidents. There is hardly a railroad or street car line that can show such a record. The automobiles of America are killing more than one hundred people per week, whereas all the amusement devices of the country have not killed one hundred patrons in the past fifty years.

Most of these Rides are designed by engineers and mechanics having a lifetime of experience. They have devoted years to the question of safety. Scores of safety devices have been designed and patented. In the larger cities a special division of the building department approves the plans before a new Ride is erected. An annual inspection is given before the license to operate is renewed. From these inspections the number of accidents has been reduced to almost nothing. They are so safe that a number of the biggest insurance companies are insuring these Rides against public accident liability for a very low annual cost. Many operators consider the risk so slight that they carry their own accident risk.

These devices are not "cheaply built." Small Rides cost from $4,000 up to $25,000. The big Rides cost up to $50,000 and many over $100,000. Probably $100,000,000 is now invested in Rides in America. The receipts are estimated by amusement men at $50,000,000 per year, of which over five million has been paid annually in recent years in taxes to Uncle Sam.

These Rides are located in parks most of which are managed by amusement men of long experience. They know that it is a vital point for them to maintain order, a high standard of conduct and clean moral conditions in these parks. Surely nothing is cleaner or more highly moral than a ride in a merry-go-round, a ferris wheel or a roller coaster. Park men all agree that the Rides are the most popular form of park amusement. They attract the people out into the open, the air rings with peals of laughter and the cost is so small that the working classes and even the poor are large patrons.

The National Association of Amusement Parks holds an annual three day convention in Chicago, together with a big exhibition of new Rides and improvements on old ones. The inventive genius of America is taxed to produce new mechanical novelties. America is now the center of the industry, and scores of new Rides are exported annually to all parts of the world to bring smiles to the faces and joy to the hearts of the young folks across the seas.

H. G. TRAVER,
Pres., Traver Engineering Co.

Beaver Falls, Pa., Dec. 5.

NEWS OF THE WEEK

New York, December 14, 1922

Fire Does $15,000,000 Damage to Astoria, Ore.

Engineering Interests Attaches to Conflagration as City Was Built on Piling

Special Correspondence

Particular engineering interest is attached to the fire which destroyed the business section of Astoria, Ore., Oct. 8, doing property damage estimated at $15,000,000, because of the fact that the greater portion of the business district was built on piling and only partially protected by an hydraulic fill. As every hotel, bank, theater, restaurant wholesale and retail house in the business district was destroyed, the control of the city has been put in the hands of a committee of business men whose announced policy is to confine temporary buildings to an unoccupied district and to rebuild the burned area with wide streets filled to grade.

The greater part of the business district of Astoria was built originally on piling over tide flats. Construction was mostly of wood with a few good buildings of modern type. In 1916 the city built a sea wall of heavy sheetpiling and raised the grades sufficiently to allow for basements, and made an hydraulic fill to the basement level.

Concrete Construction Urged

Owners raised their frame buildings on temporary wooden walls. Engineers at that time urged the construction of retaining walls along the curb lines with reinforced-concrete floors carrying the pavement and providing subway space for sewers and water mains. This plan was adopted and bids were taken, but before any contract was let heavy corporate and private property interests secured an injunction against construction on the ground that the cost would practically confiscate the property improved. The city council thereupon adopted the plan of viaducts of creosoted timber with plank floors carrying bitulithic pavement and with 4-in. hollow tile bulkheads secured to the timber frame along the curb line. This bulkhead along the curb line was continuous around each block but did not cross streets. The cost was $10 per front foot less than concrete.

The city fire chief had constantly urged property owners to build tile or concrete basement walls to reduce the fire hazard, but the extent to which this was actually done cannot now be ascertained. The entire district was thus supported several feet from the ground with continuous air space for draft.

The fire broke out about two o'clock in the morning. Appearance of it in several places at once caused suspicion of incendiarism but that fact was probably due to the city's construction. Steamers moored along the waterfront saved the docks with the aid of a strong on-shore wind, but in the balance of the filled district, the fire was beyond control almost from the beginning. At one time it was thought to be entirely stopped but suddenly appeared two blocks farther on. When the fire reached the edge of the filled district it was quickly checked. The burned and filled areas approximately coincided. Some hours after the fire started the water supply became inadequate. The details of the failure are lacking but it was possibly due to the excessive demand made upon hydrants, or the fact that they were broken by the falling viaducts. Newspapers report that the water mains were carried on viaducts but this is incorrect.

Buildings were dynamited but the attempts made to destroy the viaducts failed as the open character of the construction made it impossible to apply powder effectively. The pavement prevented reaching the fire, and caused the structures to act as flues.

Concrete Resists Fire

Examination of the burned-over area has been made by R. A. McLanathan, city engineer of Astoria, and part of his findings have been communicated to *Engineering News-Record*. His telegram follows:

"A large majority of the buildings within the burned area were frame and nearly all on piles or posts with many of the basements not enclosed. Nearly all of the streets in this area were of timber viaducts, with concrete walks and bitulithic streets laid on timber decking. Under the viaducts and along

(Continued on p. 1044)

Highway Officials Hold Annual Convention

Kansas City Meeting Largest in the History of the Association —Committee Reports of High Technical Character

Engineering News-Record Staff Correspondence

HIGHWAY administration, overshadowing questions of design and research, stood out as the subject of general interest, at the convention held last week at Kansas City by the American Association of State Highway Officials. Beginning with the address on highway department organization (p. 1028 of this issue) by A. R. Hirst, state highway engineer of Wisconsin, administration continued to be the thought uppermost in the papers and discussions on federal aid, construction and maintenance. Committee work was the second outstanding feature of the convention. One half-day period was devoted solely to committee meetings and reports were presented by all the standing committees and especially significant reports by the committees on tests, on construction, and on contractural relations. Those reports expressed the more strictly technical activities of the convention.

As the amendment to the constitution, which increased the state dues to $200, was carried, money is expected to be available for the publication of these reports. Indeed the report of the treasurer, Frank T. Sheets, superintendent of highways of Illinois, showed the finances of the association to be in an unusually good condition. With all bills paid there are $4,044.41 in the treasury. At the election of officers Mr. Sheets was re-elected treasurer and Charles M. Upham, state highway engineer of North Carolina, was re-elected secretary. The new officers elected were C. J. Bennett, state highway commissioner of Connecticut, president, and Fred R. White, state highway engineer of Iowa, vice-president. The new members of the executive committee are G. P. Coleman (re-elected) state highway commissioner of Virginia; Z. E. Sevison, state highway engineer of Wyoming; C. M. Babcock, commissioner of highways of Minnesota, and Frank F. Rogers, state highway commissioner of Michigan. The resignation was announced of G. E. Johnson, secretary, department of public works of Nebraska, who is leaving office. The deaths were announced of John N. Cole, commissioner of public works of Massachusetts, of Fred W. Sarr, deputy commissioner of highways of New York and of William D. Uhler, chief highway engineer of Pennsylvania.

Finance and Design

The discussions on finance and design were largely reviews of subjects—such as the Bates and the Pittsburg road tests and the financial plans of the California highway commission—which have received rather complete publicity during the last twelve months. In discussing finance Austin B. Fletcher, late state highway engineer of California, covered the ground of a portion of his annual report the conclusions of which are published in another page of this issue.

The articles on the Pittsburg road tests in *Engineering News-Record* June 29, 1922, pp. 1066 and 1069 and Nov. 23, 1922, p. 893, contain much of the matter presented in a paper by T. E. Stanton, assistant state highway engineer of California. In general, Mr. Stanton stated, the tests indicated the strongest pavement to be one with edges thicker than the center depth as, for example, a 9-6-9 in. section for heavy traffic and a 7-5-9 in. section for lighter traffic. In this respect of cross-section, Clifford Older, in reviewing the Bates road tests, announced substantially the same conclusion. Bridge design was discussed by Llewellyn N. Edwards, bridge engineer of the state highway commission of Maine. Emphasis was placed on location, waterway and design to insure good construction.

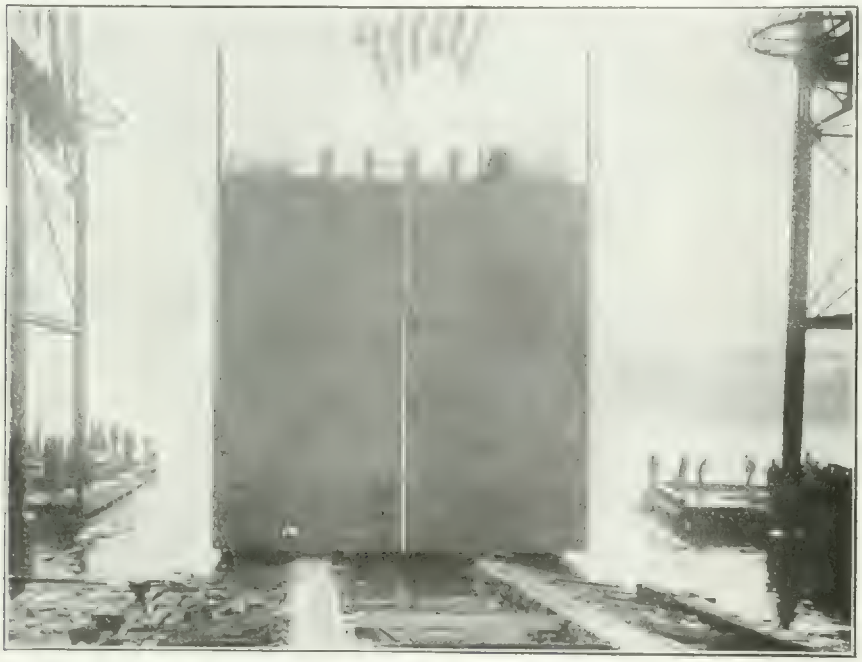
(Continued on p. 1044)

Launch Caisson for N. Y. Vehicle Tunnel Shaft

Driving of South Tube Halted by Blow Resulting from Nearby Excavation—Present Status of Project Reviewed

DURING the last couple of weeks two interesting developments have taken place in connection with the driving of the 30-ft. vehicle tunnels under the Hudson River to connect New York and Jersey City. One of these is the temporary suspension of driving on the south tube and the other is the launching of the first section for the caisson that is to form the New York river shaft. What follows is a condensed survey of the present status of the project from its construction aspect.

The principal elements of the tunnel project are the two tubes, the two land shafts at each end from which the tubes are driven, and the river shafts, a double shaft at the New York end and two single shafts at the New Jersey end. These river shafts are close to the pierhead lines and will serve to assist in the ventilation of the tunnels.



NEW YORK VEHICLE TUNNEL CAISSON LEAVING THE WAYS

This caisson will form the lower 35 feet of the New York river shaft for both tubes. Projecting above the side plating may be seen the circular sections by which the shields will pass through the shaft.

Six shields will be used. Two are to drive under the river from the New York land shaft while two from the New Jersey land shaft are driven to meet them. The other two will drive westward from the New Jersey land shafts. The tunnels from the New York land shafts eastward will not be driven by shield.

The two land shafts at the New York end have been completed. The south shaft was put under air during the last week in October and about Nov. 4 driving was begun. By the end of November, the shield had progressed about 68 ft. when it was halted because of the blowing of some 150 yards of earth, brought about by the proximity of the tunnel face to an adjacent excavation in which a city sewage plant is being built. Driving was stopped and the shield now rests with its top about 25 ft. below the surface of the ground and its cutting edge about 40-ft. from the nearest point of the excavation.

This excavation is rectangular in plan, about 45 x 90 ft., with its longitudinal axis between 40 and 45 deg. to that of the tube. It lies to the south side of the tunnel line with its nearest corner only 7 ft. distant from the outside line of the tube. The elevation of the bottom of the excavation is about 10 ft. below the top of the tube at the point nearest to it, this decreasing because of the falling grade of the tube to about 6 ft. at the far end.

The sides of the excavation are retained by steel sheet-piling which has been driven around the site about 2 ft. outside the neat line of the concrete walls and to a depth that brings its bottom edge just above the elevation of the center line of the tube. Foundation piles have been driven and a layer of concrete deposited by tremie. It will be seen that the open space between the outside of the walls and the sheet-piling would remain during the erection of the building, at least until it had reached the level of the surface, and as the contractor had estimated on no concrete for this space and on salvaging his piling he was unwilling to seal up this opening.

An attempt to drive the shield past this obvious outlet for the compressed air would have been futile and hazardous, and the losses to all concerned that would have been entailed by so long a delay would have been so great, that the tunnel commission has negotiated a contract whereby the space is to be filled with concrete and the sheetpiling left in place at the expense of the tunnel project. The contract for this work amounts to approximately \$16,000 which is bare cost and includes no profit. It is expected that this work will have been sufficiently completed to enable a resumption of tunnel driving during the coming week.

The shield that will drive the New York end of the north river tunnel is now almost completely assembled in the shaft, and it probably will be ready to start driving soon after the first of the year.

The steel caisson launched on Dec. 5, at the Staten Island Shipbuilding yard at Mariner's Harbor, Staten Island, consists of the lower 35 feet of the New York river shaft. It is designed to include the two tunnels and is 35 x 91 ft. in plan. An addition of 20 ft. in height is now being erected, after which the caisson will be towed to its site at the New York pierhead line and sunk by depositing concrete between its inner and outer shells. The sinking probably will be begun soon after Jan. 1.

The total height of the finished caisson will be about 108 ft. It will rest on ledge rock which at that point rises above the tops of the tubes. Circular bulkheads have been provided in the east and west walls of the caisson. When the shields reach them these bulkheads will be burned out, thereby permitting the shields to continue their passage through the caisson and out on the far side.

The two New Jersey shafts, which are not in one unit, will rest with their bottoms about 150 ft. above rock, and in order to insure their stability in the Hudson River silt, reinforced-concrete piles of special design are to be sunk to rock. Those for the north caisson are now being installed. This caisson probably will be launched in about a month. The south caisson also is under construction but will not be placed until spring.

At the New Jersey end the north land shaft is about half sunk and the caisson for the south land shaft is about two-thirds assembled. It is expected that one shield for the New Jersey end will be delivered shortly after Jan. 1.

Voters Defeat California Law Against Shingles and Lath

A referendum vote in California at the November election defeated by a large majority a law passed by the 1921 legislature which prohibited the use of wood lath and shingles on the exterior walls and roofs of new buildings in incorporated cities. As the law was phrased, its prohibitory effect in the direction referred to was not at first apparent, and when it was discovered a referendum vote on the act was petitioned for.

State Ownership of Water Power Defeated in South Dakota

A project for state development and operation of a hydro-electric plant on the Missouri River near Mobridge, S. Dak., was defeated by a large majority in the November election in South Dakota. The project included the construction of transmission lines to serve cities and towns in the eastern part of the state. The proposed bond issue was for \$16,000,000 and according to estimates of the state's engineers it would be several years before the system could approach a self-supporting basis.

Am. Soc. C. E. Announces Plans for 70th Annual Meeting

The seventieth annual meeting of the American Society of Civil Engineers will be held Jan. 17, 18 and 19, 1923, at the offices of the society, Engineering Societies Building, 33 West 39th St., New York.

The opening session on Wednesday morning, Jan. 17, will be devoted to the transaction of business, reports of committees, conferring of honorary membership, award of medals and prizes, and the announcement of the result of the ballot for officers. At the afternoon session the subject of engineering education will be considered. This will be a joint session with the Society for the Promotion of Engineering Education. On Wednesday evening the president's and honorary members' reception will be held, which will be followed by a dinner-dance.

For Thursday, Jan. 18, an all-day excursion to Bethlehem, Pa., has been planned. Visits will be made to the Bethlehem Steel Co., Lehigh University, and the Hill to Hill Bridge now under construction. Thursday evening, the annual smoker will take place at the society headquarters.

The subject for the morning session on Friday, Jan. 19, will be engineering research, and for the afternoon session, city planning.

A new feature this year will be the meetings of the new technical divisions. On Tuesday evening, Jan. 16, the technical division on sanitary engineering will hold a dinner-meeting at 6 p.m. at the Hotel McAlpin. Other technical divisions will meet Friday evening, Jan. 19.

The committee on local arrangements is as follows: Charles Gilman, chairman; W. G. Grove, B. B. Hodgman, C. M. Holland, T. R. Kendall, George Lucas, Thaddeus Merriman, J. F. Sanborn. The general program is in charge of the standing committee on technical activities and publications, John R. Freeman, chairman, C. E. Grunsky, Clarence W. Hudson, Richard L. Humphrey, J. J. Yates.

Oklahoma Society Joins American Association of Engineers

Amalgamation with the American Association of Engineers was voted upon favorably by the Oklahoma Society of Engineers at its annual meeting Dec. 2 in Oklahoma City. The state society with the chapters at Muskogee, Tulsa and Oklahoma City will form the Oklahoma Division of A. A. E. A program of state activity outlined includes a license law for engineers, amendments to the paving law and a good-roads program, all of which meet with the favor of J. C. Walton, governor-elect and a member of the organization. Officers elected to head the new division are as follows: President, Dan W. Patton; vice-president, Max L. Cunningham and secretary-treasurer, E. K. Ramsey, Oklahoma City.

City Manager Plan Adopted at Stockton, Calif.

At a city election at Stockton, Calif., on Nov. 28, an ordinance providing for a city manager form of government was carried by a majority of about 3 to 1.

Bethlehem Gets Philadelphia Tower Contract

On December 1 the contract for the steel towers for the Philadelphia-Camden suspension bridge over the Delaware River was awarded to the Bethlehem Steel Co. by the Delaware River Bridge Joint Commission (of Pennsylvania and New Jersey). Their bid, as reported in our last issue, page 1,000, was for $1,386,974. The next lowest bidder was the Keystone State Construction Co. and the New York Shipbuilding Corp. jointly, for a price of $82,330 higher.

The contract is required to be completed within 15 months.

St. Louis Will Vote on Bond Issues Totaling $88,372,500

The Board of Aldermen of St. Louis, Mo., on Nov. 17 passed an ordinance authorizing a bond issue election to be held Feb. 9, 1923. Twenty-one propositions, involving a total outlay of $88,372,500, will be voted on separately. A list of the several propositions follows:

1.	Establishing, opening and widening streets	$8,650,000
2.	Acquisition of land for a plaza opposite union station	2,600,000
3.	Improvement of streets and highways	5,800,000
4.	Electric street lighting system	8,000,000
5.	New court house	1,000,000
6.	Construction and reconstruction of public sewers	8,000,000
7.	Conversion of river des Peres to a public sewer	11,000,000
8.	Acquisition of land for new parks and playgrounds	2,500,000
9.	Improvement of existing parks and playgrounds	1,300,000
10.	Aquarium in zoological Park	400,000
11.	Municipal light, heat and power plant	1,000,000
12.	Hospital extension and improvement	5,000,000
13.	Municipal auditorium	5,000,000
14.	Memorial plaza	6,000,000
15.	Fire department improvement	772,500
16.	Elimination of railroad grade crossings	1,600,000
17.	West approach to municipal bridge	1,500,000
18.	East approach to municipal bridge	1,500,000
19.	New armory	1,000,000
20.	Reconstruction of public markets	1,250,000
21.	Water-works extension	12,000,000
	Total	$88,372,500

Higher Water Rates in Hoboken for Hackensack Water Co.

The New Jersey State Supreme Court has referred back to the Public Utility Commission of that state for revision upwards a rate decision estimated to produce $913,785 of revenue in Hoboken for the Hackensack Water Co. The court declares that a fair return would be between $925,000 to $950,000, until such time as a deficit is eliminated.

American Water Works Convention Date and Place Fixed

The date and place of the 1923 convention of the American Water Works Association has been announced as May 21 to 25, at the Hotel Statler, Detroit, Mich. Those having program suggestions to make are requested to send them to Abel Wolman, editor, 16 West Saratoga St., Baltimore, Md.

Road Builders Prepare Comprehensive Program

Design, Construction, Maintenance Traffic and Finance to be Given Special Treatment

A comprehensive program which embraces not only the salient problems confronting road engineers, executives, and others interested in highway construction but which will go into detail in the discussions has been prepared by the American Road Builders' Association for the annual convention to be held in Chicago, Jan. 16-19, inclusive. In connection with the Road Builders' Association will be held the thirteenth American Good Roads Congress, an exposition which promises to eclipse all previous things of the sort.

The road builders' program itself has been divided into five main parts, which will deal with thorough discussions of design, construction, maintenance, traffic studies and finance and miscellaneous considerations. Aside from this will be a general session which will precede the specialized sessions and at which main problems confronting the industry will be outlined by men of prominence.

At the session on design, which will be presided over by Thomas H. MacDonald, chief of the Bureau of Public Roads, intimate discussions will be given of design features which have been revealed as a result of traffic runs made on the Bates test road in Illinois, the Pittsburg test road in California, and the Arlington road maintained by the Bureau of Public Roads, Washington. The construction session will be presided over by J. H. Cranford, president of the Cranford Paving Co. of Washington, D. C., and during the session all the ways in which materials are handled in the construction of concrete roads will be thoroughly gone into. In addition, winter construction and lost time will be discussed.

The maintenance session will be presided over by A. R. Hirst, Wisconsin State Highway Engineer. Organization for maintenance work, patrol maintenance, gravel road maintenance, blade-grader and road-drag earth road maintenance, salvaging and maintaining macadam roads will be special subjects discussed. Thomas J. Wasser, state highway engineer of New Jersey and president of the American Road Builders' Association, will preside over the traffic session on the afternoon of Jan. 18. The effect of traffic on construction and what changes may be needed in motor vehicle legislation as results of studies will be special topics discussed. Frank Page, highway commissioner of North Carolina, will preside over the session which will discuss finance.

At the same time the thirteenth Good Roads Congress and the American Road Builders Association meetings are going on, the National Crushed Stone Association and the Midwestern Section of the American Association of Engineers, and several other organizations will hold conventions in Chicago.

As noted on p. 1048, manufacturers and the publisher of "Engineering News-Record" have co-operated in telling the story of the forthcoming meeting in a 23-page announcement appearing in the advertising pages of this issue.

Highway Officials Hold Annual Convention

(*Concluded from p. 1041*)

Calling attention to the public protest, as evidenced by the recent elections, against present economic conditions and its possible reactionary effect on highway expenditures, Thomas H. MacDonald, chief, Bureau of Public Roads, called on the states to centralize their highway administration particularly with a view to the state control of money for construction. With county initiation of construction and county control of the money difficulties were introduced into the direction of federal aid which retarded road development.

In discussing the management of Federal Aid, Rollen F. Windrow, consulting engineer, Missouri State Highway Department, criticised the delay experienced in getting approval of projects and securing federal-aid payments. He considered that the direction of federal aid should be decentralized by putting a federal engineer in every state with authority to give decisions and that at least in each district there should be a disbursing officer to expedite payments which had been earned. To reduce delays in the procedure by the state he considered that increased centralization of all federal business in the state highway department was necessary.

Continuing this subject Frank T. Sheets, superintendent of highways of Illinois, pointed out that delay had generally been due to non-conformance of the state with known requirements of the federal bureau. If the state presented its project properly its approval was reasonably prompt. A. R. Hirst, state highway engineer of Wisconsin, stated that as director of state aid to counties he had been subjected to every sort of criticism from the counties that the federal bureau was now receiving from state highway departments and the reason was much the same: "both were trying to put something over."

Maintenance administration was discussed in papers by G. G. Dillman, deputy commissioner, Michigan State Highway Department, and H. K. Bishop, chief of construction, Bureau of Public Roads. Mr. Dillman described and upheld the practice by which maintenance is performed through county road departments with the state highway department in control. State maintenance directly was described and advocated by Mr. Bishop. Active discussion followed with J. T. Donaghey of Wisconsin and F. F. Rogers of Michigan upholding administration through county departments and A. H. Hinkle of Indiana, W. R. Neil of Georgia and others advocating maintenance directly by the state. A simpler organization and closer control were the advantages claimed for state maintenance. In support of the practice of maintenance through the counties it was urged that education of the people in good road-building and maintenance by giving every locality a hand in the work was a distinct aid in highway development.

Four of the standing committees—standards, administration, maintenance and motor truck regulation—announced progress. Substantially finished reports were presented by the committees on construction, tests and co-operation with contractors.

The Engineer in Public Life

JOHN R. FORDYCE

In the civic activities of Hot Springs, Ark., Lt.-Col. John R. Fordyce, president of the engineering corporation which bears his name, has long been active. As a member of the city's Business Men's League he has served on that organization's committee on relations with Washington and made many trips back and forth to the national capital in the interests of Hot Springs, involving relations with the Interior Department and the location of a hospital for ex-soldiers. He is a member of the local Rotary Club and was appointed by Governor McRae as one of the two commissioners of the State Highway Department. He also served as chairman of a voluntary highway commission, appointed by the governor, to study highway development in Arkansas.

During the World War Mr. Fordyce served, with rank of major, Engineers, in this country, on the construction of Camp Pike at Little Rock and the Quartermaster Depot at St. Louis. Later he was assigned to the Railroad Administration as terminal engineer for the Mississippi Warrior Barge Line. He holds a commission as lieutenant-colonel in the Engineer Reserve.

Colonel Fordyce was born in Huntsville, Ala., Nov. 7, 1869, and is a graduate of Washington University, class of 1892, and of the Harvard Graduate School.

The committee on bridges announced the completion of specifications for steel bridges and corrugated culverts and stated that further specifications were far enough advanced to make possible the promise of their completion in 1923. Forms for advertising, bidding forms, forms of contract, were recommended by the committee on specifications. These are substantially the same forms as are employed by the North Carolina Highway Commission.

In general, the committee on standards recommended that, while design standards must wait on the conclusion of research work now in hand, pavement slabs should have edges at least as thick as the center; subgrade should be loosened at least 8 in. deep and recompacted by rolling; concrete thickness should be reduced no more than one-fourth for base surfaced with other material, and surface variations as shown by a 10-ft. straight-edge should not exceed ¼-in.

The committee on construction presented a report with appendices, which makes substantially a manual of road construction. The outstanding recommendations were: (1) No materials should be stockpiled on the subgrade but hauling may be allowed providing the subgrade is fully restored, rolled with a 50-lb. roller, moistened and checked by templet. (2) In mixing concrete a measured aggregate should be used with cement added directly from bags or brought in covered containers, and the mixing period should be at least 1 minute. (3) Central mixing is permissible, (4) The surface finish should be to ¼ in. for pavement and to ⅜ in. for base.

A 200-page report was presented by the committee on tests. Complete directions are contained for sampling and conducting tests on all classes of road materials. This report was adopted as the tentative standards of the association and ordered to be printed.

After three years the committee on relations with contractors presented a report embodying practically all the features outlined in the statement published in *Engineering News-Record* Nov. 2, 1922, p. 749. The report was accepted without criticism.

An important concluding action of the convention was the authorization of a paid assistant to the secretary to carry on the legislative work and other business arising during the year.

Fire Does $15,000,000 Damage to Astoria, Ore.

(*Concluded from p. 1041*)

the curb lines was a fire wall of building tile with some crosswalls at street intersections. These crosswalls had been badly broken by various public service corporations in constructing pipe lines and conduits, leaving an open passage under the streets which acted as a flue and through which the fire ran, setting buildings ablaze sometimes a block ahead of the fire fighters.

"There is no doubt that, had the streets been filled, the fire would not have spread over more than one or two blocks. There were a number of buildings in the burned area of brick, brick and tile, and concrete. With, I believe, only one exception, the brick and brick and tile buildings are completely ruined, while the concrete appears very little damaged. There are also a number of blocks where the concrete walls are carried on reinforced-concrete posts and girders, and I have not yet found a failure of these posts or girders.

"The results of the fire will be: (1) The widening of all streets to not less than 70 ft., they now being nearly all 50 ft. in width; (2) the construction of concrete retaining walls along the curb lines; (3) construction of concrete posts and girders for carrying sidewalks; and (4) the filling of streets with either earth or sand."

Denver Wants Local Engineer as Chief on Moffat Tunnel Job

With the appointment of Major L. D. Blauvelt as state highway engineer of Colorado, comes the announcement that the Moffat Tunnel Commission is soon to select a chief engineer. Inasmuch as Major Blauvelt decided to stay with the highway board, the Colorado Society of Engineers has communicated with the chairman of the commission urging the appointment of a local engineer as chief in the Moffat tunnel work.

As the commission is looking about for an engineer, word is received to the effect that opponents of the Moffat tunnel construction job, represented by a local attorney, have filed a petition for a rehearing of the tunnel bond issue case, based on the claim that the tunnel act violates the constitutional provision prohibiting the use of public credits or bonds in aid of private corporations.

Typhoid at Franklin Furnace Due to Cross-Connection

The typhoid outbreak at Franklin Furnace, N. J., which, up to Dec. 11, had caused 97 identified cases and 14 deaths, has been traced by the staff of the New Jersey Department of Health to an open gate valve and a rusty check valve on a forgotten cross-connection between the industrial and fire protection supply of the New Jersey Zinc Co. and the domestic water-works system. The latter system is owned by the company named but it supplies water for domestic use without charge.

The borough supply is taken from an artificial lake in which water from the Walkill River is impounded. After filtration and chlorination the water is pumped to a standpipe. The industrial supply is also taken from the Walkill River by pumping but at a point below the domestic intake. This supply is not treated.

Two ordinary gate valves on cross-connections were exposed by digging, one of which was found sealed and the other one open. Beyond the open gate valve was the rusty check valve already mentioned. Use of a colored chemical showed that this valve passed water from the mill to the borough system. A recent underwriters' test of the fire-protection system put a heavy extra pressure upon it. The outbreak has been confined to that part of the borough endangered by the open gate valve and the leaky check valve.

The earliest cases were reported on Oct. 24. The open gate valve was closed on Nov. 27.

The portion of Hardyston township that includes Franklin Furnace became Franklin Borough in 1912, and had a population of 4,075 by the census of 1920.

Conference Favors Plan To Number Steel Grades

After extended discussion of the problem involved in the numbering of steels, the conference called by the American Engineering Standards Committee, at the request of the Bureau of Standards, decided the matter could be handled better by a sectional committee of the American Engineering Standards Committee. For that reason no plan or program was adopted so that the sectional committee could consider the matter without limitations as to whether the classification be based on chemical analysis, heat treatment or physical tests.

It was the sense of the conference that there should be a uniform numbering system for forging, casting, structural, tool and other steels, including structural plates.

San Francisco Engineers Hold Tenth Annual Meeting

The San Francisco Engineer's Club celebrated its tenth anniversary on Oct. 31 with a luncheon at which nine of the ten past presidents were present and the tenth. W. W. Briggs of the Westinghouse Lamp Co., spoke to the meeting from his office in New York by means of the transcontinental telephone. Seven other members of the San Francisco Engineers' Club were gathered in Mr. Briggs' office in New York for the occasion and for a period of fifteen minutes during the luncheon there was an exchange of greetings between members in New York and San Francisco. The other members in Mr. Briggs' office were: Allen Hazen, A. M. Hunt, F. W. Gay, Guy Bailey, J. G. DeRemer, C. C. Broadwater, and A. H. Griswold.

After concluding the telephone conversation each of the several past presidents made brief talks and the meeting then listened to an address on "What Shall We Do With Our Past Presidents?" by George L. Dillman. New officers of the club, recently elected for the year beginning Nov. 1, are: President, W. G. Vincent, Jr.; vice-presidents, F. L. Sizer and Bruce Lloyd; secretary, C. H. Snyder.

New Unit in Service at Copco Hydro-Electric Plant

On Nov. 7 a new generating unit driven by an 18,600-hp. reaction turbine was put in service at the Copco plant of the California-Oregon Power Co. which is on the Klamath River just south of the Oregon-California line. The transmission lines of this company extend from Redding in northern California to Eugene in Oregon and while serving the power needs of intervening territory constitute a connecting link between the interconnected power lines of California and the network centering at Portland in the Columbia River Valley.

The new unit is housed in an extension of the power house for which provision was made when the first installation, a unit of the same size, was put in several years ago. The plant is served by a dam across the Klamath River, 132 ft. high above stream bed; the power house standing close to the downstream side of the dam. Additional storage for the new unit was provided by a recently completed 15-ft. increase in the height of dam made in accordance with plans laid out when the first work was done.

Place A.A.E. Employment Service on Self-Sustaining Basis

In response to a desire of the members that the employment service of the American Association of Engineers be enlarged, a plan for putting the service on a self-sustaining basis has been worked out after two years' study. The new plan is not put forth as all-inclusive but rather as the beginning of a method that can be modified in the light of further experience.

Rules under which the service will work stipulate that members only in good standing may receive service (except when qualified members are not available); that the charge shall be 10 per cent of the first month's salary, (except when the position is not more than two months in extent); and that chapters have the option of conducting free or self-sustaining service with the approval of the director of the district who is charged with the direction of all employment work in his district.

Law Protecting Surface Over Mines Found Unconstitutional

With one dissenting voice the U. S. Supreme Court on Dec. 11 declared unconstitutional the so-called Kohler law of Pennsylvania, passed by the last legislature, designed to protect the surface over anthracite mines against subsidence due to the mining operations. Most of the anthracite mining is carried on under various forms of agreement between coal owner and surface owner which give the former the right to mine regardless of surface effect.

The city of Scranton, among others, has suffered increasingly under this system. The Kohler law was designed to remedy the resulting evil conditions by prohibiting the mining of coal in a manner that would endanger lives or property on the surface. The Supreme Court now finds that this law transcends the state's police powers. Its decision states in effect that while exercise of police powers often constitutes a taking of property, in this case the taking is too extensive, and, furthermore, the law is not justified as a protection of personal safety.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

The Philadelphia Section of the American Society of Civil Engineers at its regular meeting on Dec. 4 was addressed by Nelson P. Lewis, director of the survey of New York and its environs under the auspices of the Russell Sage Foundation, who spoke on the subject of "Regional Planning." The paper was illustrated by numerous lantern slides showing the scope of the survey and some of the benefits resulting from good planning and from zoning. Milton B. Medary, architect, John A. Vogleson, chief engineer of the Bureau of Surveys and James W. Follin, chief engineer of the Bureau of Municipal Research, all of Philadelphia, took part in the discussion. Preceding the meeting Mr. Lewis was entertained at an informal dinner at the Engineers' Club.

The Associated Engineering Societies of St. Louis is planning a series of radio talks by engineers on the proposed bond issues for public improvements. A lecture on "The Arrangement of Atoms in Crystals" was given Dec. 6 by W. P. Davey, of the General Electric Co.'s research department.

The Engineers Club of St. Louis, Mo., has nominated the following officers for 1923: George E. Chamberlin, president; J. L. Hamilton, J. D. Robertson and W. W. Horner, vice-presidents; L. A. Day, treasurer, and F. C. Woermann, E. H. Tenney and W. R. Crecelius, directors.

Personal Notes

J. G. KENAN, formerly with P. T. Clifford & Son, general contractors of Valparaiso, Ind., announces the incorporation of the J. G. Kenan Co., with offices at Cleveland, Ohio. The company will conduct a general contracting business, giving special attention to railroad and industrial building construction.

BRIG.-GENERAL MORRIS B. PAYNE, engineer and architect of New London, Conn., has been appointed quartermaster-general on the staff of Governor-Elect Charles A. Templeton, of Connecticut.

JOE J. ESTILL, an assistant engineer with the Tarrant County, Texas, Highway department, has been appointed principal assistant engineer of the department under R. V. GLENN. Mr. Estill was graduated as a civil engineer from the University of Texas in 1912. During the war he served as a captain of engineers and later was associated with the firm of Lipscomb and Estill, contractors, at Ft. Worth, until joining the forces of Mr. Glenn.

A. J. ADCOCK has been appointed county engineer of Reeves County, Texas, with headquarters at Balmorhea.

TOM C. MEAD, until recently an office assistant in the division of irrigation and engineering of the California State Board of Public Works, has become an office assistant in the state engineer's office of Wyoming.

JOSEPH KLECKA, formerly a draftsman with the Pittsburgh Bridge & Iron Works stationed at Rochester, Pa., has become connected with the Morava Construction Co., Chicago, Ill. The latter concern is a steel fabricating organization and Mr. Klecka is employed as draftsman.

MAURY A. CHURCH, formerly a resident engineer in charge of highway construction with Carter & Knoch, civil engineers of Little Rock, Ark., has severed his connection with that organization to become associated with Louis Rich Construction Co., East St. Louis, Ill. His new position is that of construction engineer.

J. R. GUPTILL has severed his connection with the Empire Companies, Bartlesville, Okla., with whom he was employed as engineer, to join the River Junction Farms, Inc., of Oakland, Cal. Mr. Guptill is field engineer in his new position.

R. A. DALE, until recently a district engineer with the Wyoming State Highway Department, has established engineering offices at Glendo, Wyoming, where he will carry on general engineering practice.

R. L. HEARN, formerly assistant engineer of design of the Queenstown-Chippawa power development, is now assistant chief engineer with the Washington Water Power Co., Spokane, Wash. Mr. Hearn is a graduate of the University of Toronto. He has been successively draftsman with the Dominion Bridge Co., Ltd., Lachine; designer with the Hydro-Electric Power Commission of Ontario, on the Wasdells Falls power development, and shop inspector on the Eugenia Falls development.

FRANK H. FOX, formerly electrical engineer with Burns & McDonnell of Kansas City, Mo., has joined the organization of Arthur L. Mullergren, consulting engineer, Kansas City, in the capacity of principal assisting engineer.

E. M. SMITH, formerly structural engineer with the Houston (Texas) Light & Power Co. and the Sinclair Refining Co., has joined the organization of Arthur L. Mullergren, consulting engineer, Kansas City, Mo., as structural engineer.

J. E. CLAYTON, who has been an inspector in the state highway department of Kentucky, has gone to Florida to become associated in highway construction work at Pensacola for the Speed-Parker Co.

GEORGE H. NOLAN, who has been general manager in Cuba for the Frederick Snare Corp., contractors of New York City, has resigned that position and has become vice-president of the Clark Dredging Co., Miami, Fla.

C. H. EIFFERT was appointed maintenance engineer of the Miami Conservancy District, it has been announced by CHARLES H. PAUL, chief engineer, on Dec. 1. Mr. Eiffert has been division engineer in charge of the river improvement work at Hamilton since the beginning of construction about five years ago. Before that he was engaged on the preparation of plans and specifications for various features of the project. He is a graduate of Cornell College, Iowa, and a member of the American Society of Civil Engineers. The creation of the office of maintenance engineer marks a definite step in the change of the Conservancy organization from a construction to a maintenance basis. The flood-control works are practically complete, and have been ready to handle floods for the last year or more. As the upkeep and maintenance of the various features of the project are of principal importance now, the maintenance engineer will be directly responsible to the chief engineer's office for that feature of the district's operations.

FRED F. MCMINN has been appointed structural engineer in the Cincinnati Building Commissioner's office, succeeding RUSSELL M. EASTON, who resigned to accept an executive position with the Ohio Building & Construction Co. Mr. McMinn has served as engineer for the Rapid Transit Commission from the inception of the rapid-transit project, and has supervised much of the construction which has already been completed.

CHARLES E. HEWES, city manager of Long Beach, Calif., has been removed from office by a recall vote. The recall of Mr. Hewes is interpreted by local political observers as a condenmation of the existing council. Various political charges were made against Hewes, which are all in the nature of those to be expected when there is a possibility of removing by a recall vote a city official whose position is appointive.

THE FULLER ENGINEERING CO., whose chief office has been maintained at Allentown, Pa., announces the establishment of headquarters at Fullerton, Pa. The Fuller company has branches in New York, Chicago, Seattle, London, and Hamburg.

STONE & WEBSTER, INC., has recently opened a branch office in Philadelphia at 307 Real Estate Trust Building, with GEORGE CHAMBERLAIN as manager. The company has several million dollars worth of work under way in that city, including the Jefferson Hospital, a new building for the Insurance Company of North America, a district service building for the Western Union Telegraph Company, and foundations for a power house extension for the Philadelphia Electric Co.

R. T. SENTER, formerly assistant to the president of the Philadelphia Rapid Transit Co., has become vice-president in charge of engineering, succeeding GUY A. RICHARDSON, who has resigned. Mr. Senter's engineering work will include such part as the P. R. T. may take in transit development in Philadelphia.

GEORGE M. SHEPARD has been appointed city engineer of St. Paul, Minn., to succeed OSCAR CLAUSSEN, who recently resigned. MR CLAUSSEN had been city engineer for fourteen years. Mr. SHEPARD, who had been an associate of L. P. WOLFF, consulting engineer, is a graduate of the University of Minnesota. In 1917 he was commissioned a captain of engineers and served in the Hawaiian Islands until 1919. The change in officials was brought about by what is purported to be an effort to increase the efficiency of the department of public works.

R. C. STARR is continuing in the capacity of construction engineer for the San Joaquin Light & Power Co. while carrying on the Merced irrigation development for the Merced Irrigation District in California as engineer in charge of construction.

Obituary

F. A. WELLS, vice-president of the Wells Brothers Construction Co., Chicago, died Nov. 28 from injuries received in a street-car accident. Mr. Wells, as a prominent member of the American General Contractors, devoted a great deal of effort toward the establishment of better standards and the general betterment of the construction industry, taking special interest in working for arbitration and fixed fee contracts.

HUGH GETTY, president of the building firm of that name in New York City, died Dec. 4, aged 73 years. From 1916 to 1918 Mr. Getty was president of the Building Trades' Employers' Association, and as a result of the "housecleaning" following the Lockwood revelations he was re-elected to the office in February, 1921.

JAMES REAVEY, for twenty years assistant chemist in the San Francisco Department of Public Works, died Oct. 10.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Suggestions by Manufacturers for Contractors—

Better Equipment Maintenance and Repair Parts Service

MANUFACTURERS of construction equipment and materials have often stated that the service of their machines could be vastly improved and their relations with customers made mutually more valuable if purchasers would pay more attention to plant inspection on the job, make repairs in time and keep on hand an adequate supply of spare parts.

In wiring or writing for repair parts contractors cause many misunderstandings by failure to be specific. They may send in a rush order for a "clutch" for a machine on which several different clutches are used or for a "wheel" when front and rear wheels are of different sizes. Requests for filling orders frequently come to manufacturers from individuals whose credit standing is unknown to them.

All of this has suggested the desirability of putting on record a few of the experiences of equipment manufacturers in the supply of repair parts for their machinery. The object, of course, is constructive. The interests of the maker and the user of equipment are identical in this respect: Both want their machinery to render the maximum service on the job.

In this issue, therefore, begins a recital of some of the difficulties with which manufacturers have to contend and of some of the ways in which contractors and other users of construction equipment can cooperate in the interests of better service.

Without further introduction, therefore, it seems desirable to get down to specific cases by the following statements of the experiences of leading manufacturers.

From a Manufacturer of Pneumatic Tools and Compressors

THE difficulty with the majority of purchasers of labor saving equipment is carelessness in its upkeep. Neglecting to keep nuts set up tightly causes most of the grief. Some people think the manufacturer should provide means for locking nuts so that they will remain permanently tight. They lose sight of the fact that it is easier said than done. If it was easily accomplished there would not have been in excess of one hundred thousand patent applications covering various types of self-locking bolts, nuts, lock nuts, etc., to accomplish it. These safety devices all fail sooner or later and having accustomed oneself to rely upon them, havoc is the consequence when they do fail. The only safe plan is to look the equipment over almost daily. The increased efficiency of the equipment will pay for the effort.

When ordering parts it is too frequently the customer's habit to order by description instead of referring to parts catalogues and drawings and making use of the manufacturer's symbol numbers. When customers call a part what they think it ought to be named, instead of following the catalogue, they frequently get what they do not want, with consequent loss of time which is expensive.

Lubricants Important

Many classes of machinery require special lubricants, but users are too prone to ignore the recommendations of the builders of the equipment and take the word of the oil salesman who claims that what he has is better and costs less. When this is done there is usually quite a charge against the educational account. On reciprocating parts, such as pistons provided with rings, when rings break operators wonder at it, but no change is made in the lubricant. If the lubrication is good, rings will not break—they break only when dragging against cylinder walls for lack of lubrication or oil film.

On equipment with splash lubrication, the builders caution the users to change the oil at given periods and to provide quarters to refilter the oil removed from the crank case, but in too many cases the users keep adding additional oil to the old oil in the crank case until it becomes so badly fouled that cross-heads and guides are destroyed.

> ***Next Week***
>
> "I want rear wheels, hind wheels, back wheels. Dammit"
>
> *The contractor who sent this telegram to an equipment manufacturer could have avoided getting all "het up" if he had ordered "rear wheels," instead of just "wheels."*
>
> This incident, and others within the experience of the Western Wheeled Scraper Co., Aurora, Ill., will be discussed in next week's issue. The article will indicate to the contractor who "wants what he wants when he wants it" how to get it—*Editor.*

From the Lakewood Engineering Co., Cleveland, Ohio

IF WE attempted to enumerate the different ways that we receive orders for repair parts and to point out the combinations which contractors seem to hit upon and which fail to give us complete information, the list would be too long entirely for your use. The principal failure on their part is to give the serial number of the machine and the part number from the repair list. The two foregoing points are the most important from our standpoint, coupled with the fact that contractors in general do not seem to attempt to anticipate requirements for many parts of their machines which are subject to a slow wearing process.

We keep a special part of our shop set aside so that special repairs which we do not regularly carry in stock can be handled quickly. We have a separate repair order department and a separate repair order shipping department, all of which is for the sole purpose of giving the quickest possible service on repair parts.

We have made test shipments between express, parcel post and special delivery to determine which branch of the transportation service can best serve certain parts of the country. We send out at this time of the year, as we did two weeks ago, letters urging contractors to overhaul their machines in the early part of the winter and to send their repair orders in now so as to utilize their men who are usually kept on all of the season and to insure readiness for operation when next year's work opens. One specific cause for difficulty which has happened two or three times in the past six weeks has been the order for repair parts from the home office of the customer and failure to indicate to which job this machinery part is to be shipped, although there may be several jobs running.

Next Week: Experiences of the Western Wheeled Scraper Co., Aurora, Ill.

To Protect Boxed Freight Shipments in Transit

The Transportation Division of the Bureau of Foreign and Domestic Commerce has recently investigated the best practices in export packing. Valuable suggestions have been received from many sources, among them one from the freight claim division of the American Railway Association, advocating the use of steel box strapping, which has the approval of the division, as an efficient method of reducing annual loss from pilferage and from inadequate containers, aggregating many millions of dollars.

A case reinforced with steel binding is protected against pilferage. Rapid removal of a steel banding is not possible with the tools usually at hand nor can a cut wire or strap be easily reunited. Wire or steel strapping adds to the strength of a container in a proportion so far above its slight cost that a box designed to carry its load without reinforcement can frequently be supplanted by one having sides, top, and bottom of the next thinner commonly used box lumber, provided it is adequately reinforced by a wire or strap binder. The result is a stronger, lighter, and less expensive box.

One big concern reports that a large percentage of its shipments is strapped, and that since adopting this system its package troubles, both from damage and pilfering, decreased 42 per cent during a period in which shipments increased 20 per cent in number.

Tell Road Show and Convention Story in Graphic Form

Manufacturers and "Engineering News-Record" Donate Space in Big Promotional Effort

TWENTY-TWO manufacturers of road building equipment and material and the publishers of *Engineering News-Record* have joined forces in a campaign to secure for the American Road Builders' Convention and Good Roads Show in Chicago, Jan. 15-19, not merely a record-breaking attendance of engineers, contractors and officials of the federal government, state, cities and counties throughout the country, but to double the figures of last year's unprecedented meeting. This effort has taken the form of a combined advertisement of 23 pages in this week's issue telling the story of what promises to be the greatest assemblage of the men, the machinery and the materials behind the nation's program of highway development ever brought together in this or any other country.

The various committees this year have been tireless in their efforts to make the January meeting one of outstanding usefulness to the entire highway industry. Careful planning has governed the preparation of the technical program. Subjects of major interest have been selected for discussion and the field has been combed to secure the men best qualified to prepare papers.

Exhibit Space Sold Out

As regards the Good Roads Show, every square foot of the enormous area covered by the Coliseum and adjoining buildings has been subscribed for by exhibitors, with the result that there will be on display new types of road-building equipment and materials and improvements on old types which in number and variety will surpass all previous exhibits in this field.

The Publicity Committee felt that the unusual character of this year's road convention and show demanded other than ordinary methods of promotion—some comprehensive, forceful plan to arouse the entire industry to the opportunities offered by the Chicago meeting. Out of this thought was developed the plan for using an imposing quantity of advertising space. This space, it should be noted, has been donated by the manufacturers of equipment and materials and the publishers of *Engineering News-Record*, not to feature their own products but to tell the story of the convention and by this widespread publicity, assure the attendance not only of the maximum number of highway engineers and contractors, but also of the leaders of the industry.

Construction Equipment Exported

Figures for September, 1922, of domestic exports of power shovels, dredging machinery, cranes, hoists and derricks, have just been issued by the Bureau of Foreign and Domestic Commerce. During the month indicated 13 steam and other power shovels, valued at $108,430, were shipped, 8 of them going to Canada, 2 to Japan and 1 each to England, Australia and Algeria. Dredging machinery exports totaled 302,245 lb. priced at $48,417; Australia was the largest consumer with 31,100 lb. Sixteen cranes costing $49,643 were exported, 4 going to Canada and 4 to Brazil. Hoist and derrick exports showed a total number of 233 units valued at $61,753; 62 of these units were shipped to Japan, 30 to Canada, and 41 to Australia.

S. B. Newberry

Dr. S. B. Newberry, president of the Sandusky Cement Co., and for years one of the leaders of the Portland cement industry, died suddenly Nov. 28 while driving his car in the downtown district of Cleveland. Dr. Newberry was born in 1857. After graduation from the School of Mines of Columbia College in 1878 he studied in Germany and France from 1879 to 1881. From 1881 to 1892 he was in the chemistry department of Cornell University, finally becoming professor of chemistry at that institution.

In 1892 he left collegiate work to become general manager and consulting engineer for the Sandusky Portland Cement Co., where he remained until his death. In addition to the executive control of the company Dr. Newberry had intimate contact with all the technical problems of cement manufacture. His investigations dealt particularly with the matter of waterproofing concrete and the manufacture of white cement. For many years he has been a familiar figure at all cement and concrete meetings.

Imported Shingles May Escape Duty Under New Tariff Act

Washington Correspondence

As a result of the alphabetical arrangement of the free list of the new tariff act, building interests may find that they can import asphalt shingles and asbestos shingles without payment of duty. Under the Underwood tariff act of 1913, composition shingles were assessed for duty according to their component material of chief value. Wooden shingles were free under that act, and it was clear that only wooden shingles were intended to be free, as they were classified in the free list among other woods.

In the new tariff act the free list is arranged alphabetically and the single word "shingles" appears between other items entirely foreign to the subject. The Treasury Department is studying the subject and while no ruling has been made the indications are that all shingles of whatever material must be admitted free.

Manufacturer Creates Fellowship for Steel Pipe Research

An industrial fellowship in the Mellon Institute of Industrial Research, of the University of Pittsburgh, has been established by the National Tube Co., of Pittsburgh, for systematic study of practical methods for the prevention of corrosion in hot-water supply systems. It is also giving attention to the classification of waters of various chemical composition, with respect to their relative corrosive action upon iron and steel, particularly in the form of pipe lines, boiler-economizers, tubes, etc. The present incumbent of the industrial fellowship is Clifford R. Texter, who for the past several years has been carrying out research on the corrosion of iron and steel, where not exposed directly to the atmosphere.

Business Notes

BABCOCK & WILCOX CO., manufacturers of boilers, have discontinued their branch office at Fort Worth, Texas, and established a new office at Dallas in the Magnolia Building.

CALIFORNIA EQUIPMENT & SUPPLY CO., dealers in construction and industrial equipment, Los Angeles, Calif., has completed arrangements to represent the American Cement Machine Co., Keokuk, Iowa, manufacturers of concrete mixers and hoists. The California company is planning to extend its business by including a general line of contractors' equipment.

J. R. SHERMAN has recently been admitted as a firm member of the Yakima Cement Products Co., Yakima, Wash., which is engaged in the manufacture of concrete pipe and other cement products. He recently completed the revision of plans and estimates of the irrigation system for the Kittitas reclamation district near Ellensburg, Wash. The work of the district, however, is suspended temporarily until a new bond issue is voted. An election will be called soon and in the event of a favorable vote on the bonds it is hoped that construction work will begin early next year.

TYREE L. BELL, president Tyree L. Bell Equipment Co., Dallas, Texas, representatives for the Lakewood Engineering Co., has become associated with McElwrath & Rogers, contractors of Corsicanna, and will supervise their road work in Cameron County, at Brownsville. He will maintain his interest in the equipment business which will be conducted by Donald Lee, sales engineer.

L. H. BEACH, formerly manager of the power plant department of Weinshank & Fenstermaker, consulting engineers, Indianapolis, has opened an office as commercial engineer in the Traction Terminal Building, Indianapolis, to represent the Permutit Co., of Chicago, manufacturers of water softening equipment, in the Indiana territory.

AVERY CO., Peoria, Ill., announces its improved 25-50-hp. tractor. Except for increased power, the design follows closely that of the 20-35-hp. unit described in this journal Nov. 30, 1922, p. 955.

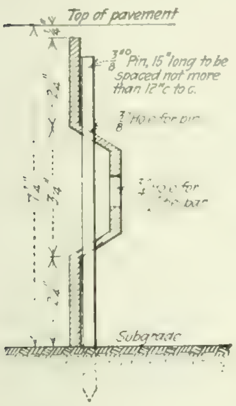
H. GOLDBERG has recently organized a pipe supply concern under his own name at 305 Cherry St., Philadelphia. For the past eighteen years he has been connected with the tool and used equipment business. For two years he was with the American Pipe & Supply Co.

Equipment and Materials

Bituminous Felt Joint Has New Tongue-and-Groove Feature

A new form of Elastite premolded expansion joint for concrete roads, embodying a tongue-and-groove feature instead of the straight face joint extensively used in the past, is announced by the Philip Carey Co., Cincinnati, Ohio. It has been developed, its manufacturer states, to fill the need of a longitudinal joint for concrete roads that would (a) prevent spalling and crushing of concrete at the joint, due to slab movement; (b) maintain a watertight seal in spite of possible movements of adjacent slabs; and (c) by interlocking action hold adjacent slabs to the same surface alignment, thus making it impossible for one slab to be forced up above or settle below its neighbor.

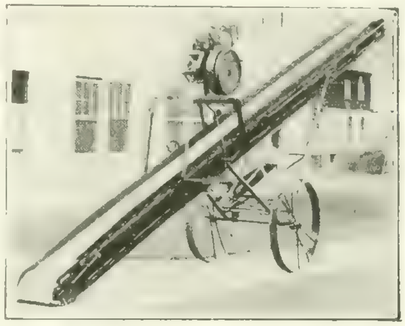
The new tongue-and-groove joint is made of the same material as the straight-faced joint and consists of a body of asphalt compound reinforced on each side with a heavy sheet of asphalt - saturated felt. The new joint is supplied in thicknesses of ¼ and ½ in., in widths from 4 to 12 in., and in any lengths up to 10 ft. To support the joint in position prior to concreting steel pins are passed through holes punched in the joint material, as shown in the accompanying sketch and driven into the subgrade. For longitudinal center-line joints the ¼-in. thickness is recommended and for transverse joints the ½-in. thickness. This form of tongue and groove joint has been accepted by the Illinois and the Michigan state highway departments. The sketch herewith is reproduced from the Illinois highway department's new standard sheet of concrete road sections.



Light Portable Conveyor for Sand Stone and Gravel

Designed originally for handling coal, the continuous-belt scoop conveyor manufactured by the Portable Machinery Co., Passaic, N. J., was modified this year in order to adapt it to the use of general contractors in loading sand, gravel, and crushed stone. Mounted on a two-wheeled steel carriage, the equipment consists of an inclined trough and belt conveyor operated by either an electric motor or a gasoline engine carried above the belt on vibration-reducing supports. The machine is made in three sizes—with 20-, 25-, and 30-ft. conveyor—and weighs from 1,500 to 2,300 lb., depending on type of power equipment and length of conveyor boom.

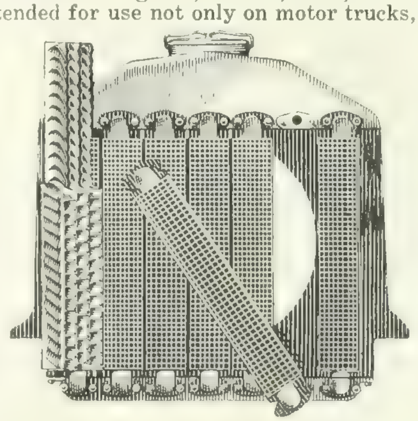
Simplicity of design was sought by eliminating self-propelling mechanism and self-feeding attachments. For the smaller-sized machine a maximum loading clearance of 9 ft. is provided and for the larger unit, 15 ft. The height of the delivery end may be varied within a 2-ft. range by a handle on the supporting arm of the wheel carriage. The width of the belt in all types is 14 in. An advantage of the overhead mounting of the power equipment is claimed to be its accessibility and protection from dirt. Under average operating conditions, the manufacturers claim, with one man feeding, 1 ton of material can be handled in from 2 to 3 min. The fuel consumption is stated to be from 4 to 6 gal. of gasoline per 8-hr. day, while in the case of the electric motor drive the cost of current is given as from 4 to 6c. per hour. The conveyor belt is operated through a chain and sprocket drive and at the feeding end a take-up bearing is provided.



One of the chief differences between the coal-handling and the contractor's type of conveyor is in the carrying trough. In the new sand and stone conveyor the belt travels between skirt plates instead of under them, as on the coal-handling type. This feature is claimed to reduce friction along the trough and to increase the life of the belt. Self-cleaning pulleys are used at both head and tail ends and special bearings are introduced.

Air Given Spiral Flow Through Sectionalized Radiator

Built in sections, so that a damaged unit may be replaced with a minimum loss of both time and money, the Spirex radiator, manufactured by the Modine Manufacturing Co., Racine, Wis., is intended for use not only on motor trucks,



but also on a wide range of construction machinery operated by gasoline engines. An exceptionally great cooling capacity is claimed for this radiator due to a special form of spiral core construction, by means of which a copper strip in each air cell produces centrifugal action on a column of air during its passage through the radiator. In addition, extra large water channels allow for constant free flow with a minimum danger of clogging or freezing.

The material used in this design is extra heavy copper radiator stock. The water channels are of one-piece construction with but one seam lapped and soldered inside and out. A $\frac{3}{16}$-in. plate of solid metal, front and back of the water channels, adds strength and leakproof qualities.

Publications from the Construction Industry

Tackle Blocks—W. W. PATTERSON Co., Pittsburgh, has just issued a new catalog showing its line of tackle blocks. The book contains 64 pages, 6x9 in., and illustrates standard wood blocks, oil-well blocks and hooks, snatch-blocks and weight blocks, as built for either manila rope or wire line. It also shows many special blocks, and "C"-hoops, Patterson design hooks, wire-rope slings, steamboat ratchets and contractors' tools. A number of field views complete the work.

Building Mixers—AMERICAN CEMENT MACHINE CO., INC., Keokuk, Iowa, is distributing a 28-page illustrated catalog and two folders dealing with its line of Boss building mixers. A feature of this equipment, which is built in sizes of from ½ to 5-bag capacity, is the use of a steel roller-pinion drive. In addition to the building mixers there is manufactured a combination building and paving mixer known as the 2-in-1. One of the pamphlets above noted deals with the Boss special highway mixer, which is equipped with pneumatic cord tires; in this machine the manufacturers claim to have saved 1,000 lb. in weight by the use of a steel instead of a cast-iron drum. The second folder features the Packard tilter mixer built in capacities of 3 and 5 cu.ft. and designed to mix mortar or plaster as well as concrete. A trailer model is shown equipped with pneumatic tires, which, it is claimed, add to the life of the engine and mixer by eliminating rattling during moves, jolting and loose bolts.

Overhead Shafting Data Book—MIDWEST STEEL & SUPPLY CO., INC., New York, in a 54-p. data book for architects and engineers, presents information to aid in solving problems relating to overhead shafting layouts in factory buildings and to the anchorage of various kinds of equipment in connection with concrete and brick work. A number of illustrations are given of the use of the company's "Ankerails," concrete inserts, and steel stringers. The Ankerails are of two types, a box section and an L section. The box rails have a hollow steel section with a continuous longitudinal slot in the bottom flange and vertical stiffening ribs on either side. The data book contains a great many cross-sectional drawings indicating how the box rails may be adapted to a wide variety of industrial uses, involving the anchorage of machinery, monorails, motors and blowers, piping, pier fenders, shaft hangers, shafting stringers. Illustrations show a number of typical layouts for overhead shafting.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Production and Materials Stocks in Nine Cities

Gain in Steel Output During Month—Cement and Brick Production Increased—Lumber Fell Off Slightly

Steel—Monthly production of steel ingots, as reported by thirty companies which made 87½ per cent of the steel ingots produced in 1921, shows 2,889,297 tons for November, a gain of only 0.5 per cent over the preceding month. The total output, thus far this year, has reached 26,336,563 tons as compared with 15,399,853, for the corresponding period in 1921. Operations in the iron and steel industry, are proceeding at about 80 per cent of capacity, with much headway being shown upon tonnages booked during the strikes.

Lumber—An average of 311 mills reporting weekly, to the National Lumber Manufacturers' Association, show 952,502,697 ft. cut; 794,682,118 ft. shipped and orders for 877,714,760 ft. b.m., for the four weeks ending Nov. 25. This represents a drop of about 4 per cent in production; a gain of 6 per cent in shipments and 17 per cent in orders, over the four weeks, preceding. The industry, as a whole, now stands at about 10 per cent below normal, as to output; with orders 19 per cent and shipments, 20 per cent below normal.

Cement—October shipments exceeded production by 567,000 bbl., for the entire country, according to the Geological Survey. A total of 12,287,000 bbl. were produced during October as against 11,424,000, for September. Shipments reached 12,854,000 bbl. in comparison with 12,444,000, during the preceding month. With an increase of 7 per cent in production, outweighing an increase of 6 per cent in shipments, stocks on hand Nov. 1 amounted to 4,157,000 bbl., a drop of 12 per cent from the previous month.

Brick—Information as of Nov. 1, received from members of the Common Brick Manufacturers' Association, producing 70 per cent of the country's output of common brick, shows that stocks of burned brick on hand increased 21 per cent and unburned, 83 per cent during the month. Orders fell off only 0.4 per cent between Oct. 1 and Nov. 1, 1922. Sixteen plants closed on account of the season. Stocks are piling up in anticipation of the Spring demand.

San Francisco—Fair supplies of track materials, metal lath and hollow tile. Large stocks of road-oils, asphalt, sewer pipe, brick, steel sheets and manila rope. Scarcity of cement, triangle mesh and wire nails. Prompt mill deliveries on reinforcing bars but slight shortage of structural shapes. Lumber being consumed as fast as shipped from mill.

Denver—Brick on hand around 4,000,000, an ample supply for all calls on immediate delivery. Lumber stocks built up in anticipation of demand and are now very complete, in spite of transportation difficulties. Brick plants to operate during cold weather, in view of heavy demand.

Minneapolis—Dealers report conditions of stocks in all building materials, notably better than month ago, due to seasonal falling off in construction operations. About 20,000 bbl. of cement in local warehouses. Dealers able to furnish enough brick. Lumber stocks low, as usual at this time, estimated at about 25 per cent below normal for season.

Detroit—Sewer-pipe stocks small, but sufficient to supply demands. Cement shortage relieved; ample supply for immediate shipment at nearby mills. About fifteen carloads of lime at warehouses, with quick shipments from Ohio and Michigan plants. Hollow tile stocks depleted; large deliveries take several days. Moderate reserves of dimension lumber but scarcity of structural timbers. Asphalt deliveries require one to two days.

New Orleans—Stocks of sewer pipe, cement, lime, brick and hollow tile considered fair; with demand active. Sand and gravel situation better, with no market for crushed stone. Production of Southern pine continues below volume of orders received.

Atlanta—Plenty of common brick and yellow pine lumber. About five

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Cement, Minneapolis, 20,000 bbl.); time required for delivery of carload lots to city job, example: (sewer pipe Atlanta, 6 to 8 days) [illegible]

	San Francisco	Denver	Minneapolis	Detroit	New Orleans	Atlanta	Philadelphia	New York	Montreal
Sewer pipe	Plenty	Del. 24 hr., local plant	Improved	Small but sufficient	Stocks fair	Del. take 6 to 8 days	Stocks depleted	Mill del. better	Ample
Cement	Stocks low	Del. retarded by car shortage.	20,000 bbl	Shortage relieved	Sufficient	20 cars	Supply low; del. slow.	No shortage	Plenty
Lime	Fair supply	Plenty	Better than [illegible]	[illegible]	Ample	20 cars	Stocks limited and uncertain	Plenty	Well supplied
Common brick	Plentiful	4,000,000	Able to supply all [illegible]	Plenty in local yards	Plentiful	Unlimited	[illegible]	Enough for this winter; capacity [illegible]	Del. take [illegible] days
Hollow tile	Enough	Sufficient	Supply no [illegible] limited	Depleted	Enough	Del. take 4 to 6 days	Del. [illegible] slow	Well supplied; [illegible]	Short; del. take 3 days
Lumber	Used [illegible] as it arrives from mills	Complete, all dimensions	About 25 per cent below normal	Structural timbers scarce	Production below orders	Plenty pine	Not equal to demand	Mill del. take 7 to 9 wk. from time order is placed.	Retail stock large
Asphalt	Large stocks native.	About 10 [illegible]	No shortage	Del. take 1 to 2 days	No market	25 cars	Heavy reserves	Plenty in reserve	
Structural steel	Lack of shapes	No scarcity reported	Notably better than [illegible]	Enough	No shortage	5 cars	Sufficient warehouse [illegible]	Heavy warehouse stocks; mill del. [illegible]	Well stocked

REPORT ON COMMON BRICK FROM 94 YARDS AS OF NOV. 1, 1922

Dist. No.	Including States of	No. of yards reporting	Plants closed down	Burned stock on hand	Unburned stock on hand	Orders on books	Price per thousand at brickyard
1.	N. Y., New England	7	4	5,877,000	5,515,000	2,590,000	$12.00 to $18.00
2.	Pa., N. J., Md., D. C., Del.	10	0	9,062,000	8,052,000	32,648,000	13.50 to 19.00
3.	Va., N. C., S. C., Ga., Fla.	7	0	2,829,000	2,407,000	2,974,000	12.00 to 18.00
4.	Mich., Ohio, W. Va.	11	1	14,906,000	11,107,000	13,453,000	12.50 to 15.00
5.	Ill., Ind., Wis.	25	1	175,792,000	31,511,000	157,298,000	9.50 to 15.50
6.	Ky., Tenn., Miss., Ala., [illegible]	8	1	[illegible]	[illegible]	[illegible]	[illegible] to 16.00
7.	N. & S. Dak., Minn., Neb., Ia., Kan., Mo.	8	4	4,255,000	1,838,000	2,153,000	10.25 to 18.00
8.	Okla., Tex., N. M.	6	2	5,611,000	1,701,000	1,390,000	7.00 to 12.00
9.	Wash., Ore., Mont., Wyo., Ida., Utah, Colo.	6	2	1,880,000	801,000	745,000	12.00 to 16.00
10.	Calif., Ariz., Nev.	6	1	7,853,000	10,787,000	10,000,000	11.00 to 15.50
		94	16	232,733,000	77,426,000	232,694,000	

carloads of structural steel; twenty cars each, of lime and cement; and twenty-five carloads of asphalt, on sidings. Hollow tile deliveries take four to six days; six to eight, required on sewer pipe.

Philadelphia—Rail deliveries slow on sewer pipe and hollow tile; stocks depleted. No paving stone or wood blocks; asphalt plentiful. Cement, lime and common brick reserves, low; shipments uncertain. No surplus stocks of lumber, except some few odd sizes; supply inadequate to meet the heavy demand.

New York—Mill shipments of long leaf yellow pine, take seven to nine weeks from time order is placed. Unprecedented shortage of materials in crushed stone market. No new orders being booked; dealers concentrating upon filling of contract obligations. Enough brick for winter needs. Slow mill deliveries on all construction materials.

Montreal—Ample supplies of sewer pipe, cement, lime and other construction materials. Brick deliveries, however, take from three to seven days. Shortage of hollow tile reported. Large retail stocks of lumber.

Business Briefs

Stock market more active, but not because of participation by general public.

Ford Motor Co. capital stock amounted to $17,264,500, its surplus $289,935,296, and its reserves for income taxes (halfway through the year) $44,848,893, according to the last statement.

Steel production was at the rate of 35,555,000 tons per year in November, the largest since November, 1920. Total output of 1921 was only 16,826,946. Pig iron production was at the rate of 94,990 tons per day, against 85,092 in October.

Building contracts of $150,000 and up awarded in the United States this year, to Dec. 1, numbered 1,790 worth $682,986,000, according to Construction News figures of *Engineering News-Record*. These comprised such structures as offices, banks, schools, hospitals, etc., and did not include industrial works, which numbered 1,272 projects worth $40,000 and over, totaling $180,151,000.

Petroleum production in the United States was 63,620,520 bbl. in 1900, and 469,639,000 in 1921. In the ten years from 1912 to 1921 inclusive the Standard Oil Co. of New Jersey, which leads all the oil companies in the volume of business, showed net earnings of $775,163,260, of which $115,517,677 was paid for taxes, $222,065,226 for dividends, and $437,580,357 was absorbed by the business.

Foreign exchange's feature is the strength of sterling, which on Monday closed at $4.59½, the highest since 1919. The New York *Times* says "there is little doubt that England has been buying her own exchange in the open market." Authorities state that the French financial situation is improving and the fact that this improvement has not been reflected in exchange suggests that the franc is more responsive to political events than to the economic situation. The German mark sold for .01$\frac{3}{16}$ to .01¼ cent.

Avoid Transportation Waste To Reduce Car Shortage

Loading To Cubical Capacity; Prompt Unloading, Key To Problem—No Cars To Ship Repair Materials

That "the railroad problem has ceased to be merely a problem for the railroads," is the opinion expressed by the National Industrial Conference Board, in its survey of Dec. 3. The report continues: "It has become one of the great industrial problems of the country. It has ceased to be merely a matter of combinations, rebates, rates, regulations and the like. It has become a question as to whether this country shall have a real railroad service administered for the benefit of the country as a whole, or whether a variety of diversified interests, — the farmers, labor, or any other group,— shall seek to regulate the railroads for their own exclusive benefit.

"The railroads have been regulated to the point of debility. Wages, together with working conditions, form a large item of expense. They have been regulated, usually upward, by a government board. Income has been regulated through control of rates, with a consequent progressive reduction of the ratio of earnings to cost of service. Intercorporate agreements which would have permitted desirable operating economies are prohibited. How the railroads—or for that matter any business enterprise—under such conditions, could be expected to maintain service, improve their equipment and roadbed, seek new capital for needed extensions and pay a fair dividend on the invested capital, is a problem for which those who are occupied in framing railroad regulation have offered no solution. Certain individuals and certain groups in Congress are threatening further drastic regulations of the railroads. But so far no comprehensive or intelligent plan for attacking the vital problems involved has been advanced."

No Cars To Ship Car Materials

The situation resolves itself into a condition where there are no cars available to ship materials to build new cars or repair those in bad order. Several car-building and repair companies are having trouble in securing shipments of lumber, already contracted for. Owing to the greatly increased demand for car repair materials and the necessity of putting into use all available freight cars, anything that can be done to expedite the movement of materials to these car companies will not only help the railroads, but will also put more cars in service at an earlier date. Following a decrease in car shortages, consequent to a seasonal decline in freight loadings; as well as a reduction in the number of bad order cars and locomotives, due to gains in employment of shop mechanics, comes the Car Efficiency Circular, issued Dec. 1 by the American Railway Association. This circular embodies an appeal to shippers, made with the full knowledge that railroads recognize their own responsibility for prompt movement, of loaded and empty equipment, as being one of the primary measures necessary to avoid waste of transportation. Among the several important factors contained in the circular, are the following suggestions to shippers and receivers:

(1) In buying other than "less car load" shipments, specify "car loads," not fixed quantities as governed by tariff minimums or set trade units.

(2) Load cars the day placed.

(3) Load to cubical, or 10 per cent above marked capacity.

(4) Unload cars the day received thus releasing equipment and avoiding demurrage.

Car loadings by weeks (Oct. 28 to Nov. 25), as reported by the American Railway Association, during the last three years, are shown in the following table:

Week	1922	1921	1920
Nov. 25..........	955,495	673,465	803,701
Nov. 18..........	969,094	790,363	889,138
Nov. 11..........	953,909	755,777	927,586
Nov. 4..........	994,827	837,576	915,615
Oct. 28..........	1,014,480	951,384	981,242

The demand for freight cars in excess of supply, reached 152,565 for the week ending Nov. 23, as against 158,236 cars during the week of Nov. 15, 1922. This represents a decrease in shortages of over 5,000 cars in one week.

Of the 2,258,949 cars on all lines, 235,660 or 10.4 per cent, were in need of repairs on Nov. 15. This shows a slight decrease in comparison with 249,960, in bad order on Nov. 1, 1922.

Union Rejects Award by Jurisdictional Board

Trades Clash Provokes Strikes on New Cleveland Bank—Hoover Regrets Defiance of Board

Washington Correspondence

Much interest is being shown in Washington as to expected developments from the refusal of the carpenters' union to accept the decision of the National Board for Jurisdictional Awards in the building industry, which declared that metal-trimming work properly belonged to the sheet metal workers. The board met Nov. 15 and 16, but withheld announcement of its proceedings for a week.

Attention has been attracted to the attitude of the carpenters in connection with work on the new Cleveland Federal Reserve Bank building, where a clash of interests between the carpenters and metal workers led to a strike of other crafts.

Inasmuch as the Board for Jurisdictional Awards is a voluntary organization, without governmental force, set up to bring harmony to the crafts of the building industry and save loss to all concerned from conflicts over which union shall perform specific classes of work, there has been a special effort to prevent lawsuits and preserve the organization as a mutual give-and-take proposition.

There have been indications recently that the carpenters might ask for a rehearing of the metal trimming case. If this were done before the board at its last meeting, the fact was not made public.

Hoover Interested

Secretary of Commerce Hoover has expressed his views as follows:

"I greatly regret to see the strike in Cleveland from failure of acceptance of the awards of this board. I interested myself greatly in the creation of the board, comprised, as it was, of the representatives of the building trades, contractors, architects and engineers. Its

awards as to jurisdictional limits in the different trades have been universally accepted except in one trade, and it has saved, literally, millions of dollars for the workers, contractors and owners of buildings. Nothing is more impossible to deal with in strikes than quarrels between the trades themselves, and this board bade fair to secure national solution of this entire problem in the building trades.

"It would be a national calamity if there were failure of the public and the workers themselves to support the board's decisions and to require through public sentiment, adherence to them.

"This board represents also the ability of American industry to get together and solve its own quarrels and set up its own standards without official interference, and a voluntary acceptance and good will toward the board by all parties in a community is absolutely essential if we are to make progress in the solution of our many thousands of troubles."

I. C. C. Removes Restrictions on Open-Top Cars

Washington Correspondence

All restrictions on the use of open-top cars have been removed by the Interstate Commerce Commission and all priority of movement of certain commodities has been cancelled. This action was taken Dec. 8 when the Commission issued amendment No. 4 to Service Order No. 5 and amendment No. 2 to Service Order No. 24.

Service Order No. 22 is the only general service order still outstanding. This order directs all common carriers to forward traffic to destination by the routes best calculated to expedite its movement and to relieve congestion. There are a few orders outstanding, dealing with the placement of cars to meet individual and specific emergencies.

Next week—résumé of recent public bond sales, showing rate, yield, price and by whom handled.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 7; the next, on January 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.14	$3.95	$4.40	$3.02½	$3.15	$3.85	$3.25	$3.80	—$3.50
Structural rivets, 100 lb.	3.85	4.00	4.00	3.75	4.00	4.80	4.75	4.25	+6.00
Reinforcing bars, ½ in. up, 100 lb.	[illegible]	3.85	4.00	2.92½	3.05	—3.02½	3.35	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	53.35%	45%	59½%	57-5%	41%	59.2@51.8%	40%	30.00
Cast-iron pipe, 6 in. and over, ton	[illegible]	45.82	55.00	+51.20@52.20	—54.16	63.61	54.00	—53.00	55.00
Concreting Material:									
Cement without bags, bbl.	2.60	2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd.	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd.	1.00	1.32	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.10	1.65	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	[illegible].00	36.00	40.00	+52.00	+40.75	39.75	35.00	23.50	50.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	+18.00@19.10	11.50	9.90	11.00	18@19	12.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	+.0859	.115	....	.0796	.065	....	.11	+.115
Hollow partition tile 4x12x12, per block	.1230	+.0859	.115	—.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	.90	—.96	—1.05	.95	1.00	1.08	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	....	....	.50@.55	.5[illegible]	.50@.60	....
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2 ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags, common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Hollow tile, 5¾ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.37). Bbl. charge is 80c. per bbl. [illegible] per bbl. [illegible] payment within [illegible] days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

General downward trend of coke and pig iron prices, finds basic and No. 2 foundry iron at $25 per ton, Pittsburgh, including freight from valley. This is a drop of $2.50 per ton during week. Current price of steel shapes at minimum of $1.90 per 100 lb., f.o.b. mill, for delivery in first quarter of 1923. As high as $2.10, however, has been quoted on orders for immediate shipment. Plate tonnages are not being placed so readily; quotations now $1.90@$2 per 100 lb., Pittsburgh. Plate buying mostly for tank construction and railway use. Reinforcing bars, $1.90 for first quarter delivery; current business still at $2 per 100 lb.

Lumber price situation strong, for the present, with rises reported in two important centers. Chicago quotes yellow-pine structural timbers (base sizes) at $52, up from $51; and Minneapolis reports Douglas fir at $40.75, advanced from $39.75 per M ft. b.m.

Rise of $1 per M in common brick, on New York market, attributed to unusual demand for this season of the year. Brick now $18@$19.10, delivered to job, as against $18@$18.55 per M., last week.

Linseed oil market firmer in most cities; declines reported, however, of 1c in Atlanta and 2c. per gal. in Dallas.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 89 NEW YORK, DECEMBER 21, 1922 Number 25

The Spirit of Christmas

HOW clouded have been the Christmastides of recent years! We have tried hard to throw ourselves into them wholeheartedly, but always there has been the shadow of great disturbances. The first Christmas with this clouded background was that of 1914. The oppression of war increased in the following years until 1917 our hearts were overseas and Christmas was a prayer for those whose lives were in the balance. Then the relief of 1918, to be followed by holiday seasons darkened more and more by hunger, starvation, economic ruin.

This year there is less war and there is less of hunger, less of actual starvation, but more of economic ruin. Central Europe is near despair. The hates of the war have become the hates of peace, preparing for new war. The ententes of war days have become the distrusts of the pseudo-peace.

Nor if we look at home can we find relief. There is no war here, it is true; hardly even hate. But of distrust there is much, distrust between employer and employed. The consequences of the great strikes are still with us; the omens betoken another great conflict in prospect.

Is there a panacea? Our answer always is that there is no panacea. In practice that is true, and it is true not because a great remedy does not offer, but because we humans refuse to accept the remedy. There is a panacea, if we would but convert the world, ourselves, to its use. That panacea is the spirit of Christ—the spirit that the Christian world will celebrate and praise next Monday, but which it fails to carry into action. That spirit, His spirit, is the negation of hate. It teaches us that we must not covet our neighbor's goods. It tells us that we must do to others as we would be done by.

Idle words? Ah, no. Good words on idle ears.

The hope of the world—the warring economic world of Europe, the strifeful economic world here—is in the adoption as an active force throughout the entire year of the spirit we turn to on Christmas, the spirit of Christ, of love one to another.

The Season's Greetings

THIS week will find the mail of each reader of *Engineering News-Record* swelled with greeting cards. From far and near they come. Here is one from a business acquaintance, there one from a companion of boyhood joys and griefs, another from a relative separated by a continent's or an ocean's span.

One and all they bring the cheery greeting of Christmas. They radiate good will. They tell us that at this season we forget our particular daily cares and expand into the spirit that embraces the whole Christian world.

In this welcoming group, with those friends who are wishing you a Merry Christmas and prosperity in the New Year, *Engineering News-Record* wishes to be included—yes, included as a friend. And surely the editors have a right to feel that their greeting will be welcomed, for never in the history of the paper, or that of its lineal predecessors, have we had a year in which you have shown so much interest or given us so much co-operation. We have had occasion as never before to ask your advice and assistance. Through questionnaire and letter we have called on you for help, and most generous has been the response.

Therefore, our Christmas greetings are freighted not merely with good wishes for the great day and for the future but with our sincere gratitude for your support and assistance. You have been most generous. Without you our efforts would have been less fruitful. We thank you and pray for you the choicest blessings of Christmas day—happiness and the peace which surpasseth all understanding.

State-Owned Power Again

SINCE his election last month Governor-elect Smith of New York has several times taken occasion to emphasize his intention to insist on the state's owning and controlling all of its water power resources. State control of water power, he says, was one of the tenets of the Democratic platform and therefore becomes a command to a candidate elected upon that platform. This is, of course, the proper political attitude, and no one can doubt the governor's honest intent. The issue, however, is much too big to be blanketed in a party platform and to be settled by a vote which was affected by a dozen other conditions quite unrelated to water power. It deserves a special referendum of its own, just as it had last month in both California and South Dakota. It is easy to inveigh against the exploitation by private interests of the great power resources of the state, but when a definite state ownership program is submitted, the complications become apparent and the voters are apt to follow the lead of California, where a comprehensive state owned power system was rejected and of South Dakota, where a specific state-owned plant was turned down. New York should profit by the example of its sister states.

Steelwork and Weather Exposure

SUMMARIZING years of experience in maintaining large steel outdoor structures, an engineer recently stated that the older structures under his care have proved to be seriously lacking in resistance to weather exposure, due to certain minor details. Excessive spacing of stitch rivets was his principal point of criticism; the riveting fails to draw the component parts of the steel members into contact tight enough to prevent

moisture entering and rust beginning, and, corrosion once started, its wedging effect due to volume expansion as oxygen is taken up produces a further spreading of the plates and facilitates the destructive process. Closer stitch riveting in the later structures has virtually eliminated this trouble. The widely spaced riveting was laid out with a view to the structural strength of the uncorroded part, in other words for proper strength under indoor conditions, but it proved inadequate in the long run for outdoor exposure. It happens, unfortunately, that current designing rules do not differentiate between the requirements of indoor and outdoor exposure. At most they recommend taking account of the effects of the weather by adding a certain thickness of metal for loss by rusting—an oldtime rule whose value today is rather questionable. As the experience above quoted indicates that exposure resistance may depend on the detailing, there appears to be opportunity for improving the rules of practice. In preparation for such improvement, it would be of value to have the question illuminated by notes from the experience of other maintenance engineers.

Wide Piers on the Pacific

SEEMINGLY the port development technique developing on the Pacific Ocean differs materially from that on the Atlantic. It has for its basis long and wide piers, over 300 ft. in width in many cases, amply covered with tracks and warehouses, with full equipment of railroad tracks both on the piers and in the approach area, which may be devoted to warehouses or to factories. The type is well developed at Seattle and Vancouver on the east shore of the ocean, with similar tendencies at such minor ports as Astoria and Los Angeles, and now we see from the latest report from Kobe that Japanese engineers are following with an accuracy typical of their nation the principles of pier layout made familiar in the English speaking Pacific ports. European ports do not run to piers for ship docking so there is little comparison there but the great Atlantic American ports have been most reluctant to adopt the wide and long pier now apparently standard on the Pacific. Philadelphia and Boston have gone further in this respect than New York, but none show such structures as either Kobe or Seattle, though advanced port thinking indicates that the piers at the latter port should be most satisfactory for easy and economical freight handling and transference.

Survival of the Stronger

IN THESE days of automobile crowding and speeding, it need not be surprising if we read that a car in trying to cross a bridge missed its aim at the clear roadway and struck the bridge instead, as happened in Central Pennsylvania recently. Nor is there much ground for being alarmed at hearing that the bridge succumbed under this treatment and fell into the river. A single accident of the kind does not throw doubt on the strength of highway bridges generally. But when a second accident of precisely the same kind happens within a few weeks not many miles from the location of the first, the matter becomes almost sensational. In any clash the stronger contestant is apt to survive and the weaker fail; and it now appears that in a clash of automobile and bridge, the bridge proves to be the weaker—the automobile in some fashion survives, but the bridge goes down. This is likely to be a disillusionment to the people who pay for bridges and use them. They expect a bridge to weather both the fair and the foul. Bridge builders doubtless have the same idea. But their conventional rules and principles of bridge design contain nothing about making a bridge strong enough to resist the shock of a colliding automobile; there is much hairsplitting detail about loads, dynamic effect of traffic, wind action, and the like, but not a word concerning the trouble-making potentialities of even a Ford roadster run amuck. Obviously, if all the careful proportioning for normal service does not make a bridge strong enough to withstand the rough handling of day-by-day existence, its practical value is open to question. If collisions will happen, the bridge should not go down, whatever becomes of the car. As to the chance of such collision, everyone who has rounded a sharp turn and seen a narrow bridge coming toward him at the rate of some forty feet per second is sure to have a lively sense of the possibilities. Unless the two Pennsylvania wrecks are so exceptional as to merit no further consideration, we must either provide mechanical traffic guidance at bridges, or we must build the bridges strong enough for the colliding vehicle.

A Complaint Without Particulars

WITHIN the last few weeks three of the six commissioners of the New York Port Authority have separately and publicly charged the railroads with a failure to co-operate adequately in carrying out the Port Authority's plan for the unification of port facilities. Now we learn that the Interstate Commerce Commission is to bring to bear on the roads such pressure as it may command. It is too bad that the consuming public, which is so vitally interested in the progress of the Port Authority, has not been informed in greater detail as to the plans in which the railroads have failed to co-operate. The Port Authority is so constituted and its powers are so circumscribed that if ever it is to deal successfully with the independent transportation agencies it must enjoy a considerable measure of public support. This support will not be forthcoming in the interest of general principles and vague proposals, and we suggest for the consideration of the Interstate Commerce Commission in its inquiry a policy of more definite explanation to the public as to what it would like to have the carriers do. Incidentally, it might help to learn the recommendations of the Committee on Economics and Engineering of the National Association of Owners of Railroad Securities. Composed as it was, of engineers, all eminently qualified technically, and free from commercial or political interest, this committee must have arrived at some conclusions that would be helpful. They may, for example, have worked out specific plans for the consolidation of car-floatage equipment and other terminal facilities, to which one of the commissioners has alluded. As the representatives of railroad security owners in general, they may have worked out also a basis of co-operation that would be fair to all the roads whose interests are affected. But although this report was completed several months ago it has not yet been given the publicity that was accorded to a similar report by the same committee on the Chicago situation.

Higher Pay for Government Engineers

EVERY year the deplorably low standard of pay for the engineers in the federal departments is brought before the limited audience which reads the annual reports of the heads of those departments. Between times the subject becomes one of those unpleasant topics generally recognized as unpleasant and therefore avoided by everyone but those immediately concerned. This year the departmental reports are, if anything, more insistent on the evils of under pay than ever before. Every head of a department puts this before everything else as a matter requiring immediate remedy and as an explanation of deficiency in morale or execution.

"The very heart of the government," says Director Jones of the Coast and Geodetic Survey, "is being eaten away, leaving what appears from the outside viewpoint a working organization but one which is steadily and certainly deteriorating from within." Director Putnam of the Lighthouse Service says "The legislation most urgently needed is a revision of the salaries to permit the service to attract a high grade of suitable and efficient employees." Secretary Hoover thinks that the excessive turnover in his department may be "attributed to an abnormal condition of dissatisfaction and restlessness resulting from inadequate salaries."

In the same week that these reports were being made public, the Civil Service Reform League met in Washington and in convention assembled resolved that $700,000,000 a year could be saved in Washington by "abolishing useless jobs, dismissing incompetents, providing adequate pay for adequate work, introducing modern methods and promoting only the most capable workers." While the latter part of this generalization has the same import as the plaints of the government heads, it is the first part which explains most of the delay in providing adequate compensation for the government employee, including the engineer. Money must be saved, not spent, in Washington now. Somewhere up near the top of government must be some one who looks with a cold and unsympathetic eye on any expenditure, who regards every dollar spent as a dollar wasted and who permits to go through only such appropriations as are absolutely necessary to the state.

Freely it is admitted that there may be expenditures today which save money tomorrow and savings today that will take many times their value to pay for some years hence. That, however, is the academic and general statement. What the Budget Bureau and the Appropriations Committee have to consider is that the cost of government must be reduced and the obvious and easy way to retrench is to refuse to appropriate. The government officials who feel that their departments are disintegrating under their very eyes and the civil service reformers who would save nearly a billion each year must particularize if they expect to influence a hard-boiled Congress. They must show definite increases in efficiency by increases in salaries. Congress is in no mood to believe in theories.

This is written in complete sympathy with the needs of government salary revision, especially in the technical branches, but in like sympathy for the demands on Congress and the budget makers for a reduction in expenditure. So long as the cost of government continues to increase and the field of government service continues to enlarge, it will be difficult to establish a more equitable basis of government salaries. The proposed departmental reorganization will make such rearrangement of salaries easier than at present because it will, or should, establish similar qualifications for similar work and facilitate a standard classification. It will, or should, hasten the ideal conditions pointed out as necessary by the Civil Service Reform League, and show Congress, by example rather than by precept, how to save by spending.

Meanwhile it may be pointed out that in every organization those who think and produce are paid less than those who sell those thoughts or products. The world puts a disproportionate value on getting the signature on the dotted line. The government, be it noted, has nothing to sell, at least for the coin of the commonwealth. Its workers are all producers and thinkers and they have to suffer with the rest of that class, though to be sure they suffer somewhat more than the general run in private business. Any campaign to raise government salaries must be made a part of a reform which will tend to teach those who control wages and salaries that quality controls sales just as much as does salesmanship but that in our present social and economic system those who produce quality and quantity are made subordinate always to those who make or exploit a market.

Much Heat but Little Light

IN THE course of his very helpful discussion of the fundamentals of highway department organization before the annual meeting of the Association of State Highway Officials, A. R. Hirst, state highway engineer of Wisconsin, turned aside to pay his respects to the railroads and their managers. "Most of the railroad executives" said Mr. Hirst, "are running around weeping and wringing their hands because the motor trucks and the motor buses are making it impossible for them to operate at a profit. At the same time, crops rot in the field, road crews lie idle, manufacturing plants shut down, because the railroads have no equipment to transport with when transportation is offered and needed. * * * They (the railroads) are not a pulsing part of the American business fabric but a dead body clogging the stream of progress."

As might have been expected, this criticism has not passed without comment from those whose sympathies are with the railroads. The *Wall Street Journal* in particular registers a protest that has been echoed by others like minded as to the issue. Mr. Hirst is denounced by that journal as an "agitator," an "engineer in politics," and a "merchant in grievances."

Thus does intemperance breed intemperance and intolerant criticism generate much heat but little light. For everyone knows that although the railroads are staggering under grievous burdens not of their own making, controlled as to income and outgo by governmental dictum until their credit has been seriously impaired and improvements and upkeep halted, there are all too many railroad executives who are hidebound by tradition and who would fall if judged by the standards applied in private competitive business.

Let us grant that the railroads are not a "dead body clogging up the stream of progress" and that Mr. Hirst is none of the undesirables with which the *Wall Street Journal* has linked his name. And then with good business standards let us turn to the task of developing our railroads, our highways, our waterways into an effective transportation machine.

Track Elevation on Long Concrete Viaduct at Aurora, Ill.

Burlington Railroad Builds Three-Track Structure Through City—Concreting by Dump Cars—Heavy Fills on Line and Grade Revision

A DEPARTURE from general practice in track elevation work is the construction by the Chicago, Burlington & Quincy R.R. of a three-track concrete viaduct more than 1,400-ft. long, instead of the more usual earth fill between retaining walls, to carry its line through the city of Aurora, Ill. Provision is made for widening the viaduct to carry five tracks when traffic requires. A view of a portion of the viaduct is given in Fig. 1; showing the south side at Main St. The viaduct is the city portion of a four-mile improvement which includes revision of grades and curvature and new station and freight yard facilities.

FIG. 1—TRACK ELEVATION VIADUCT AT AURORA, ILL.

Advantages resulting from the adoption of a viaduct instead of a fill are noted as follows: (1) The use of the right-of-way beneath the flat-deck viaduct for revenue-producing purposes; (2) a slight saving in cost; (3) a more attractive appearance than a continuous wall dividing the city into two parts. No decision has been made as to the use of the covered space, but propositions have been made to rent it for stores, garages and warehouse purposes. The appearance of the long row of columns will be more effective than a stretch of retaining wall, especially as many walls of this kind become unsightly owing to cracks, seepage and discoloration. When walls were proposed it was planned to build them at first of sufficient height for a three-track fill, and to extend them to full height when the two additional tracks were required. With the viaduct construction as adopted a new two-track structure will be built later paralleling the north side of the present viaduct, where the old surface tracks are now laid.

Topographically the situation is as follows: The main business portion of the city occupies a strip of level land along the south bank of the Fox River, and from this a steep slope rises to the higher ground of the residential section. At the foot of this slope runs the railway, so that as a surface line it involved fourteen street crossings, several of which were at the foot of steep inclines. A plan of the new and old lines is shown in Fig. 2. At Spring St. and High St. there were viaducts across the tracks. On the new line the fourteen crossings are eliminated, an old street bridge is replaced by a subway and two railway grade crossings are eliminated.

From the east the railway is on a descending grade of 0.2 and 0.3 per cent to the far side of the river. A short grade of 0.3 per cent then rises to give clearance over the Elgin, Joliet & Eastern Ry., beyond which the line descends at 0.3 per cent to the old grade at Montgomery, about three miles west of Aurora.

Viaduct Design—For the three-track viaduct a 23-in. deck slab is carried by three rows of columns spaced 18 ft. c. to c. transversely and 19 ft. longitudinally as shown by the typical drawing Fig. 3. Over the columns are drop panels 11 in. deep. At the streets there are three-column bents on the curb lines and in the middle of the street, giving two roadway spans 24 ft. c. to c. of columns, with a headroom of about 16 ft. In these street spans the thickness of the slab is increased to 27 in. by lowering the floor of the form, thus reducing the drop panels to about 7 in. in depth. The columns are of circular section, except that rectangular columns are used for street spans and twin rectangular columns at the expansion joints. Owing to the varying directions of the streets, the column bents are skewed at some points, thus interrupting the uniformity of longitudinal spacing of the columns. Slab decks for the street spans were poured in place as a rule, but were separated from the viaduct deck by joints.

This viaduct was designed for E-65 live-load, including impact. In making the calculations for the slab deck the wheel loads were converted to a uniform loading of 1,675 lb. per square foot, for although this is equivalent to more than E-65 loading with tracks spaced 14 ft. c. to c. it was considered that the load might not be distributed over the full width of 14 ft. All columns were designed for E-65 loading on each track.

Viaduct Details—With a track spacing of 14 ft. the total width of deck is 44½ ft. over the curb walls or parapets. On one side is a thin vertical parapet against which are built the conduits for electric wires. On the opposite side the parapet has an inclined face and serves simply to retain the ballast. Iron handrailing will be placed along both sides. The exposed surfaces of the deck slab are flat, except for paneling at street spans, and a smooth mortar finish without form marks is secured.

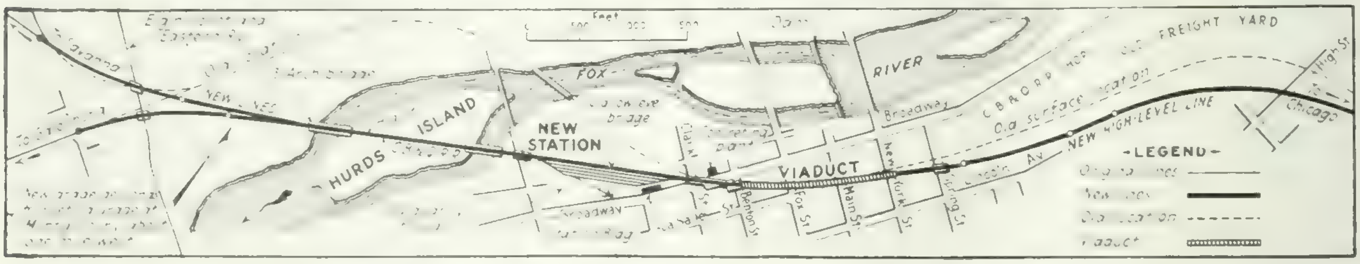


FIG. 2—RELOCATION AND TRACK ELEVATION AT AURORA, ILL.; C. B. & Q. R.R.

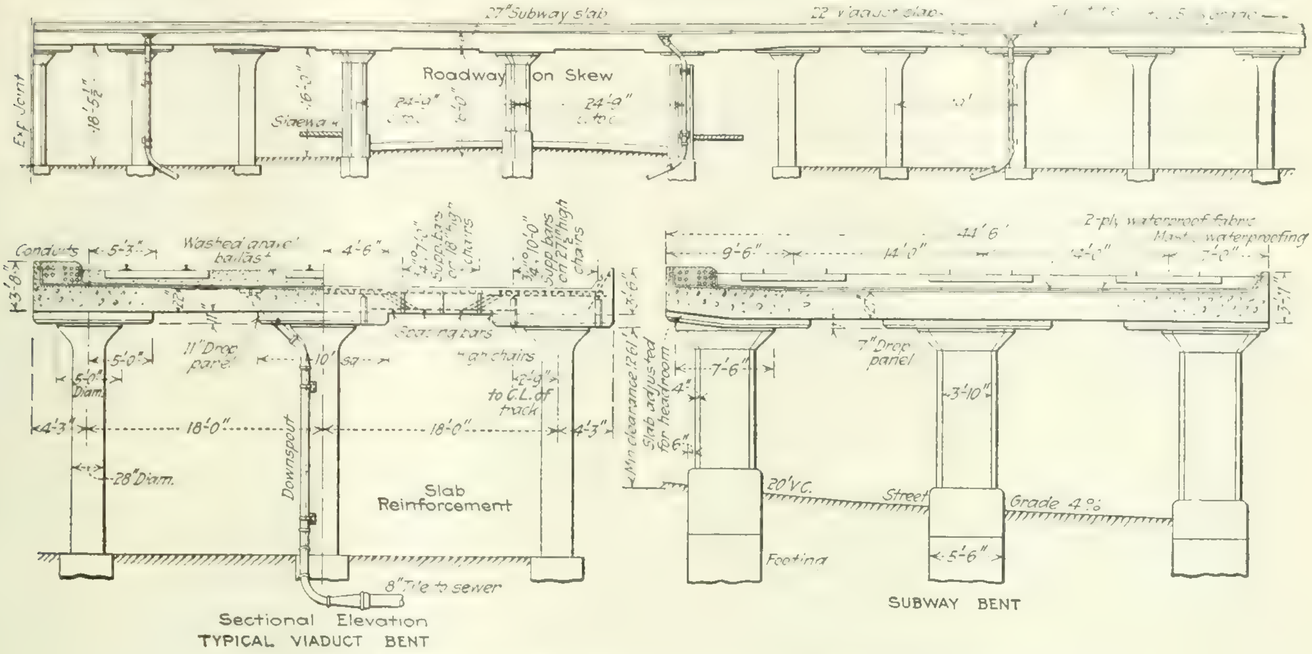


FIG 3—THREE-TRACK CONCRETE VIADUCT, WITH SUBWAYS

Column footings are circular and are carried to rock at depths of 10 to 16 ft. These footings were poured first and then the column (see Fig. 4). The deck slab with drop panels was poured last and is anchored by the projecting vertical bars of the columns. Drainage planes formed on the top surface of the slab lead to the inlets of downspouts attached to the columns and having sewer connections. A watertight deck being essential as a roof to the covered space, not only was a waterproofing compound used in the concrete but the slab is covered with a two-ply course of waterproofing fabric and a top layer of mastic. Upon this layer will be a bed of washed-gravel ballast 6 in. deep under the ties.

Heavy four-way reinforcement is used in the deck slab, and the positive moments in the center of the panels are taken care of by bars bent down from the top at about the edge of the drop panel. Cross bars were used over all rectangular bands to equalize the stress between the various reinforcing bars in these bands. No stirrups were used. All bent bars in the slabs were bent before placing on account of the heavy reinforcement used. This bending was done in the field. In the forms, the lower bars are supported by chairs of heavy wire, while those for the top reinforcement are laid on supporting bars carried by chairs of sheet steel pressed to angle shape for stiffness.

Concreting—Gravel concrete of a 1 : 2 : 4 mix was used, with 10 lb. of waterproofing compound per cubic yard of concrete. Steel forms were used for the columns and wood forms for the slab, the latter being shown in Fig. 5. Concreting of the slab was done in sections varying from 60 to 115 ft. in length. For this work, wood joists resting on the sides of the deck form carried two standard-gage tracks for concreting trains, each train consisting of two ½-yd. bottom-dump cars, or one 1-yd. car, attached to a motor section car. A one-car train is shown in Fig. 6.

Concrete was mixed at a stationary plant near the west end of the viaduct (see Fig. 2) and having two 1-yd. mixers to provide against interruption. At first the concrete was spouted into place from a double elevator tower but when the work extended beyond the reach of the spouting system the spouts delivered the concrete to hoppers from which the dump cars were charged. The viaduct was built on the south side of the old right-of-way so that there was no interference with traffic.

Expansion Joints—Expansion joints 1 in. wide are provided at intervals of about 225 ft. No filling is placed in the column joints, but in the deck the slot is closed by a steel plate projecting from the face of one slab and entering a groove formed by plates embedded in the face of the adjacent slab. This construction is shown in Fig. 7. A filling of flexible cement is laid upon the plate. In addition, the top of the slot or joint is closed by an apron plate 16 in. wide which is anchored on one side. Over this the waterproofing membrane is formed in a hollow rib to provide for expansion and contraction movements. For the electric conduits, each expansion joint is covered with a zinc plate and a similar plate is placed between the conduit and the curb wall of the viaduct.

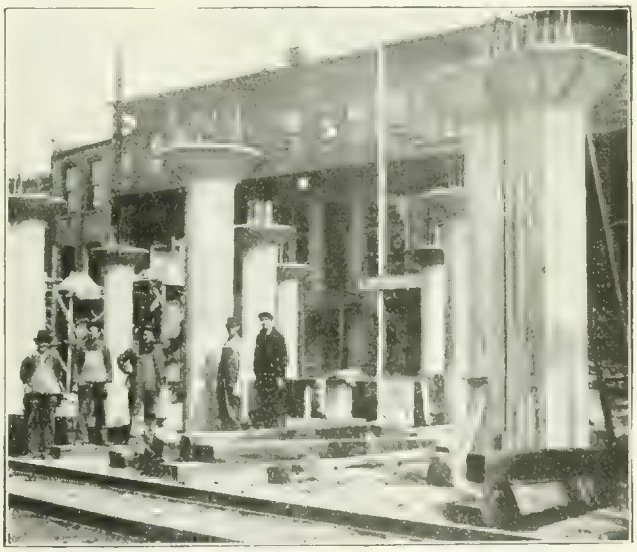


FIG. 4—COLUMNS FOR TRACK ELEVATION VIADUCT
Operated surface tracks in foreground. Twin column for expansion joint at right.

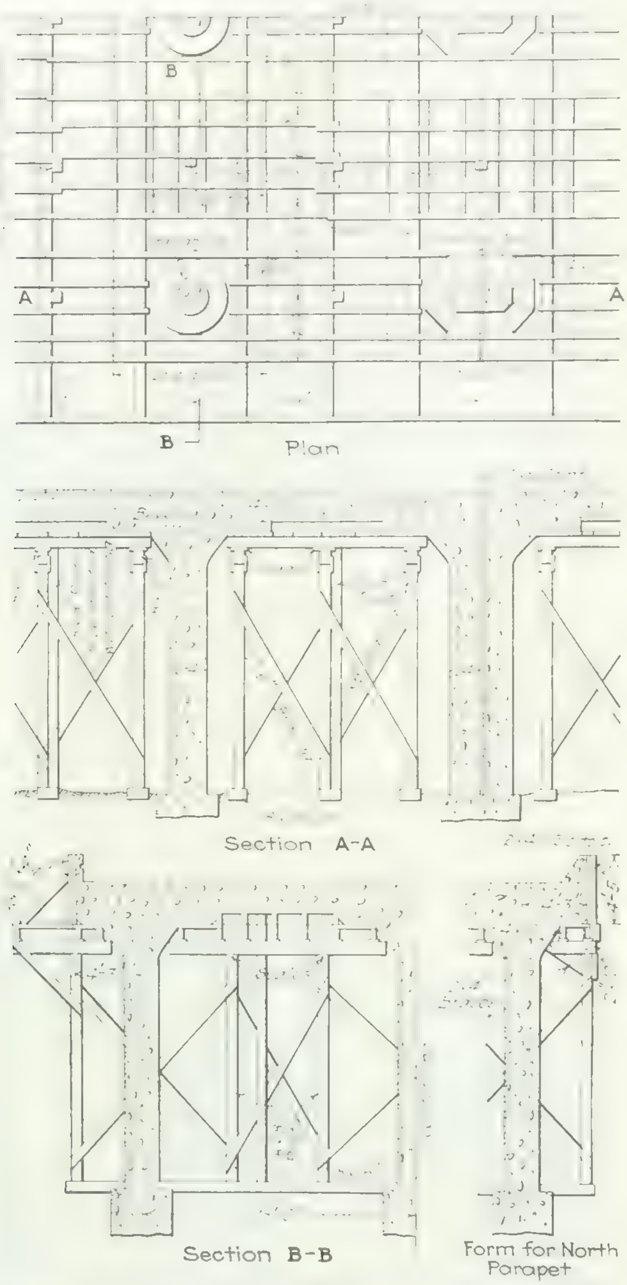


FIG. 5—FORMS FOR VIADUCT SLAB AND PARAPETS

As a rule the streets are not lowered and their grades are not changed. At some of the steep streets, therefore, the bottom of the slab of roadway spans is inclined upward on the uphill side, parallel with the street surface, in order to provide the standard headroom (see Fig. 3).

Line and Grade Improvements—Although the viaduct is the most prominent structural feature, it is only a part of the general improvement of the railway in and near Aurora. Originally the line through the city at street level was in a long sag with grades of 0.53 per cent, requiring pusher engines on heavy eastbound freight trains. Further, the right-of-way in the city was only 36 ft. wide, so that there were only two tracks on which to handle the main line and suburban (Chicago) passenger traffic and the heavy freight traffic. Difficulties of operation were increased by the fact that the lead tracks of the freight yards encroached upon the ends of this narrow space. In addition, at the west end of the city there was a long reverse-curve location with a low level bridge over the river. To improve the physical and operating conditions additional property was secured for a five-track right-of-way through the city, with an east approach practically paralleling the old line but with a grade of only 0.3 per cent.

A relocation was made at the west end (see Fig. 2), straightening the line and carrying it across a deep abandoned stone quarry which required a great amount of filling. The new line also requires two bridges over the channels of the Fox River, which is here divided by an island on which there is a high fill. These are concrete arch bridges, with two and three arches respectively of 65 ft. span, having spandrel arches which carry a concrete deck 35 ft. above the river. The piers and abutments are built of full length for a five-track bridge, but the arch spans and deck at present are only built for three tracks.

From Chicago to Aurora, 40 miles, the railway has three main tracks, the middle track being used mainly for eastbound traffic in the morning rush hours and for westbound traffic in the evening.

Subways—In addition to the streets crossed by the viaduct, eight streets are accommodated by concrete subways in the solid fill approaches. There are also two subways for the Elgin, Joliet & Eastern Ry., which formerly crossed the Burlington line at grade. Box-type abutments are used at four of these subways, each having a thin deck slab and back wall, with the roof and footing extending over and under the column bent on the curb line (see *Engineering News, March* 22, 1917, p. 473). In all cases the footings were carried to rock and the slab decks were poured in place. At Spring St., the old steel bridge over the railway is replaced by a concrete subway, the new track level being at about the height of the old bridge floor.

Slabs cast in place and having one-way reinforcement were used for the large subway at the crossing of Broadway, Clark St. and Benton St. (see Fig. 2), the three subways at this point forming practically one structure beginning at the north curb bent of Benton St. Owing to the skew of this crossing, plate girders were used along the faces to carry the ends of the skew slabs, the lines of the slabs being at right angles to the streets, so that intermediate slabs have square ends. Alternate slabs were poured first and paper joints provided between adjacent slabs.

FIG. 6—MOTOR CONCRETING TRAIN WITH DUMP CAR
Tracks laid on completed slab.

New Passenger Station—No room being available for a station of adequate size on the site of the old station in the business district at New York St., a new location was adopted at Washington St., just west of the viaduct and fronting on Broadway, which is the main business thoroughfare (see Fig. 2). As Aurora is the terminal of the Chicago suburban service, provision

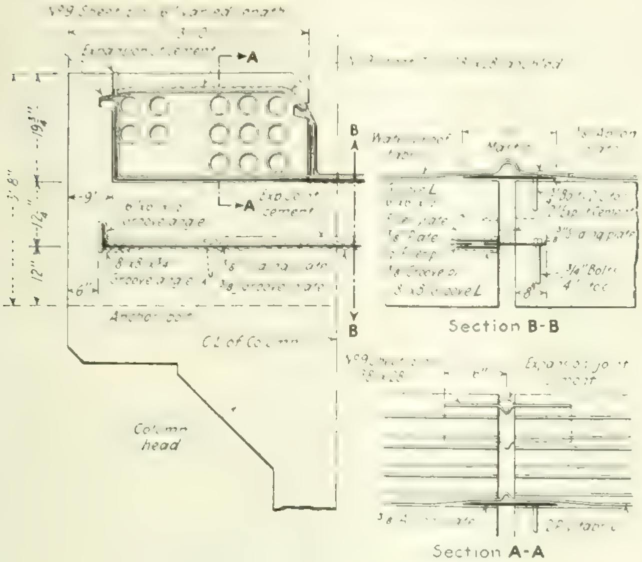


FIG. 7—EXPANSION JOINT IN DECK OF VIADUCT

is necessary for both local and through trains and for turning the engines of suburban trains. This new station has three main through tracks and four double-end local station tracks with three platforms 800 to 1,000 ft. long. The track level is reached through a subway with covered stairways to the platforms. There are also four coach tracks and a stub track having an ashpit, turntable and water column for serving the suburban engines. Platform shelters are of the butterfly type, with two rows of precast roof slabs supported on T-head columns. A two-story building provides station facilities on the first floor and railway division offices above.

The operating conditions at Aurora may be judged from the fact that there are 29 main-line through passenger trains daily, 37 freight trains and 19 suburban trains. Furthermore, Aurora is a division point, with extensive freight yards and other facilities in addition to large locomotive and car repair shops. The old city yards have been abandoned in order to provide for the enlargement of these shops, a new freight yard and engine terminal being established at Eola, just east of Aurora. In this way all switching will be kept clear of Aurora, only a shop connection and small local freight yard with team tracks being retained in the city.

The total length of the track elevation and relocation is about four miles and involves 1,500,000 cu.yd. of earth fill besides the 1,400-ft. concrete viaduct. This improvement was commenced in 1914, but was delayed by the World War. Traffic was diverted to the west part of the new line in 1921 and to the concrete viaduct in November, 1922. The viaduct was built by company force. Filling was done by Morris & Dougherty, St. Paul, and Roberts Brothers, Chicago. The station was built by G. A. Johnson & Son, Chicago.

All design and construction was under the direction of A. W. Newton, chief engineer of the Chicago, Burlington & Quincy R.R.; with C. L. Persons, assistant chief engineer. The subway and viaduct designs were prepared by G. A. Haggander, bridge engineer, and the station plans by W. T. Krausch, engineer of buildings. The construction work was in local charge of C. J. McCarthy, engineer of track elevation. The total cost of the improvement is approximately $4,500,000, of which the concrete viaduct represents about $220,000.

Wide Concrete Road Constructed Half at a Time

Light-Truck, Heavy-Truck and Industrial-Railway Haulage Compared—Center Joint Formed With Key-way and Groove

BY L. E. ANDREWS
Assistant Civil Engineer, New Jersey Highway Department, Collingswood, N. J.

AN UNUSUALLY wide concrete road, heavily reinforced, forms the last link completed in the New Jersey across-state route from Camden to Atlantic City. With a traffic reaching on holidays as many as 9,000 vehicles in 24 hours, the pavement was made 36 and 29 ft. wide and was reinforced with 71½ lb. of bar reinforcement per 100 sq.ft. The slab is uniformly 8 in.

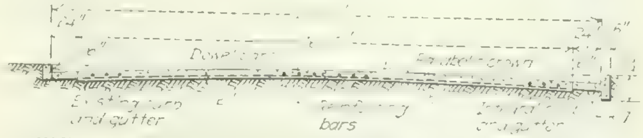


FIG 1—WIDENED PAVEMENT SLAB ON SECTION 8

thick of 1:2:4 concrete, and as shown by Figs. 1 and 2 has a parabolic crown on a crowned subgrade.

Construction was carried on in three sections, 8, 9 and 10, respectively, 3.82, 3.76 and 5.58 miles long. The

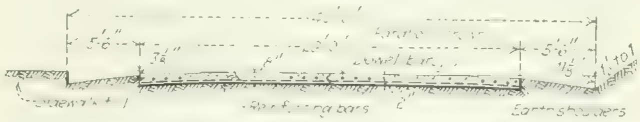


FIG. 2—NORMAL PAVED ROAD ON SECTIONS 9 AND 10

old road built over was mostly bituminous macadam on telford base and it was completely removed, leaving a uniform earth subgrade. One contractor, W. Penn Corson, Camden, N. J., is building section 8 and another, the John M. Kelley Contracting Co., Camden, N. J., is building sections 9 and 10. Except that it was required that all sections should be graded and paved half at a time thus reserving one-half of the road for hauling and to accommodate local traffic, each section was constructed by a different outfit as follows:

Section 8—Aggregates were received in barges of 500 tons capacity at Camden and were unloaded by electric crane into storage bins holding 500 tons each of sand and gravel. A fleet of 20 rear-dump trucks, each carrying all the materials for one four-bag batch did the hauling. The average one-way haul was three miles. One 21-E gasoline paver placed an average of 700 sq.yd. per day. The paved surface was designed to meet existing curbs and gutters as far as possible. The width of paving in excess of 29 ft. was paid for by the boroughs and townships concerned.

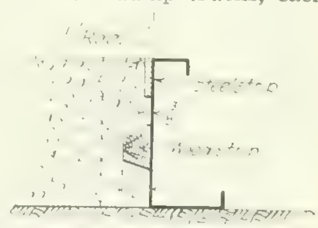


FIG. 3—CENTER JOINT, STEEL FORM AND ATTACHMENTS

Section 9—On this section industrial railway haulage from a central proportioning plant was used. The equipment consisted of two seven-ton and two three-ton gasoline locomotives and thirty industrial cars carrying two five-bag batches each. The average one-way haul was about two miles. One 21-E steam paver placed an average of 800 sq.yd. per day. All materials were re-

ceived by rail at Ashland, a point opposite the center of the job, with a dead haul of one mile. The storage bins for sand and gravel had a capacity of 150 and 200 tons, respectively.

Section 10—This, the longest of the three sections, was handled by one 21-E steam paver and one 16-E steam paver. Each paver was supplied from a separate loading yard. One yard at Lindenwold equipped with steel proportioning bins, of 75 tons capacity, supplied the smaller mixer and one at West Berlin, of 100 tons

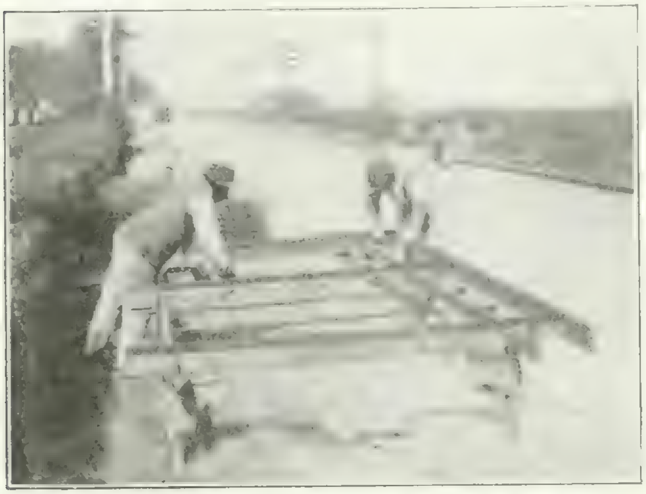


FIG. 4—FABRICATING REINFORCING MATS

capacity, supplied the larger mixer. Aggregates were delivered to the mixers in motor trucks. The average number required was five $2\frac{1}{2}$-ton pneumatic-tired trucks carrying two five-bag batches and two 5-ton solid-tire trucks carrying four four-bag batches. The average daily output of the two mixers was 800 and 600 sq.yd.

Slab Fabrication—As shown by Fig. 3 the doweled center joint was obtained by bolting a wedge-shaped section of oak timber to the side form and a steel strip flush with the top edge of the form. When placing the opposite half of pavement the face of the abutting slab was painted with tar. A 2 x $\frac{3}{4}$-in. wood strip was held in the groove at the upper edge of the slab by steel pins driven into the sub-grade. After the finishing was complete and the concrete was sufficiently hardened, the wood strips were removed, leaving the desired slot which was ready for filling with bituminous mixture. This center joint slot, in addition to forming a reservoir for bituminous material, also served as a marker to keep traffic on the right of the road.

Fig. 4 shows the method of fabricating the reinforcing steel into mats 13.5 x 7.5 ft. for placing in the pavement. These mats were made of $\frac{3}{8}$ in. deformed bars spaced 1 ft. 10.5 in. c. to c. transversely, 8.25 in. c. to c. longitudinally and weighing approximately 71.5 lb. per 100 sq.ft. of reinforcement. Two men made from 80 to 100 mats per day, the average cost of fabrication being 6.5c. per mat or about 40c. per 40 ft. slab.

Hand finishing with strike board, roller and belt was used on all three sections. Due to the narrow width of half-pavement a very good surface was obtained by the method. Wet strips of canvas were applied to the fresh surface as soon as this could be done without marring it. As soon as possible during the same day the canvases were removed and a 6-in. layer of straw or hay was applied and wet down. This was kept wet for a period of ten days and after fourteen days the pavement was thrown open for traffic purposes.

There were in the three contracts about 240,000 sq.yd. and the cost of all work was approximately $780,000.

T. J. Wasser is state highway engineer. J. J. Albertson, Camden County engineer, was engineer for the work and A. J. Williams is division construction engineer for the state highway department. Plans were made under the supervision of H. W. Griffin, survey engineer. The resident engineers for the work were F. Harris, A. J. Lichtenberg, and L. E. Andrews for Sections 8, 9 and 10 respectively. R. F. McMullin was general superintendent for the John M. Kelley Contracting Co., and S. Curriden was superintendent for W. Penn Corson.

A British Railway Man Speaks of Sir Henry Thornton

An Appreciation of His Work on the Great Eastern by the General Manager of One of the Foremost British Railways

By Felix J. C. Pole

General Manager, Great Western Railway of England

Henry W. Thornton, formerly of the engineering staff of the Pennsylvania R.R. and later general superintendent of the Long Island R.R. now returns as Major General Sir Henry Thornton from his service as general manager of the Great Eastern Railway in England to become president of the 17,000-mile Canadian National System. By invitation of Engineering News-Record Mr. Pole here records the estimate placed upon his work by his fellow railway men in Great Britain—EDITOR.

HENRY WORTH THORNTON has come and gone. English railwaymen were grieved at his coming, because it was heralded throughout the country as a censure upon them. The business of his advent was badly bungled, for Lord Claud Hamilton, the chairman of the Great Eastern Railway, announced to the world that on the English railway systems at that time there was a dearth of first-class men capable of fulfilling the duties of general manager. Today no one would be more ready than Sir Henry Thornton himself to admit the injustice of this aspersion upon the country in which railway operation had its birth. Indeed, he was not long in England before he had formed a very high opinion of what he had found here. Speaking in the year following his arrival he said:

"I found existing here a high standard of railway management, and it was my first duty to maintain that, which is the outgrowth of three-fourths of a century, created by the best thought of the country identified with the science of transportation. I am confronted with the record of a glorious past. To keep up to that high standard will be an honorable achievement."

As much grief as was felt at his coming is now occasioned by Sir Henry's departure. He has made good in every respect, and in nothing more than in that of *camaraderie* among officers and men. Upon his appointment he said he would begin his service in the Great Eastern Railway by endeavoring to enlist the confidence and support of every member of the staff, from top to bottom. He did this not only on the Great Eastern Railway, but in a still wider sphere as one of the Negotiating Committee of General Managers which frequently met the trade unions during the seven years in which the government were in possession of the railways. This confidence was evidenced by a recent pres-

entation which was made by the Rt. Hon. J. H. Thomas, M.P., the general secretary of the National Union of Railwaymen. A presentation by a trade union to a railway officer had never previously been made, and Sir Henry Thornton doubtless values the gold medal of the National Union of Railwaymen which is inscribed: "Presented to Sir H. W. Thornton, General Manager of the Great Eastern Railway, by members of the Executive Committee of the N.U.R., as a slight token of their regard and appreciation of his courtesy and fairness in all negotiations."

But it must not be supposed that Thornton pandered to the trade unions. When necessary they came under the lash of strong criticism, particularly in respect of lack of discipline in the trade union ranks. He described it as nothing less than a pest, and said that he and his colleagues had frequently come to an understanding with the representatives of the men on some particular question only to find that when the representatives went back to their constituents the whole thing was upset. If British trade unionism was to get on, and was to earn the confidence of employers, it must look to its internal discipline, and see that when a bargain was made by the leaders of a union that bargain was adhered to by all unionists as faithfully as by the employers.

It was early in 1914 that Sir Henry took the reins of the Great Eastern Railway, and big things were expected of him, particularly in the direction of the electrification of the lines. Within a few months of his appointment, however, the war broke out and, of necessity, changed completely the prospects of important developments. Still, the year 1915 witnessed many notable improvements on the Great Eastern Railway, among which was a drastic rearrangement of train working, the London suburban services being entirely reorganized. This was before the railways were taken over by the government. On decontrol, there was again evidence of his developing hand.

Described as one of the cleverest things done in the handling of a vast suburban traffic by steam-operated trains in and out of a London terminal, an improved service was inaugurated on the Great Eastern in 1920. The service provided a 50 to 75 per cent increase in train frequency, and was brought about by the close co-operation of the traffic and engineering departments. By close departmental co-operation—which was all along the key-note of Sir Henry's management—the seemingly impossible was successfully accomplished.

Early in 1916, Thornton became a member of the Railway Executive Committee, the body which controlled the British railways for the government. After the war period, he continued as a member of the Railway Advisory Committee, associated with the Ministry of Transport. Also in 1916, he was appointed Honorary Lieut. Colonel of the Engineer and Railway Staff Corps of Territorials. In the following year he was made Deputy Director of Inland Waterways and Docks, and afterwards Deputy Director-General of Movements and Railways, with the rank of brigadier-general. His valuable war services were recognized by his being created, in 1918, a Knight Commander of the British Empire. For the year 1921, he was chairman of the General Managers' Conference of the Railway Clearing House.

Into his railway deliberations he brought a robust spirit and a great measure of sound common-sense. For many years the attainment of efficiency in the working of British railways had been sought rather by Act of Parliament than by co-operation between the management and the staff. Enormous sums of money had been spent in the provision of complex signalling and other safety appliances, yet accidents increased in number year by year. From first to last, Sir Henry's policy was to encourage, and to rely upon a loyal and responsive staff. He believed in the dignity of service, in honest endeavor on the part of those in the position of employees and a deep realization of their responsibilities by those in the position of employers.

Photograph by International News Service
MAJ.-GEN. SIR HENRY THORNTON
President Canadian National Railways

He was a strong believer in taking the public into the confidence of the railway management in regard to the many operating difficulties that followed the war. In signed articles to the press he did excellent service in creating a better understanding between the public, the lay press, and the railways. His conviction was that the most valuable asset any railway company could have was a satisfied public—"people who were so pleased with what they got for their money that they came back for more."

* * *

We hope that we have not seen the last of Sir Henry Thornton in England, and while wishing him the best of luck in Canada, look forward to frequent visits from him and to see him helping to cement the good relations between the mother country and the dominions. Situated as he is, midway between Great Britain and the great dependencies of Australia and New Zealand, and with his broad outlook on men and things, no one could be better fitted than he to inaugurate an English-speaking railway congress—a movement which would have a wide appeal and a very great measure of usefulness.

Japanese Port Adds Large Unit to Harbor Facilities

Kobe Builds Four Quays with Berthing-Space for 19 Vessels and Cargo-Handling Capacity of 2,100,000 Tons—Walls Are Precast Caissons

THE present year will see completed one section of an ambitious program of harbor improvement commenced in 1907 by the Port of Kobe, Japan. The new facilities have added to the harbor berthing-space for 19 vessels and capacity for handling incoming or outgoing cargo to the amount of 2,100,000 tons. This is based on an available wharf frontage of 8,172 ft., and a unit cargo-handling capacity of 250 tons per foot per year.

FIG. 1—GENERAL MAP OF KOBE HARBOR

The project has involved the dredging of some 270 acres to a depth of 30 to 36 ft. below mean low water and the reclamation of 65 acres which have been brought to an elevation of 11 ft. above mean low water at spring tide. The four moles which constitute the backbone of the improvement have involved the construction of 9,556 ft. of quay walls and 18 sheds, of which 16 were built on the moles and 2 on shore for the use of lighters. The sheds on the moles are of steel construction while the lighter sheds are of wood. Ten miles of railway and nearly 2¾ miles of roads provide access to the moles, each of which is equipped with traveling cranes, electric and gas lighting and water mains with numerous fire hydrants.

The new facilities have been put to use as rapidly as they have been completed. The first unit was opened in 1913. In 1920 the total volume of imports and exports for the port reached 5,544,000 tons, of which 37 per cent, or 2,066,000 tons, were handled by the new facilities. As the original object of the improvement was to provide capacity for 2,100,000 tons of cargo per annum, it will be seen that even before its completion the new improvement had practically attained its objective, a fair indication of the need for the additional facilities. Since 1873 the commerce of Kobe has shown an average increase of about 70 per cent at the end of every fifth year.

Location and Site—The Port of Kobe is situated in the southwestern part of Settsu Province, 20 miles from Osaka, and embraces Kobe and Hyogo Bays. It faces toward the south and is sheltered on the north by the Rokko mountain range, which rises two miles from the coast. The prevailing wind is from the north, but thanks to the shelter afforded by the mountains, it does not interfere with shipping in the harbor. During the winter, westerly winds sometimes visit the port, but owing to the geographical position of Wada point, they do no harm. During the summer months, however, southerly and easterly winds sweep over the expanse of open water between Kobe and Osaka, frequently causing damage to small craft. Despite this, operations in the harbor are not suspended because of rough water more than twenty times a year.

The harbor is deep with a slightly sloping bed. No stream carrying alluvial deposits empties into it and the bottom, consisting of mud and sand, affords a safe anchorage. With regard to its location, Kobe harbor is ideal, but the sudden expansion of its trade found its piers and terminals to be inadequate.

In April, 1906, as a temporary measure to meet the increasing needs of the port, plans were prepared and work commenced on a mole and steel pier at Onohama to be built in six years at an estimated cost of 3,960,000 yen. As these tentative plans proved inadequate, a more far-reaching and general plan of improvement was suggested in September, 1906, by the national Minister of Finance. The city of Kobe volunteered to bear a portion of the cost. The original plan was then altered to provide for reclamation of the foreshore from the projection of Onohama westward to the front of the former foreign concession, thereby providing facilities for the handling of 4,000,000 tons of cargo per annum. The plan provided also for modern facilities

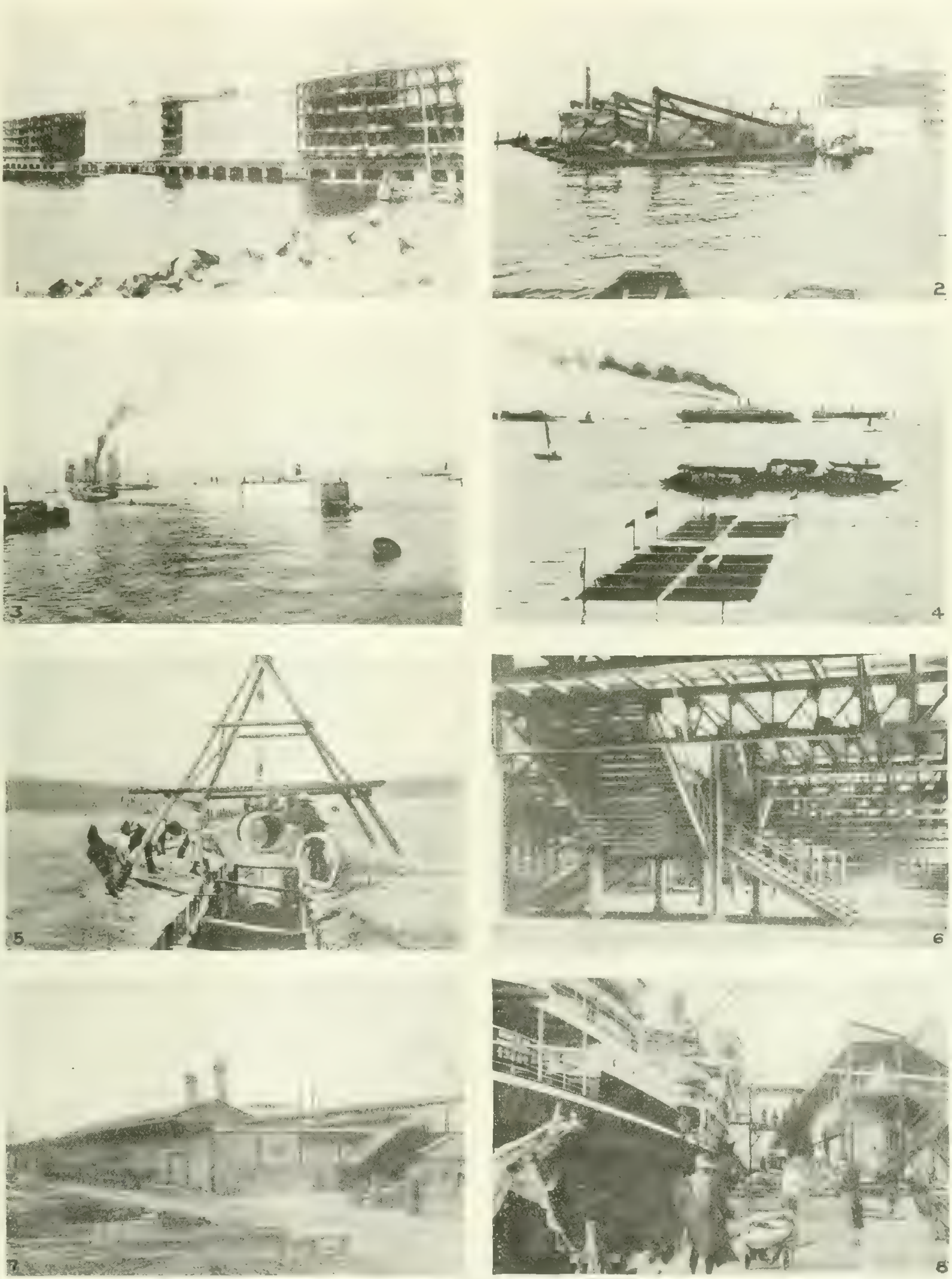


FIG. 5—CONSTRUCTION AND OPERATION OF KOBE MOLES

1. Caissons on the casting pier.
3. Caisson being towed to site.
5. Laying main sewers on mole.
7. Cargo handling on Mole No. 1.

2. Caisson leaving depositing dock.
4. Caisson being sunk.
6. Interior of double-decked shed.
8. East side of shed on Mole No. 1

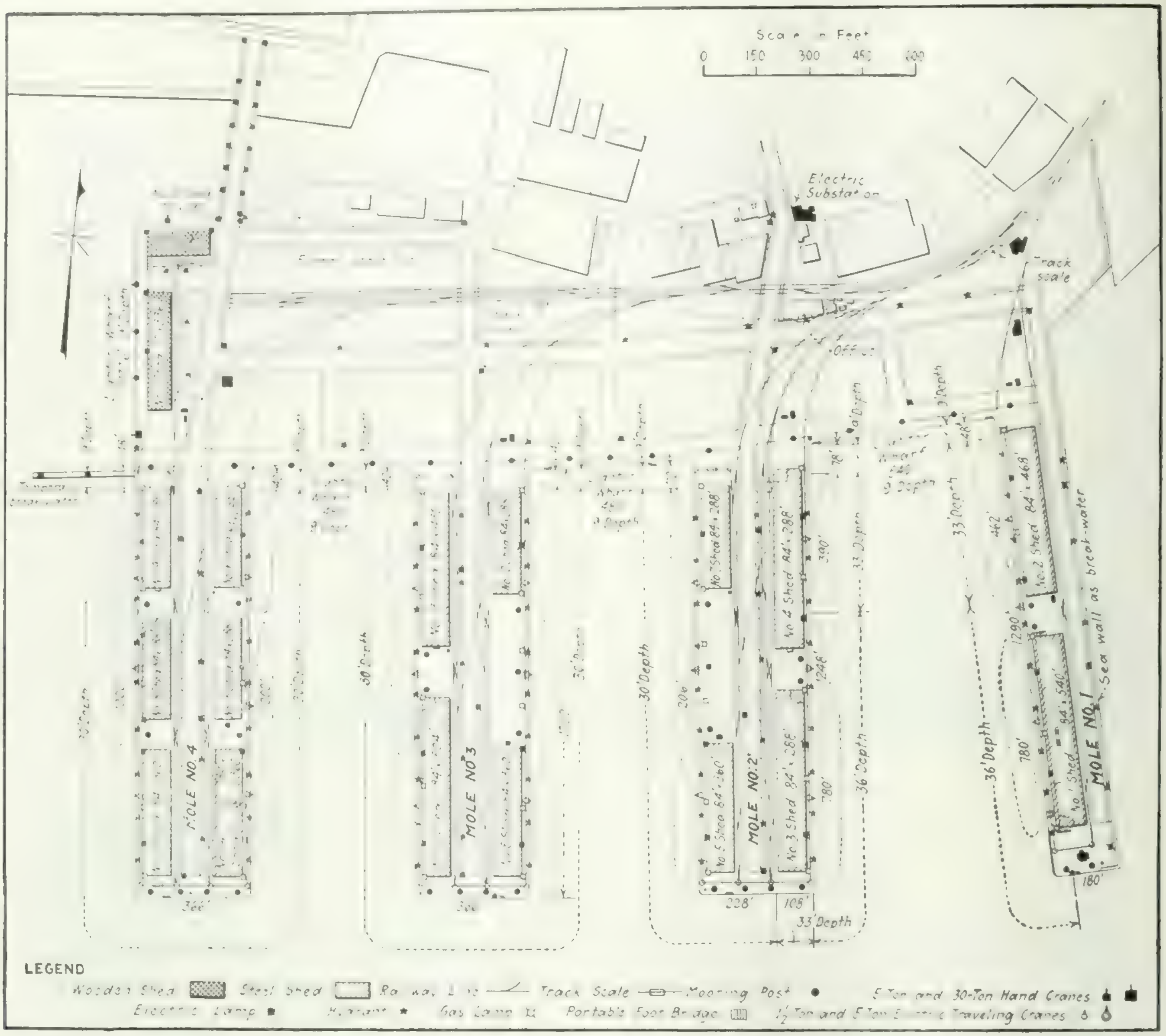


FIG. 2—NEW MOLES BUILT FROM RECLAIMED FORESHORE

to handle sea and rail traffic between Kobe and Hyogo. The estimated cost was increased to 28,905,145 yen. In March, 1907, the plan was divided into two sections.

First Section—It was decided to build first the four wharves on the foreshore of the reclaimed ground at Ono with accommodations for handling 2,100,000 tons of cargo per annum. This section was to be completed in eight years. Work was commenced on Mole No. 1 in September, 1917, but owing to the war it was found necessary to extend the time for completion.

The modified project was to build four moles as shown in Fig. 2, providing two slips each 480 ft. wide and one 540 ft. wide. Mole No. 1, at the eastern end, had its easterly side built as a sea wall to act as a breakwater with its inner side only serving as a quay. This mole is 180 ft. wide and 1,290 ft. long, while the other three are 1,200 ft. long and 336 ft. wide.

These were built out from the reclaimed foreshore. The total area of the reclaimed ground, including the moles, is about 65 acres and is 11 ft. above mean low water at spring tide. Where the four moles project, the sea has a depth of about 20 ft. Sand-pump and Priestman dredges constituted the main floating equipment for the reclamation work, which was commenced in 1907 and completed in 1921. As shown in Fig. 2, the slip between Moles No. 1 and No. 2 is mainly 36 ft. deep at low water; between Moles No. 2 and No. 3, 30 ft. at low water; between No. 3 and No. 4, 30 ft. at low water, and on the western side of Mole No. 4, 30 ft. below low water. The depth of the fairway in front of Moles No. 1 and No. 2 is 36 ft. below low water. About 60 per cent of the mud obtained by dredging was used for the lower layer of the reclaimed ground, the upper layer being of sand. The dredging was commenced in 1909 and completed in 1918. Priestman dredges were chiefly used in this work.

Lighter Wharves—Lighter wharf No. 1 is 774 ft. long, the others being 480 ft. and 540 ft. as shown in Fig. 2. These were built upon concrete blocks piled on a rip-rap foundation. Three of them slope gradually upward in order to facilitate the handling of cargo by hand to and from lighters. Between Moles No. 2 and No. 3, however, the wharf was built with a steep face in order that charging and discharging of lighters might be done by cranes. The wharves are available for lighters and launches drawing about 9 ft. of water

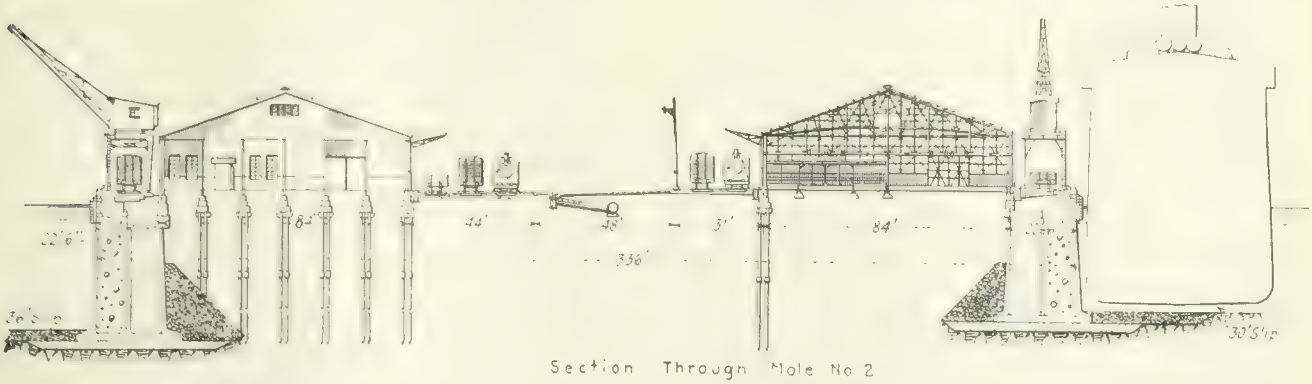


FIG. 3—SECTION THROUGH MOLE NO. 2, SHOWING TYPICAL LAYOUT

Quay-wall on left-hand side has been raised to provide for greater depth of water by the use of concrete blocks on top of caissons.

and are equipped with steel steps, portable steam-cranes or fixed hand-cranes, together with all necessary bitts and rings. They were commenced in 1908 and completed in 1922.

Quay Walls—The easterly side of Mole No. 1 was built as a sea wall of concrete blocks upon a rubble mound. It is about 2,118 ft. long and has its top elevation 17 ft. above low water. This work was started in 1907 and completed in 1914.

The total length of the quay-walls proper is about 9,556 ft. with 8,172 ft. available for cargo handling, as shown in the following table:

Quay	Height of Walls	Depth of Low Water	Effective Length	Number of Ships Alongside
Mole No. 1, south end	47 ft.	36 ft.	780 ft.	1
Mole No. 1, north end	44 ft.	33 ft.	462 ft.	1
Mole No. 2, east side, south end	47 ft	36 ft	780 ft	1
Mole No. 2, east side, north end	44 ft.	33 ft	390 ft	1
Mole No. 2, west side	44 ft.	30 ft.	1,134 ft.	3
Mole No. 3 and Mole No. 4	41 ft.	30 ft	4,626 ft.	12
Total			8,172 ft.	19

The sea bottom consists of soft mud to a depth of 6 or 7 ft. with layers of fine sand or hard clay underneath. The stratification, however, is not uniform which caused serious difficulty in laying the foundations of the quay-walls. It was eventually decided to build a series of reinforced-concrete caissons, the idea being to simplify the work of erection and to distribute the load over as broad an area as possible. These were built on shore and towed to the site where they were sunk by filling them with concrete and sand. At the beginning of operations, the bottom was carefully examined to determine the depth at which it would be necessary to bed the caissons and it was found necessary to dredge about 10 ft.

The caissons were built on special wooden piers resembling a comb in plan. Each was long enough to provide for three caissons, which were taken from the casting piers by a depositing dock of special design. This dock measured 145 ft. long, 137 ft. wide and 51 ft. high. Eight pontoons were attached to it, so spaced as to form the counterpart to the projections of the comb-shaped casting pier. The spaces between the pontoons were slightly wider than the projections of the pier. Each of these pontoons was of steel, 17 ft. deep, 12 ft. wide and 70 ft. long, and was equipped with the necessary valves for flooding and discharging in order to submerge or float the dock. To receive a caisson, the pontoons were pushed into the spaces left in the pier. When the dock was loaded an outrigger 4 ft. deep, 67 ft. wide and 137 ft. long served to counterbalance it.

The height of the caissons varied with the depth but most of them were designed for 30 ft. of water. These were 35.5 ft. high, 22.85 ft. wide on the top, and 120 ft. long. At the bottom, a footing 4 ft. wide and 4 ft. high was provided. Both inside and outside walls of the caissons sloped inward 1 to 20 toward the top, but the ends were vertical. On each end was cast a vertical key which provided a union with the adjoining caissons. In plan the caissons were divided into twenty chambers, formed by a longitudinal wall through its center and nine transverse walls. The two outside walls and the longitudinal wall ranged from 18 in. in thickness at the bottom to about 8 in. at the top, while the transverse walls were 15 in. thick at the bottom and 8 in. at the top. A description with drawings of these caissons and the depositing dock was published in *Engineering News*, June 1, 1911, pp. 647-648.

When in place the caissons extended 18 in. above

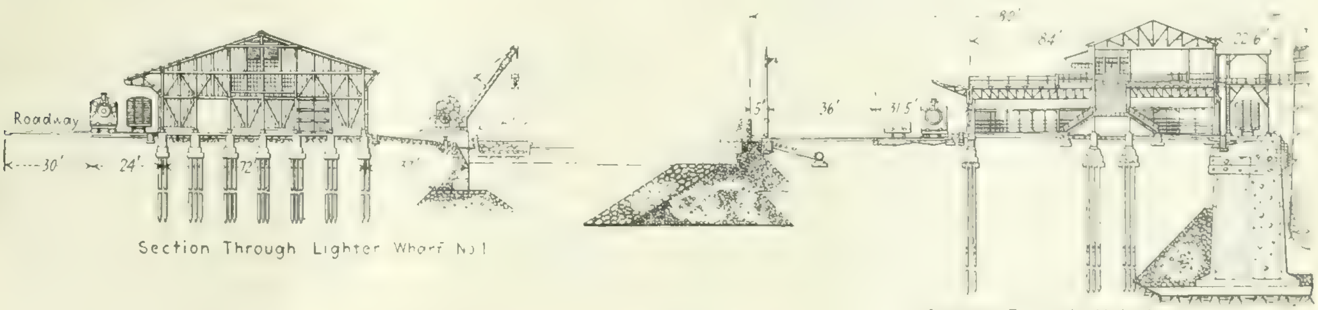


FIG. 4—SECTIONS THROUGH LIGHTER WHARF AND MOLE NO. 1

The sheds on the lighter wharves are of timber construction while those on the moles are of steel. The eastern face of Mole No. 1 has been built to serve as a sea wall, the western side only providing berthing space.

water at low tide. They were covered with a steel watertight cap and the water pumped from the front chambers, that is those that would be on the outside of the quay wall. These chambers were then filled with concrete through a cylinder at the top of the cap and the inside chambers filled with sand. When all ten chambers had thus been filled, the caisson was completed and formed a unit of the foundation for the quay walls. Ten of these were required for each side of a mole and a space of 6 in. was left between them. This later was filled in with concrete. The weight of one caisson for 30 ft. depth of water was about 2,000 tons, while those for 33- and 36-ft. depths weighed 2,300 tons. Caissons of the same size were used in 33 ft. and 36 ft., and concrete blocks were placed upon the tops of those in deeper water to make up the difference. The total number of caissons required was eighty. Operations were begun in 1911 and finished in 1918.

Sheds—Sixteen steel sheds were built on the moles for the use of ocean-going steamers and two wooden sheds were built on the lighter wharves. Each steel shed was 84 ft. wide and from 288 to 540 ft. in length, all of them covering an area of 539,451 sq.ft. The wooden sheds had a span of 72 ft. and cover an area of 38,316 sq.ft. The sheds on the moles were built parallel to the quay-wall and 23 ft. from its face. The wooden sheds were built at a distance of 32 ft. from the face of the lighter wharves.

The floors of all the steel sheds are of asphalt and concrete and those of the wooden sheds of granolithic concrete. With the exception of two sheds, one on Mole No. 1 and one on Mole No. 4, the floors of all the steel sheds are level with the quay-wall. The two sheds excepted are of special two-story construction for passenger service. On one side of the shed there is a railway platform about 2 ft. high. All are equipped with electric light for handling cargo at night. This work was commenced in 1910 and completed in 1921.

Railway—One line of track was laid between the steel sheds and the quay-walls and two or three lines in rear of the sheds. Several storage tracks were provided on the reclaimed area back of the moles. All these are of 3 ft. 6-in. gage, total more than 10 miles in length, and are connected with the main line at the Onohama station. Twenty-one turntables of 14-ft. and 15-ft. diameter and six track scales of 30- and 24-tons capacity have been provided; and 1.6 miles of track, 13 ft. 6 in. wide, was laid along the quay walls in front of the steel sheds for the use of electric traveling-cranes. This work commenced in 1910 and was completed in 1922.

Cranes—Each quay has electrically operated traveling cranes of various capacities ranging from $1\frac{1}{2}$ tons to 5 tons. These travel along the quays in front of the steel sheds and handle cargo directly to and from the hatches. On each side of the quays, two $1\frac{1}{2}$-ton cranes and one 5-ton crane were installed, the total number on the moles being fourteen $1\frac{1}{2}$-ton cranes and seven 5-ton cranes. Electric power is supplied from a generating station in Kobe and is distributed through underground cables by the substation in the customs compound. In addition to these, one 30-ton crane and four 5-ton fixed handcranes were installed in front of the wooden shed. The first of the cranes was erected in 1908 and the last in 1922.

Electric Light and Water Supply—Electric lights were installed along the roads of the new compound and electric as well as gas lights were installed along the quays. Water mains were laid along the quay walls for supplying vessels and along the sidewalks of the main roads numerous fire hydrants were installed. This work was commenced in 1910 and completed in 1922.

Roads and Bridges—Asphalt roads varying in width from 42 ft. to 72 ft. connect all the moles with the main business section. The total length of the roads is about 14,160 ft. On the quays and at the entrances to all sheds, granite paving was laid. A bridge 66 ft. wide and 66 ft. long and high enough to allow lighters to pass underneath was built between the northwestern part of the reclaimed ground and the main road of the former foreign concession. These operations began in 1908, were finished in 1922.

Cost—The cost of the various items here described is given as follows:

	yen
Reclamation	518,858
Dredging	221,531
Lighter wharf	263,635
Sea wall	408,759
Quay walls (including mooring posts, bollards, steel rings and steps)	2,825,400
Sheds	2,616,210
Railway	474 211
Cranes (including substation, building)	650,306
Electric lights and water supply	182,700
Roads and bridge	837,788
Total	8,999 398

The yen has a par value of 49.8c.; at current exchange it is quoted at 48c.

Staff—All this work has been under the jurisdiction of the construction section of the Department of Finance and has been carried out by the Kobe branch of the section. The responsible officers at the head office in Tokyo are K. Yabashi, director; F. Kimoto, business controller; T. Chichibu, architect; H. Inoue, civil engineer. The officers of the Kobe branch are O. Matsumoto, chief; K. Morigaki, chief engineer; J. Ikeda, architect; Y. Asai, civil engineer.

Further Improvements—Further improvements under construction and contemplated include the east breakwater, 3,792 ft. long, and the south breakwater, 3,000 ft. long, commenced in 1910 and 1917 respectively. A program now in force includes the improvement at Hyogo of facilities for domestic trade, an extension of facilities on the sea front of Hamabe-dori for foreign trade, and at Kaigan-dori for both foreign and domestic trade. More of the shore at Hyogo and Kobe is to be reclaimed and more landing and mooring places for lighters are to be provided.

The facilities for foreign trade will be provided by the national government while those for domestic trade are undertaken by the city of Kobe. The total expenditure is estimated at 41,270,000 yen of which 16,450,000 will be borne by the city of Kobe.

District and County Taxes Almost Equal Rent

An application for extra renumeration on account of considerable engineering work done outside his regular duties was recently denied to H. W. Boardman, surveyor to the Barmouth Urban District Council, Wales, on the ground that although Mr. Boardman deserved the extra compensation, it was not advisable to grant it because the local rate was 6s. 3d. and the country rate 10s. 6d. per pound of the rent value. That is, what in America would be called the local and county taxes combined are in Barmouth 83.7 per cent of the rental value of real estate, besides which there is in England a heavy national income tax.

Non-Uniform Flow and Significance of Drop-Down Curve in Conduits

A Study in Conduit Design Making Possible Flatter Grades, Smaller Conduits on Available Grades, or Cost Reduction

By H. E. Babbitt

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As conditions of uniform flow rarely exist at and above the outlet of conduits which do not discharge entirely submerged, the common hydraulic formulas, such as Kutter's, Manning's, etc., cannot be applied without modification for some distance above the outlet. The flatter the slope of the conduit invert, the further above the outlet will the conditions of non-uniform flow persist.

Under conditions of non-uniform flow the surface of the stream is not parallel to the invert of the channel. As a free outlet is approached the depth of flow decreases, for a constant rate of discharge, and the curve of the surface of the stream is generally known as the drop-down curve. In order to determine the depth of flow at any point, the rate of discharge, or other hydraulic elements, it becomes necessary to study the drop-down curve. This is especially important above the outlet of large conduits on flat slopes, or in studying the effect of obstructions in conduits.

It may be possible, by the study of the drop-down curve, to place conduits on flatter grades, to use smaller conduits on available grades, or to reduce the cost of outlet protection works, below the grades, diameters, or costs as computed by applying formulas applicable to conditions of uniform flow.

The factors involved in problems of non-uniform flow are: The shape of the conduit, which must be determined on other than hydraulic principles alone; and, (1) the dimensions of the conduit, (2) the rate of discharge or the capacity of the conduit, (3) the slope of the invert, (4) the depth of flow at any known point, and (5) the coefficient of roughness. In general if the shape of the conduit and any three of the five enumerated factors are known, the other two factors can be determined.

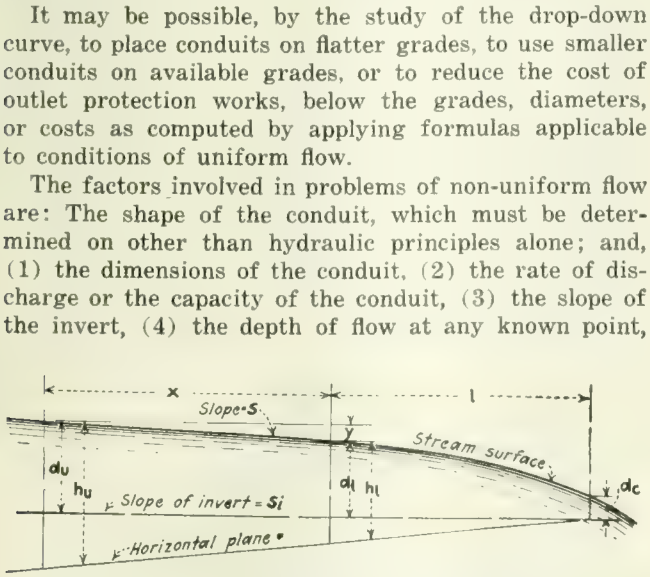


FIG. 1. ILLUSTRATION OF NOMENCLATURE EMPLOYED
Lines normal to slope of invert are presumed to be vertical.

The method for determining these factors will be explained, together with the solution of an example. The nomenclature used will be:

A_n = The area of the cross-section of the flowing stream at section, n.
A_m = The mean of the cross-sectional areas of any two sections being studied.
b = The width of a rectangular channel.
C = The coefficient in Manning's formula, $V = CR^{\frac{2}{3}}S^{\frac{1}{2}}$.
D = The "diameter" or vertical height of any closed section.
d_c = The depth of flow at a "control" section, or the so-called "critical" depth.
d_l = The depth of flow at the lower of two sections being studied.
d_n = The depth of flow at any section, n
d_u = The depth of flow at the upper of two sections being studied.
g = The acceleration due to gravity.
h_f = The head lost due to friction.
h_e = The vertical distance from datum to the invert at the lower of two sections being studied.
h_u = The vertical distance from datum to the invert at the upper of two sections being studied.
l = The distance from the outlet to the lower of two sections being studied.
Q = The rate of discharge.
R = The hydraulic radius of the conduit.
R_l = The hydraulic radius of the stream at the lower of two sections being studied.
R_m = The mean of the hydraulic radii at any two sections being studied.
R_u = The hydraulic radius of the stream at the upper of two sections being studied.
S = The value of $h_f \div x$.
S_i = The slope of the invert of the channel.
V_l = The average velocity of flow at the lower of two sections being studied.
V_m = The mean of the average velocities at any two sections being studied.
V_u = The average velocity of flow at the upper of two sections being studied.
x = The horizontal distance between two sections being studied.
y = The drop in the hydraulic gradient between any two sections being studied.

TABLE I—COMPUTATIONS TO DETERMINE THE DEPTH OF FLOW 500 FT. ABOVE THE OUTLET OF A 3-FT. RECTANGULAR CHANNEL ON A SLOPE OF 0.001, CARRYING 100 SEC.-FT. C, IN MANNING'S FORMULA=100

Distance from Lower Section to the Outlet l	Lower Section: Depth (Correct) de	Area Ae	Velocity Head $Ve^2/2g$	Hydraulic Radius Re	Upper Section: Depth (Assumed) du	Area Au	Velocity Head $Vu^2/2g$	Hydraulic Radius Ru	Average: Area Am	Velocity² Vm^2	Hydraulic Radius Rm	$Rm^{4/3}$	Slope $\frac{V_m^2}{C^2 R_m^{4/3}}$ S	Distance Between Sections* x
0	3.28	9.84	1.604	1.03	4.22	12.66	0.969	1.107	11.25	79.2	1.066	1.10	0.0072	50
50	4.22	12.66	0.969	1.107	4.55	13.65	0.836	1.129	13.16	57.9	1.118	1.168	00496	50
100	4.55	13.65	0.836	1.129	5.00	15.00	0.691	1.153	14.32	48.9	1.141	1.206	00405	100
200	5.00	15.00	0.691	1.153	5.32	15.96	0.611	1.17	15.48	41.8	1.162	1.23	00340	100
300	5.32	15.92	0.611	1.17	5.79	17.37	0.517	1.191	16.64	36.2	1.18	1.26	00287	200
500	5.79													
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

$$^*\left[\left(d_u + \frac{V_u^2}{2g}\right) - \left(d_e + \frac{V_e^2}{2g}\right)\right] \div \left[S - S_i\right]$$

Fig. 1 shows some of the lettering used for the dimensions.

In every case the depth at the outlet, or other "control" section, must be determined. A "control" section is one at which the sum of the depth of flow (the potential head) and the velocity head is a minimum. The depth at a "control" section is known as the "critical" depth. The fact that a "control" section occurs at the outlet of all channels discharging freely or only partly submerged is demonstrated in an article "The Hydraulic Jump and Critical Depth in the Design

of Hydraulic Structures," by Julian Hinds in *Engineering News-Record*, Nov. 25, 1920, p. 1034.

The critical depth for a rectangular section can be determined as follows:

By definition; depth plus velocity head equals a minimum. The depth is d_c

the velocity head is $\frac{V^2}{2g} = \frac{Q^2}{2gb^2d_c^2}$

therefore

$$d + \frac{Q^2}{2gb^2d^2} = \text{a minimum}$$

and, by calculus, the minimum value of the expression is obtained when

$$d_c = \sqrt[3]{\frac{Q^2}{g\,b^2}}$$

Values of critical depths for different widths of rectangular channel, and different rates of discharge, have been plotted in Fig. 2.

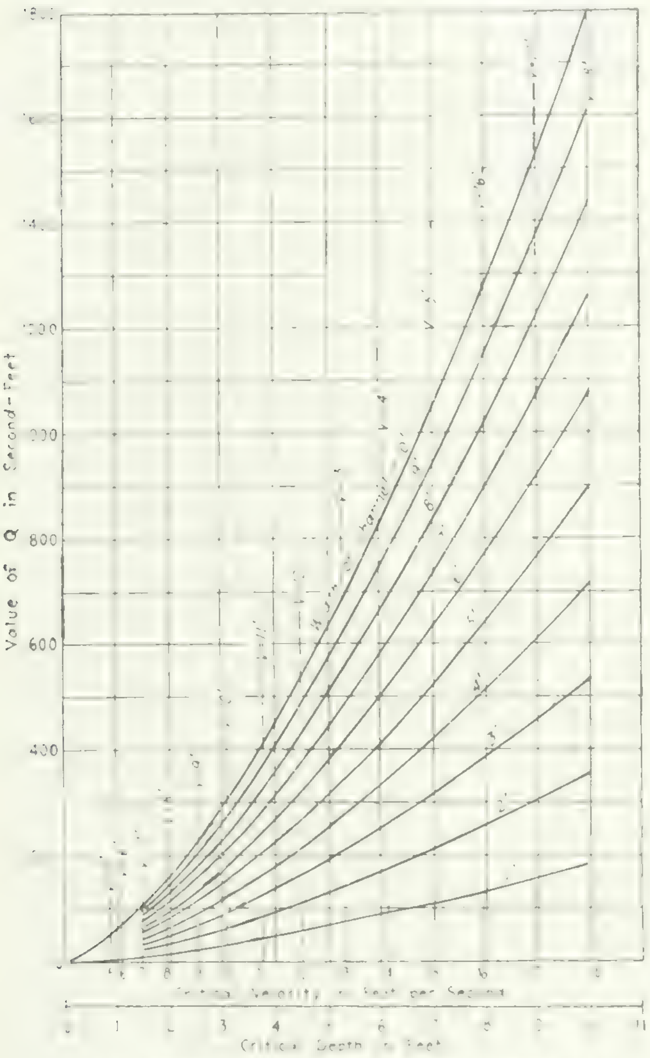


FIG. 2—CRITICAL DEPTHS AND VELOCITIES IN RECTANGULAR SECTIONS

V_c (the critical velocity) $= \frac{Q}{bd_c} = d_c^{\frac{1}{2}}g^{\frac{1}{2}}$ hence V_c is constant for any value of d_c. Values of V_c have also been plotted in Fig 2.

The critical depth for circular, and many irregular sections, can be determined best by a method of trial. The values of critical depths for some circular sections with different rates of discharge have been plotted in Fig. 3.

Possibly the simplest form of problem suitable for explaining the use of the drop-down curve in the study of non-uniform flow will be the determination of the depth of flow at some point in a rectangular channel of known width and material, on a known slope, and discharging at a known rate. In general the method is as follows:

(1) The critical depth at the outlet is computed, or it may be read from Fig. 2.

(2) The depth of flow at a section at some unknown distance, x up stream, is assumed.

(3) The loss of head between these two sections is computed in terms of the unknown distance x, and the mean of the hydraulic radii and velocities at the two sections, by means of Manning's or some other formula applicable to conditions of uniform flow. The value of S is then expressed in terms of x.

(4) The value of x is then equated to the difference between the total heads (depth plus velocity head) at the two sections, divided by the difference between S and S_1. The depth at, and the location of, the next higher section are now known.

(5) The steps are repeated, section by section, until the depth at the required section has been determined, or the required section has been located.

TABLE II—VALUES OF Q (SEC.-FT.) FOR DIFFERENT VALUES OF CRITICAL DEPTH (FT.) AND WIDTH OF RECTANGULAR CHANNEL (FT.)

The curves in Fig. 2 were plotted from this table.

Critical Depth, Ft.	Width of Channel, Ft. 1	2	3	4	5	6	7	8	9	10
1	5.7	11.4	17.0	22.7	28.4	34.1	39.8	45.4	51.1	56.8
2	16.1	32.1	48.3	64.3	80.4	96.4	113	129	145	161
3	29.6	59.2	88.8	118	148	178	207	237	266	296
4	45.4	91	136	182	227	272	318	363	408	454
5	63.5	127	190	254	317	381	444	507	571	635
6	83.5	167	251	334	418	501	585	668	752	835
7	105	210	315	420	525	630	735	840	945	1,050
8	128	256	385	513	642	770	898	1,028	1,156	1,283
9	153	307	460	613	767	921	1,073	1,227	1,381	1,534
10	180	355	538	718	897	1,078	1,255	1,436	1,614	1,795

As this method involves considerable computation, the figures should be tabulated. The figures for the solution of the following problem are shown in Table I.

Determine the depth of flow 500 ft. from the outlet of a 3-ft. rectangular channel on a slope of 1 in 1,000, discharging 100 sec.-ft. The material is such that the coefficient in Manning's formula is 100.

The table should be filled line by line, as follows: In Column 1 enter the distance of the known section above the outlet. In the first line this will normally be zero; in Column 2 enter the critical depth or known depth at this section; in Column 3 enter the cross-sectional area of the stream; in Column 4 enter the velocity head; in Column 5 enter the hydraulic radius of the wetted section; in Column 6 enter any desired depth, which must, however, be equal to or greater than the critical depth entered in Column 2. This depth is assumed to exist at some section up stream, the location of the section being unknown. The smaller the increment of increased depth, the greater the accuracy of the result. In Columns 7, 8, and 9 repeat the steps for the upper section that were entered in Columns 3, 4, and 5 for the lower section. In Column 10 enter the average of the areas of the two sections. In Column 11 enter the square of the average velocity, found by squaring the quotient of the rate of discharge divided by the area entered in Column 10. In Column 12 enter the mean of the hydraulic radii entered in Columns 5 and 9. In Column 13 raise the mean hydraulic radius to the 4/3 power; in Column 14 enter the value of S as expressed in Manning's formula

$$S = \frac{V^2}{C^2R^{4/3}}$$

In Column 15 enter the distance between the two sections as found from the expression

$$x = \frac{\left[d + \frac{V^2}{2g}\right] - \left[d + \frac{V^2}{2g}\right]}{S - S_1}$$

Proceed in the first column of the next line by entering the sum of the above value of x and the value of l recorded in the first column. The remaining columns are filled in the same manner as the columns in the first line.

TABLE III—VALUES OF CRITICAL DEPTHS IN CIRCULAR CHANNELS

The curves in Fig. 3 were plotted from this table

Diam. Ft.	Q Sec. Ft	Critical Depth Sec Ft.	Diam Ft.	Q Sec. Ft.	Critical Depth Ft.	Diam Ft.	Q Sec. Ft.	Critical Depth Ft	Diam Ft.	Q Sec. Ft.	Critical Depth Ft	Diam. Ft	Q Sec. Ft.	Critical Depth Ft.
1	0.1	.13	3	2.5	.48	5	10	.87	7	25	1.26	9	50	1.71
..	0.2	.20		5	.66		20	1.19		50	1.79		100	2.39
..	0.4	.27		10	.90		30	1.54		100	2.56		300	4.14
..	0.5	.30		15	1.23		50	1.98		200	3.68		500	5.49
..	0.6	.33		20	1.44		70	2.33		300	4.55		700	6.53
..	0.8	.38		30	1.80		100	2.85		400	5.22		1,000	7.74
..	1.1	.43		40	2.07		150	3.73		500	5.81		1,200	8.24
..	1.5	.52		50	2.28		200	3.98		600	6.37		1,400	8.55
..	2.0	.60		60	2.49		300	4.65		700	6.55	–	——	——
..	2.4	.66		70	2.64		400	4.86		1,000	6.79			
				80	2.73	—		–	–		–	10	50	1.60
..	2.7	.69		90	2.78								100	2.25
..	3.0	.73		100	2.88	6	10	.80	8	50	1.72		300	4.15
..	3.3	.78	—				25	1.29		100	2.48		500	5.30
..	4.0	.84					50	1.89		200	3.56		700	6.35
..	4.5	.90	4	5	.64		75	2.37		300	4.40		1,000	7.70
—	—	——		10	.92		80	2.46		400	5.04		1,200	8.25
				15	1.12		90	2.49		500	5.68		1,400	8.75
2	1.0	.33		20	1.28		100	2.67		600	6.40		1,600	9.25
..	2	.48		30	1.60		200	3.87		700	6.68		1,800	9.50
..	5	.80		50	2.08		300	4.80		800	7.04		——	——
..	8	.98		70	2.52		400	5.44		1,000	7.48			
	10	1.12		90	2.96	.	500	5.69			—			
..	15	1.42		100	3.08	—	——							
.	20	1.64		150	3.64									
.	25	1.82		175	3.76									
	30	1.80		200	3.92									
	40	1.94	--											
—	——	——												

In the example given the depth is 5.8 ft. at a point 500 ft. above the outlet.

The practical value of the solution of the following problem is more easily comprehended though it is a trial and check method.

Determine the diameter of a circular conduit, at a point 1,000 ft. above the outlet, to carry 200 sec.-ft. The conduit is on a grade of 1 in 1,000 and C in Manning's formula is to be taken as 100.

The problem is solved in the same manner as the preceding example, the depth of flow at the 1,000-ft. section being taken as the required diameter. As it is necessary to know the diameter of the circle before the hydraulic elements of the sections can be computed, the required diameter must be assumed, and if not found correct, other assumptions must be made, until the assumed and the computed diameters agree. Such a method of trial would not be necessary for a rectangular channel of known width, or a triangular channel of known base angle, etc.

As computed by this method the required diameter is approximately 7 ft. As computed for conditions of uniform flow the required diameter would be about 11.5 ft. The use of a 7-ft. diameter in the place of an 11.5-ft. diameter for a distance of 1,000 ft. would make an appreciable saving.

In order to determine the capacity of a conduit, when given its dimensions and slope for some known distance above the outlet, a method of trial must be followed. The capacity is assumed and the depth at the known section above the outlet is computed as in the example solved in Table I. If the computed depth agrees with the actual depth the assumed capacity is correct. If they do not agree other assumptions of capacity must be made and the computations repeated, until the computed and the actual depths agree.

Other problems involving different combinations of the five factors, any three of which are known, can be solved by similar methods.

If the conduit is discharging into a body of water whose surface level is above the critical depth at the outlet of the conduit the actual depth at the outlet must be used instead of the critical depth. If the level of the stream into which the discharge is falling is below the critical depth, the critical depth should be used.

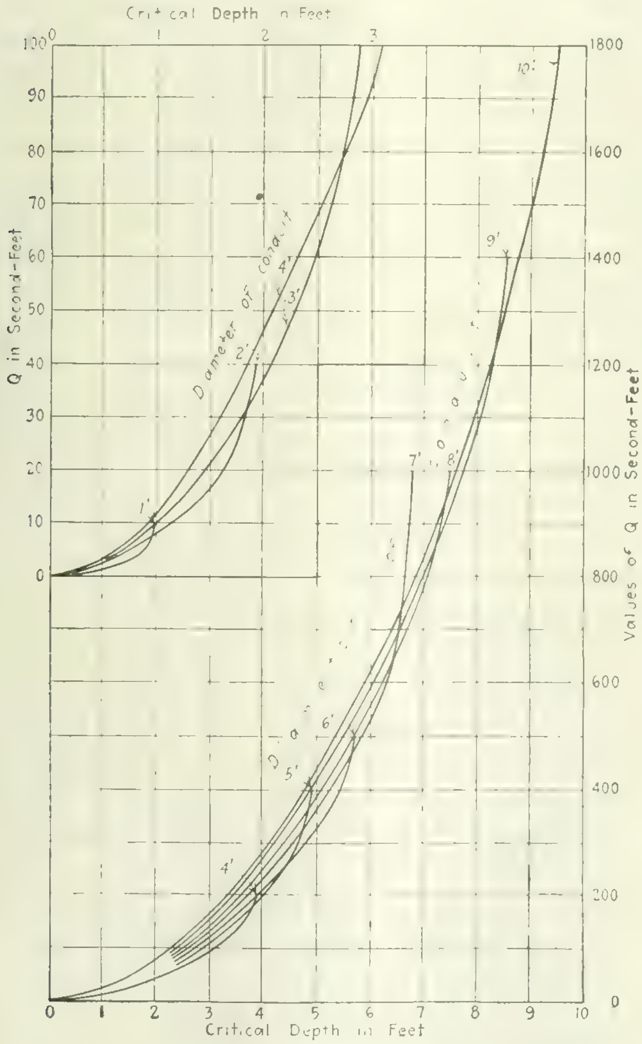


FIG. 3. CRITICAL DEPTHS IN CIRCULAR SECTIONS

Jugo-Slavia Plans Railroads to Open Up Resources

Survey of Existing and Projected Transportation Facilities—American Syndicate To Finance Improvements

BY COL. W. G. ATWOOD

THE transportation system of central and eastern Europe was disorganized by the breaking up of the Austro-Hungarian Empire as a result of the Treaty of St. Germain. The situation in 1919 after the armistice was similar to that which would have existed in this country had all railroads terminated at the state lines and all through freight been unloaded and reloaded at each state line. Later adjustments have corrected this condition so far as interchange of equipment is concerned.

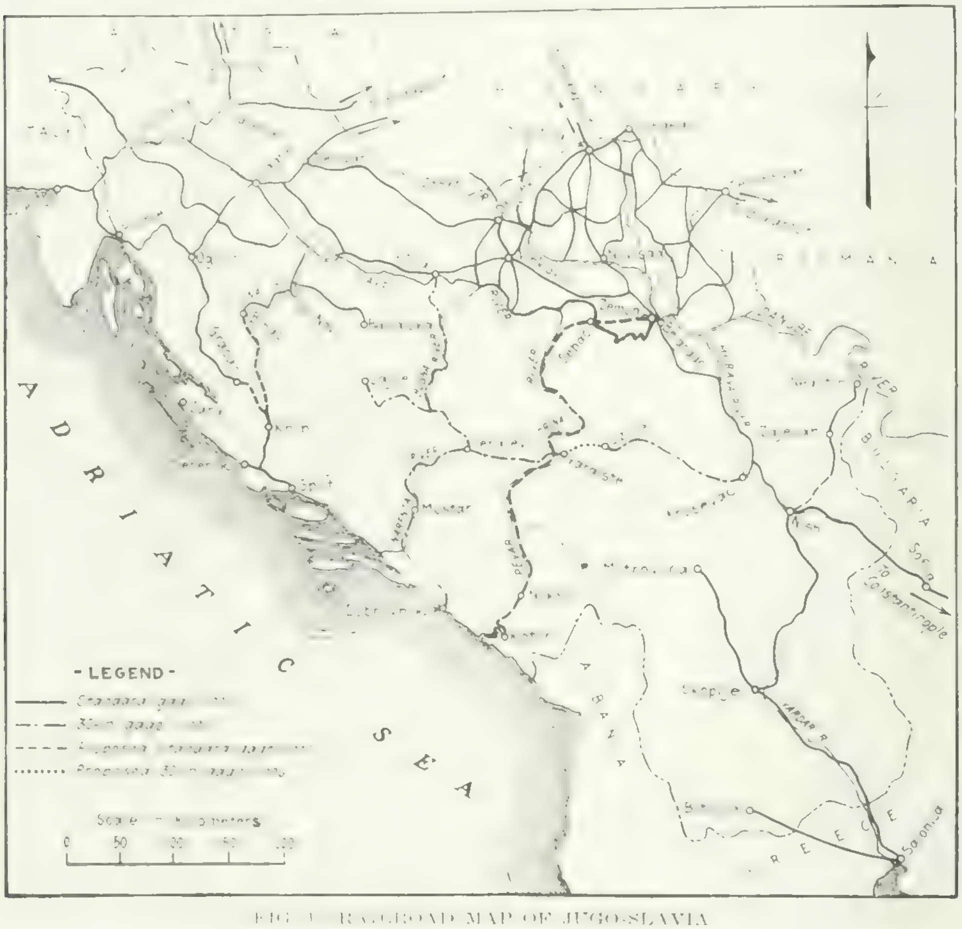


FIG. 1—RAILROAD MAP OF JUGO-SLAVIA

The main heavy-traffic roads of the Dual Empire radiated from Vienna and Budapest for strategic reasons and also in order to force traffic through these two cities. These lines were supplemented by others of less capacity parallel to the Imperial frontiers. In the details of location military requirements always governed and economy of construction or operation was secondary. The end of the war found all rolling and shop equipment in bad condition. Each country held all equipment within its borders with the result that the number of types in any given country was excessive. In Jugo-Slavia there were over 100 types of locomotives in a total of about 1,500.

The conditions in the kingdom of the Serbs, Croats and Slovenes, known in the United States as "Jugo-Slavia," are of especial interest because rehabilitation and the construction of new lines are being financed by an American syndicate headed by Blair & Co. The first installment of this loan is $25,000,000, of which $10,000,000 is to be expended for rehabilitation, and an equal amount for new construction. William B. Poland, assisted by J. H. Porter, are engineers for Blair & Co in Belgrade.

Jugo-Slavia is made up of the former independent kingdoms of Serbia and Montenegro with a number of the southern provinces of the former Austro-Hungarian Empire. The railway system of which the principal lines are shown on the map, consists of 5,647 km. of standard and 2,020 km. of narrow-gage lines, of which 197 km. are 60-cm. and the remainder 76-cm. gage. These lines are government owned except 819 km. of standard gage in the western part of the country owned by the Southern Railway Co.

The railroads in the old kingdom of Serbia were probably more completely destroyed than those in any of the other war-torn countries. The rebuilding of the structures in the face of an almost complete absence of resources presents one of the best examples of engineering efficiency and resource conceivable. This work was a monument to the ability of the profession, and one for which the Serbian engineers deserve the highest praise.

The system of Bosnia-Herzegovina is all 76-cm. gage in a very mountainous country. This system radiates from Serajevo, reaches the Adriatic at Dubrovnik (Ragusa) and connects with the standard gage at Brod. Serajevo, the capital of Bosnia, is located in a basin at the head of the Bosnia River. (Fig. 2.) The grades of all lines except that which follows the Bosnia River to the north, are heavy. Those of the line to Dubrovnik are the heaviest; 6 per cent for 18 km. on which the Abt rack system is used.

The primary need of the kingdom is adequate facilities for foreign trade. Supplying this need involves both port and railroad construction, the construction of adequate terminal facilities at several junction points and the changing from 76-cm. to normal gage of some of the narrow-gage lines. There are available two ports under foreign flags, which are already connected to the interior by railroads, Salonica and Fiume. Salonica is economically available only as the outlet for the southern portion of old Serbia, and Fiume will properly serve only the extreme western portion of the kingdom. The 2.5 per cent grade on the railroad out of Fiume is a great handicap as is the small size of the port itself.

The two ports, Split (Spalato) and Kotor (Cattaro) under the Jugo-Slav flag, which as yet have no rail

FIG. 2—CORNER OF THE MARKET PLACE IN SERAJEVO

connections, are fortunately much better located to serve the whole country than Fiume or Salonica and have better natural harbors. Split has a small harbor with few facilities but on the opposite side of the point on which the present city stands there is a large well-protected bay with ample area and deep water. The Roman Emperor Diocletian was born in Split and his palace now houses about 3,000 of the inhabitants of the city. There are three very large cement mills on the bay, operated by hydro-electric power. There is sufficient area for the construction of ample rail terminals near the Roman city of Salona, many of whose walls are still standing.

Shortly before the war, railroads to connect Split with the interior were commenced. The line connecting the two ports of Sebenik and Split and extending toward the interior as far as Knin were completed, and the so-called "Lika" line is now completed to Gracac as well as about 50 per cent of the grading between Gracac and Knin, a distance of about 50 km. This line is badly located, has 1.8 per cent uncompensated grades and heavy curvature. The Una River line was completed a short distance beyond Bos-Novi leaving 120 km. yet to build to a connection with the Lika line to Knin. This line will have only a short section of 1.8 per cent summit grade with a ruling grade of less than 1 per cent on the rest of the line. Undoubtedly the completion of this system and the construction of the necessary port facilities at Split will be one of the first projects undertaken by the existing syndicate.

The development of Split will not furnish sufficient facilities, and port and railroad construction to develop the Bay of Kotor will undoubtedly follow. Kotor is one of the best and most thoroughly protected harbors in Europe. It has a large area, deep water, is thoroughly protected against high winds by the high mountains surrounding it, and is not accessible to artillery fire from the sea. It was the principal sea-plane and submarine base for the Austrian navy during the World War.

FIG. 3—AN IMPORTANT STREET CORNER IN BELGRADE

The railroad to serve this port will be entirely new and will tap a virgin country. It will start from Zemun across the Save from Belgrade and follow the Save, Drina and Pevar Rivers to Niksic in Montenegro whence it will follow the sides of the mountains around the Bay of Kotor to a point on the south side of the central section of the bay where there is ample area suitable for terminal construction. The length of this line will be about 440 km. of which about half will be very light construction and the other half fairly heavy mountain work. There will be one tunnel, 10 km. in length.

The territory tributary to the lines to Split is a fairly productive agricultural country, has large deposits of iron and coal, large areas of good timber and in the vicinity of Zagreb some well-developed industries. The Kotor line will give an outlet for some of the best agricultural land in Europe and make it possible to open many important deposits of coal, copper, lead, antimony and salt in Serbia and Bosnia.

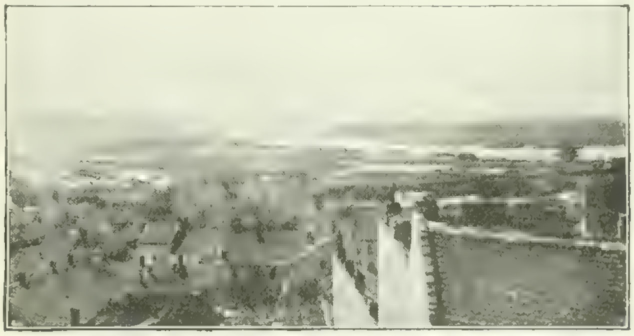


FIG. 4—LOOKING UP THE SAVE RIVER FROM BELGRADE
The bridge at this place was destroyed three times during the World War.

Belgrade-Zemun and Zagreb will be the most important transportation centers and their terminals require great expansion. Belgrade is built on a promontory at the junction of the Save and Danube Rivers. It is a well built city of about 130,000 inhabitants. (Fig. 3.) There is insufficient area for the necessary terminal expansion and because of this as well as the fact that the traffic requirements also favor it, the expansion will be made at Zemun on the opposite side of the Save. The two cities are connected by a bridge which was blown up three times during the war (Fig. 4), and are from a traffic standpoint, practically one city. Zagreb was an important terminal before the war, but even with the present difficulties of transportation, the traffic on the state railway system has increased from 45,000 cars in 1913 to 72,600 in 1919, and it is estimated that capacity for 100 per cent greater traffic must be provided.

The narrow-gage line from Krusevac to Uzice passes through a zone which contains oil and many important mineral deposits and produces a large agricultural surplus. This line can easily be made a normal gage (Figs. 5, 6, 7) and will serve as a connection between the new Drina River line to Kotor and the existing line between Belgrade and Nish.

FIG. 5—ON THE SERBIAN NARROW GAGE

FIG. 6—AT BANJASKA BANJA
On the narrow-gage railway, 30 miles from Krusevac.

FIG. 7—AT IZVOR, ON THE SERBIAN NARROW GAGE

There is abundant water power in a large part of Serbia, Bosnia and Dalmatia. The only large developments are at Jajce where there is a carbide factory having a plant which runs about a 30-m. head in two penstocks about 60 cm. in diameter, and the still larger plant operated in connection with the cement mills at Split.

There is no country in Europe, with the exception of Russia, which has so great undeveloped resources as Jugo-Slavia. The people are peaceable and hard working and now that American capital is becoming interested it is a country which deserves and will demand the attention of American engineers.

Street Sprinkling in Peking, China

In Peking, China, the sprinkling of the streets is accomplished by the primitive method of filling with water rather closely woven willow baskets, attached to long poles, and shaking the baskets over the street.

Improved Daylight Factory Lighting

By G. P. Richardson
Detroit Steel Products Co., Detroit, Mich.

HOW to improve the daylight lighting for shop work was a problem in utilizing an old five-story building to provide additional manufacturing capacity for the automobile division of the Studebaker Corporation at South Bend, Ind. The building is 165 x 278 ft., of timber beam and girder mill-type construction, with wood columns, plank floors and brick walls.

FIG. 1. OLD WINDOWS GAVE POOR LIGHT DISTRIBUTION

In the original construction each 19½-ft. longitudinal bay had two window openings 6 ft. wide, with box frames, sliding sash, and arched top 18 in. below the bottom of the floors. Small brick piers carrying no load from the floors were built between the windows. With this arrangement for a building 165 ft. wide the center part was very poorly lighted.

To provide more light on the first and second stories, the old wood sash and small brick piers in the long sides of the building were removed and the openings were carried up to the underside of the next floor, steel lintels being installed to carry the brick curtain walls between the main piers. Steel-frame windows were

FIG. 2. EFFECTIVE LIGHTING WITH NEW STEEL SASH

then placed in the new openings and without weakening the building the glass area was increased 83 per cent. This alteration was planned by Lockwood, Greene & Co., Boston and Chicago, engineers for the Studebaker Corp., and was carried out without interference with manufacture by the H. G. Christman Co., South Bend.

Dry Fill and Hydraulic Sluice Methods On Same Dam

Different Methods Employed on Opposite Sides of Thin Concrete Core Wall in Earth Dam on Hetch Hetchy Project—Core Wall Has Contraction Joints in Length

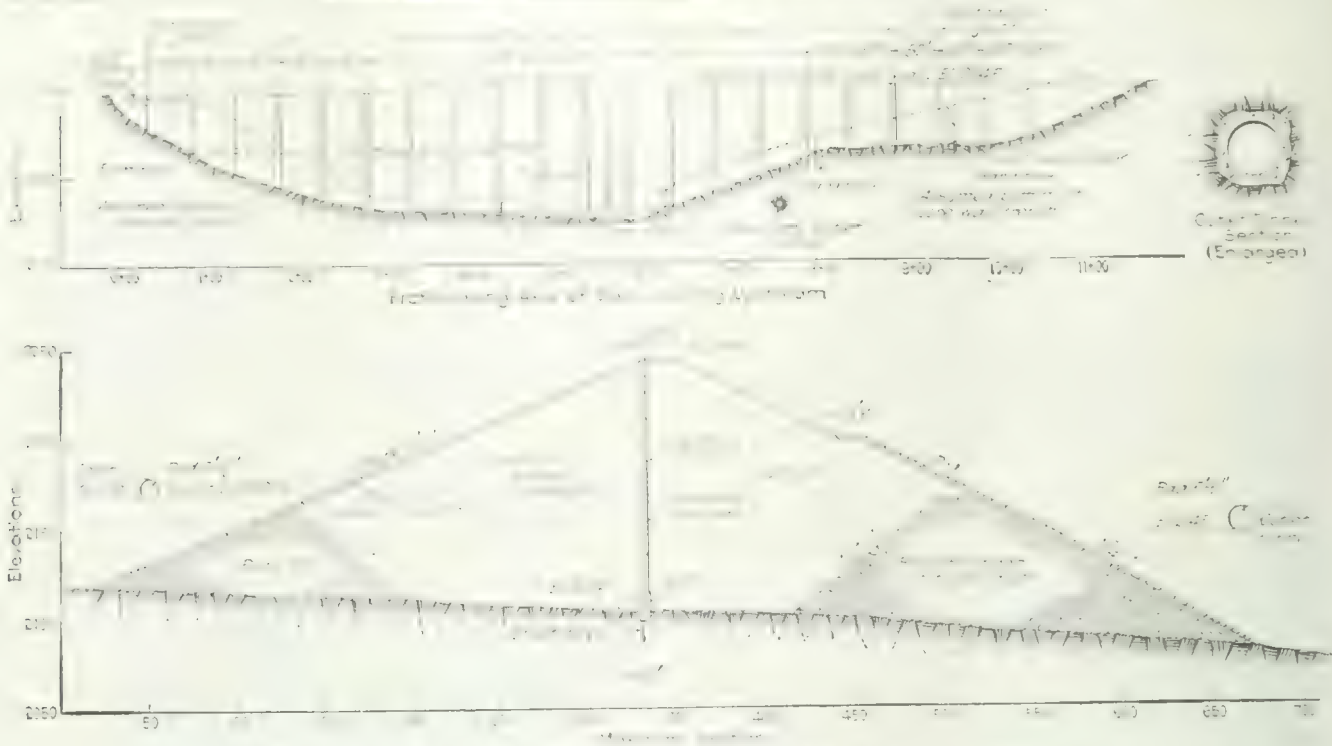
PRIEST DAM is being built to provide a forebay for the Moccasin Creek power plant which is the first large power unit to be installed on the Hetch Hetchy water and power project now being carried out by the city of San Francisco. The dam will have a maximum height of 145 ft. and will be about 1,000 ft. long on the crest, developing a storage of 2,500 acre-ft. The lower end of the 18-mile section of the Hetch Hetchy tunnel will be submerged in the reservoir formed by this dam and the penstocks of the Moccasin Creek plant will be supplied by a tunnel leaving the reservoir several hundred feet upstream from the dam.

VIEW OF PRIEST DAM SHOWING TWO CONSTRUCTION METHODS
At extreme left, track to first borrow pit on far side of dam. Hydraulic monitor for washing fines from dry fill against core wall. First bents for trestle from next borrow pit level appear at far end of dry fill. First sluicing pit in center background. Pumphouse in extreme right foreground.

Features of the structure are (1) the design of the concrete core wall which is provided with numerous joints to permit flexure without cracking should material in the fill settle unequally and (2) the adoption of different methods for placing material on the up- and the downstream sides of this core wall. By the use of the two methods of handling material a suitable embankment which will allow drainage if necessary, is secured on the downstream side at low cost while a well-compacted impervious fill will be made on the upstream side. The work was begun in October, 1921, and is to be completed in 700 days. A total of about 800,000 cu.yd. of material will be placed in the structure. Both up- and downstream slopes are to be faced with riprap 2 ft. thick on downstream face, with variable thickness on the upstream face as follows: 5 ft. thick below El. 2,150, 3 ft. thick from El. 2,150 to 2,200, and 2 ft. thick above El. 2,200. A concrete lined spillway with a capacity of 1,000 sec.-ft. will be provided around the east end of the dam. The main channel of this spillway is 4x20 ft. in cross-section, the entrance end, however is a tapered section on a variable grade in order to accelerate the water to the required velocity. This is considered ample as there is only a very small drainage area in the natural basin above the dam and water will rarely, if ever, pass over the spillway. The only other waterway in the dam is the scouring tunnel around the east end which was driven on a 2.222 per cent grade and taps the reservoir at the lower level. This tunnel is 6 ft. in diameter inside a 12-in. concrete lining and is 900 ft. long. Control of the tunnel is to be provided by two 30-in. valves at the upper end and operated by hand equipment in a concrete tower.

Foundation for the core wall was poured in a trench excavated into rock. Holes were drilled in the bottom of the trench at intervals of 5 ft. into which grout was forced through pipes driven into the drill holes and carried up through the concrete. The core wall is being carried up in 16-ft. lifts, just fast enough to keep well ahead of the fill. As shown in the accompanying drawing, the core wall has horizontal joints every 16 ft. and vertical joints every 50 ft., these joints having adjacent faces tarred to prevent bonding and No. 10 gage copper strips to keep them water tight.

As a means of steadying and strengthening the wall against unbalanced pressure that might occur during



ELEVATION OF PRIEST DAM AND CROSS-SECTION AT MAXIMUM HEIGHT

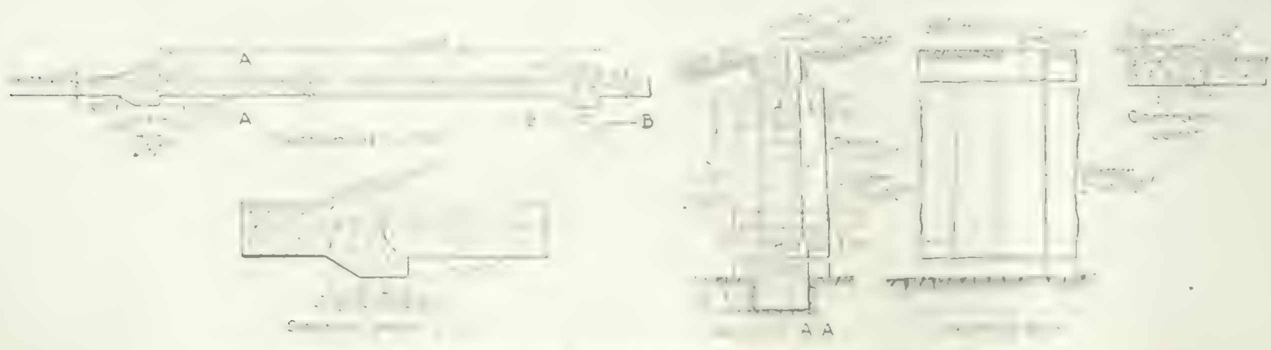
construction and before the two fills have settled, the wall is tied to deadmen in the fills on both up- and downstream sides by cables. The cables are attached to 1½-in. eyebolts set in the concrete 16 ft. apart vertically and 50 ft. apart horizontally.

A means of carrying up this core wall without staging on either side was devised by combining the staging with concrete forms and supporting them on completed sections of the work. The core wall is poured from the east end, where the concrete mixer is located, and whence the work progresses toward the west end. By the time the full length of each 16-ft. lift is completed the forms first placed are raised and the process is repeated. The bents or frames of 6x6-in. timbers that carry the track for concrete cars are placed 9 ft. 9 in. apart and are attached to the concrete by ¾-in. bolts which extend entirely through the core wall and project on each side. These bolts are left in the concrete when the bents are raised. Between the timber bents built-up panels, 4 x 9 ft. 3 in. in size, are used, held in place by ordinary tie wiring. Planks carried at two levels alongside these panels are useful as staging from which carpenters can work on the forms. Forms for the enlarged sections that occur every 50 ft. at vertical joints are not alike in successive tiers and have to be built up independently of the standard form.

Concrete for the core wall is supplied by a mixing plant close to the core wall trench on the east abutment. At this point the hillside has a uniform slope and as the wall is carried up, the mixing plant will be moved up the hill; the plant was built up on skids in three sections to facilitate the moves, of which there will be three. A 1:2:4 mix is used in the core wall and also in the bypass tunnel lining which was supplied from the same mixing plant. Cement, sand and crushed rock for the concrete are delivered to the mixer by means of an incline from bins on the hillside above the dam level.

Both the dry fill and hydraulic sluice material is being taken entirely from the western bank. The sluicing pits are upstream from the dam and the borrow pits in which the steam shovel works are on the downstream side. When the present work started some 80,000 cu.yd. of rock was already in place on the downstream toe of the dam, this material having been dumped within predetermined limits as it was mucked from the 18-mi. tunnel whose portal is only a few hundred feet distant. The steam shovel began work at a level 65 ft. above the lowest point in the dam and by dumping on the upstream edge of the existing tunnel dump widened it until the upper edge of the fill came close to the core wall.

A small hydraulic monitor is used for washing down fine material from the upper face of this dry fill whence



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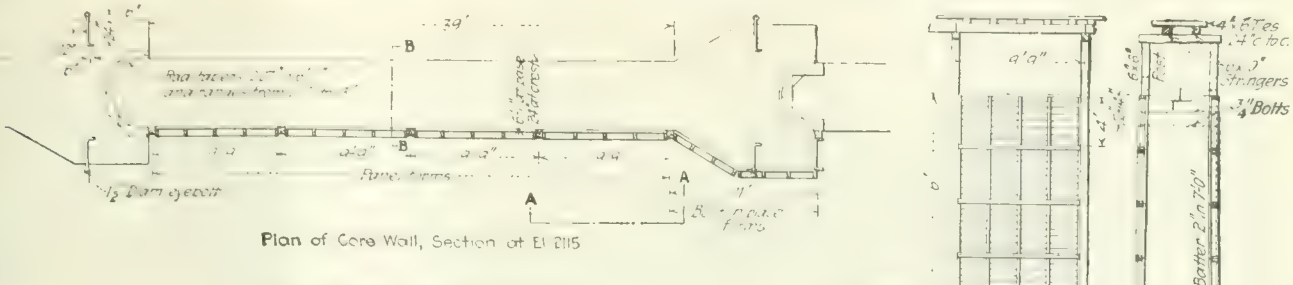


FORMS FOR THE CORE WALL

it lodges the fines against the downstream face of the core wall in the form of well compacted layers. This feature of the construction program is very successful, the fine material is readily washed out by a jet directed downward from the top of the fill and the water remains in a pool against the core wall long enough for the material in suspension to deposit. That the downstream fill is sufficiently porous is shown by the fact that this sluicing water readily seeps through to the downstream toe whence it may be caught in the natural stream bed and used again, should any water shortage develop.

With the first level of the dry fill completed, the plan is to have the steam shovel make an inclined bench cut up which it can move to a new borrow pit level 35 ft. higher. From this new level tracks will be carried along the sidehill and thence at the same level on a trestle 35 ft. high entirely across the dam and supported on the portion of the dry fill already placed. When the material dumped from this trestle reaches track height the track will be moved over onto the fill and by dumping along the upper edge, the fill will be widened until the toe of the slope again reaches the core wall. Sluicing down the upper face of this fill will be continued and as the fines are washed down the level of the deposits against the downstream face of the core wall will be built up.

This program will be continued to the top of the dam, the fill on the downstream side being regulated so as to be equal to or slightly ahead of the fill on the upstream side of the core wall, which will always be saturated. Four levels for the steam shovel work and the three trestles, the last two trestles each being 22½ ft. high, will be required to carry the dry fill up to the prescribed height.

Water for sluicing operations is pumped from a pool maintained above the dam and is delivered through a 14-in. wood stave pipe line tapped by 12-in. laterals. The main line extends about 1,000 ft. from the pump house to a point on the hillside above the dam where five laterals are taken off at suitable levels for sluicing material down a 5 per cent grade to five successive trestle heights on the dam. The sluicing water is delivered by a pump which is direct-connected to a 500-hp., 440-volt motor. The pump, which was built especially for this work, has only one stage and operates at 1,800 r.p.m. with a rated delivery of 4,250 gal. per min. under a head of 350 ft. For auxiliary sluicing and other water supplies on the work, a smaller pumping unit in the same plant delivers 600 gal. per min. under a 250-ft. head.

From the sluicing pits material is carried in flumes to a trestle along the upstream face of the dam whence distribution is effected by laterals as desired. A crew of about six men with shovels is required to keep the upstream face of the fill shaped up to the desired slope, These men stake a 2x12-in. plank on edge to mark the limit of each successive fill in accordance with the slope predetermined by surveys. When sluiced material has piled up against the plank to the desired height, the delivery is continued through some other lateral while the men shovel material from the inside over the plank to smooth off the outer slope. The plank is then raised 1 ft. and moved back from the slope to carry up the next step.

The dam was designed under the direction of M. M. O'Shaughnessy, city engineer of San Francisco. W. A. Kraner designed the construction layout and is supervising construction for the city.

Seepage from Earth Canals in Texas

By W. F. Heath

San Benito, Tex.

TESTS for seepage and evaporation in one of the canals of the San Benito (Texas) Irrigation District indicate 92 per cent of the total loss is seepage and 8 per cent evaporation. Spread over the whole district these losses amount to nearly 1 acre-ft. per acre over the total 60,000 acres of irrigable land in the project, half of which is in cultivation. The cost of pumping and delivering this extra water is small compared with the damage done to the land, a large portion of which has become alkaline and unfit for cultivation. Even land still in brush has become "salted."

Two methods of preventing seepage are suggested; lining the canals and constructing drains on each side of the canals. The first is expensive but would reduce the seepage to a minimum; the second would not reduce the seepage but would minimize its harmful effects.

From the logs of many borings the soil is found to be deposited with a top layer of silt, 2 to 5 ft. deep, a second layer of clay, 4 to 9 ft. deep and a third layer of quicksand of indefinite depth. It has been noted that seepage water travels on top of the clay stratum gradually working to the surface with its load of dissolved alkali, most of which is common salt.

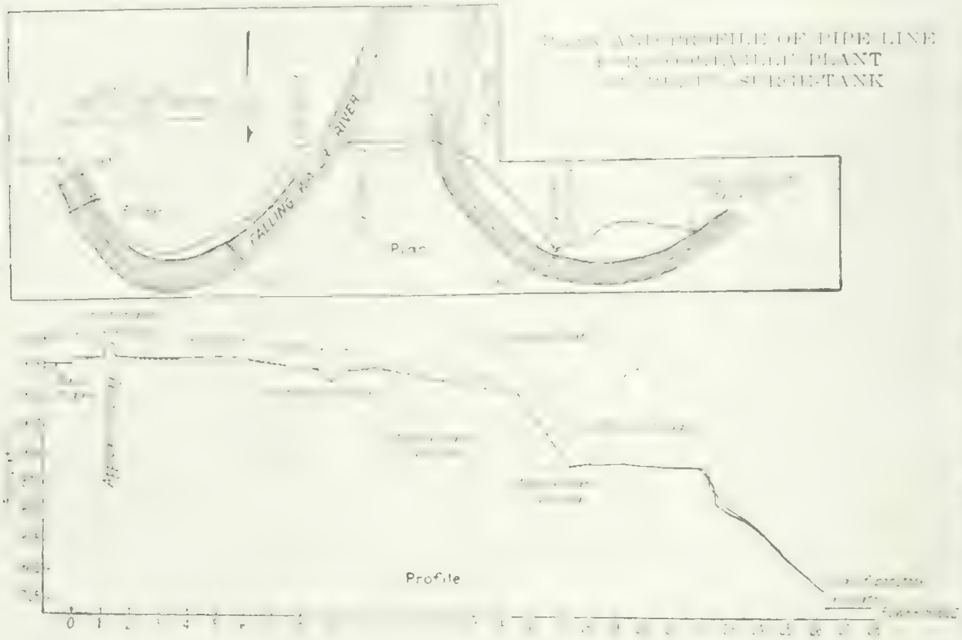
In canals in which the borrow pits extend down into the clay and are connected with main drains very little trouble is experienced from seepage, but for many of the older laterals the earth to make the levees was taken from the center and no borrow pits were made. The harmful effects of seepage are more apparent in land adjoining these laterals.

In the design and building of earth canals with the idea of making the effects of seepage the least harmful in this district the wetted perimeter should be made as small as possible and drains having a good grade and connecting with main drain ditches should be built each side of the lateral, extending well down into the clay.

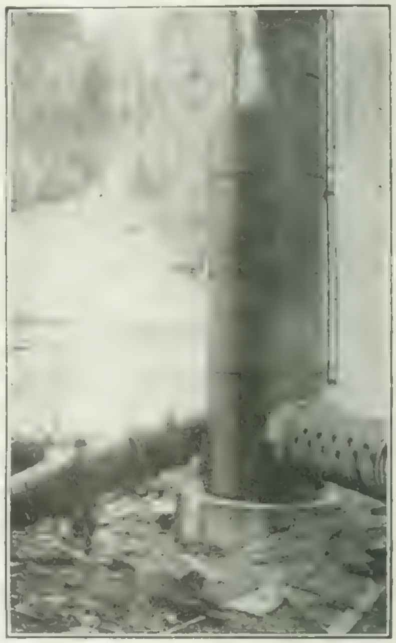
Small Municipal Hydro-Electric Plant in Tennessee

Cookeville Installs 450 Kw. Station With Concrete Dam and Long Wood Pipe Line Crossing River on Suspension Bridges

THE city of Cookeville, Tenn., having a population of less than 3,000, has recently completed the building of a hydro-electric plant embodying some unusual features. As an example of a small waterpower development, designed and built along modern lines, it is of more than local interest.



PLAN AND PROFILE OF PIPE LINE [illegible] PLANT [illegible] SURGE-TANK



The plant is located on Falling Water River, a creek having a minimum discharge of but 12 sec.-ft. Within a distance of one mile, the stream has a fall of approximately 200 ft. In making the preliminary study of the project, it was found that by twice crossing the stream on suspension bridges, and tunneling an intervening bluff, the length of the penstock could be reduced to half a mile.

EARTH AND CONCRETE DAM [illegible] FT. HIGH [illegible]

The penstock is a 30-in. wood-stave pipe, built by the Continental Pipe Co., of Douglas fir, and its length is 2,631 ft. The head works consist of a dam, 26 ft. high and 310 ft. long, approximately one-half being concrete, of gravity section, and one-half of earth, with concrete core-wall. The dam creates a very valuable storage, being located at the head of the series of falls which intervene between dam and power house, and causing back-water three miles long.

From the dam, the penstock is laid (on concrete cradles where firm foundation was not available) along one bank of the stream to a point about 1,000 ft. from the dam, where a 45 deg. turn leads onto the first suspension bridge. The span of this bridge is 238 ft., and leads directly into the tunnel. The tunnel, driven on a 10 per cent grade, and terminating in a 40-deg. horizontal curve, is 285 ft. long, driven through solid limestone rock. From the lower portal, the penstock enters immediately upon the lower suspension bridge, of which the span is 167 ft. long. On this bridge the pipe makes a vertical reverse-curve, entering nearly horizontally, and leaving horizontally, 40 ft. lower. The bridges carry a load of 400 lb. per lin.ft. The cables were furnished by the A. Leschen & Sons Rope Co. The design of the bridges is quite simple as shown in the views. The two main cables are $1\frac{5}{8}$ in. diam. and the suspender rods are $\frac{3}{4}$-in. rods, with channel-iron floor beams carrying timber stringers.

From the lower suspension bridge for a distance of another 500 ft., the pipe follows the bank of the river, here reaching the brink of Burgess Falls, which has a sheer drop of 115 ft. On the brink, the penstock enters a steel surge tank, 6 ft. in diameter, and 120 ft. high, which is self-supporting. The penstock, leaving the surge-tank, plunges at an angle of about 35 deg. down the gorge to the power house, 550 ft. beyond, and 120 ft. below the base of the surge-tank. For a part of this

THE TWO SUSPENSION BRIDGES WHICH CARRY THE PIPE LINE

The lower bridge is shown at the left, the upper bridge at the right. These bridges are supported at one end by tower and at other by cable entering rock face. One 167-ft. span bridge has steel tower; other bridge, with 238-ft. span, has single concrete tower. From both bridges pipe enters tunnel in rock face of river bluff.

distance the penstock is supported in stirrups, hung by cables from above, on the side of the gorge.

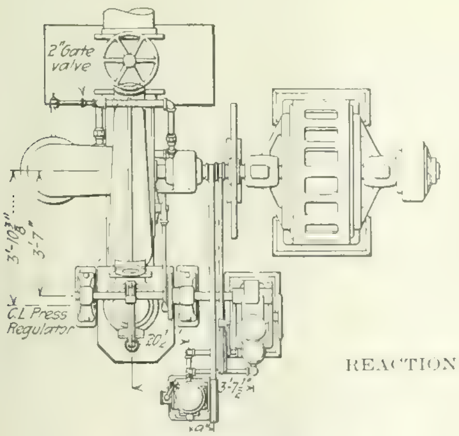
The tunnel was made just as small as it was possible to drive it. It is only 6 ft. wide, and for most of its length, less than 6 ft. high. It is in a hard limestone formation, and no shoring was needed. The wood-stave pipe is continuous, and so was built in place. Although the space in the tunnel is very cramped, there was no complaint from the workmen. There is barely room for one to edge his way through the tunnel, between the pipe and the walls, and he cannot walk through erect.

The hydrostatic head on the plant is 230 ft. The turbine is a horizontal, scroll-case machine, built by the Wellman-Seaver-Morgan Co., and it has the distinction of being the smallest wheel ever built by that concern. The runner is of bronze, 19 in. in diameter. The scroll-case is fitted with a relief valve, actuated by the hydraulic governor, both relief valve and governor being built by the Woodward Governor Co. Under the working head of 220 ft., the turbine develops approximately 650 hp. The relief valve, together with the surge-tank insure exceedingly close speed regulation—regulation not attained by many a hydro-electric plant of much larger output.

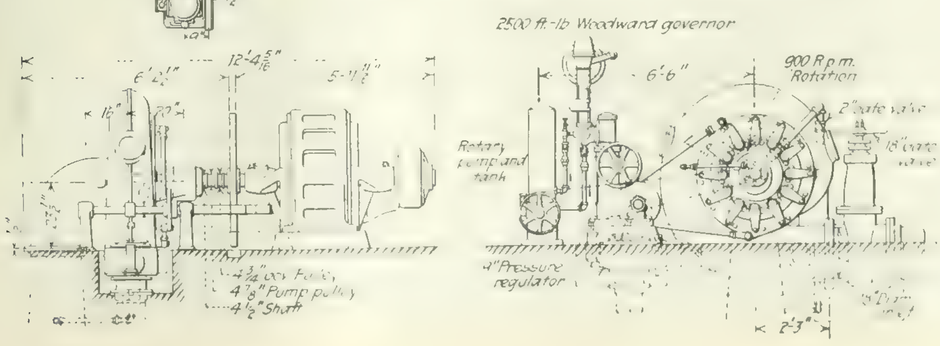
The plant is not automatic, but requires an attendant. Current is generated at 2,300 volts, and the windings are protected from lightning which might conceivably strike between the generator and the transformers by the 2,300-volt lightning arresters. Transmission is at 13,200 volts over a wood pole line 12 miles long. The transformers are placed on top of the cliff, 300 ft. above, and about 400 ft. away from the power house. Since all bearings are ring-oiling, the plant could very well be run without an attendant, except for the possibility of the opening of the circuit-breaker.

The power house is of steel and measures only 18 x 20 ft. It is amply large to house the single unit now installed. The foundation is of solid concrete, on solid rock foundation. The tailrace has a smooth concrete bottom, which insures minimum tailrace loss of power. There is not a stick of wood about the power house, as walls and roof are of steel, and the windows are steel sash.

The plant is designed to permit the future installation of a second unit, when the demand for power shall require. However, when it is considered that the present plant displaces a steam-electric plant of 75-kw. capacity, a 450-kw. plant looks to the people of Cookeville like an exceedingly dignified hydro-



REACTION TURBINE OF 650 HP. CAPACITY FOR COOKEVILLE PLANT



electric development! The total cost of the plant was about $110,000, divided as follows:

Cost of power site and reservoir area	[illegible]
Machinery, including turbine and governor, generator, Tirrill regulator and switchboard	20,000
Twelve-mile transmission line, including transformers and lightning arresters	[illegible]
Construction of dam, pipe line, tunnel, suspension bridges, surge-tank, power house, valves, sluice gate and trash-rack, and engineering service	35,000

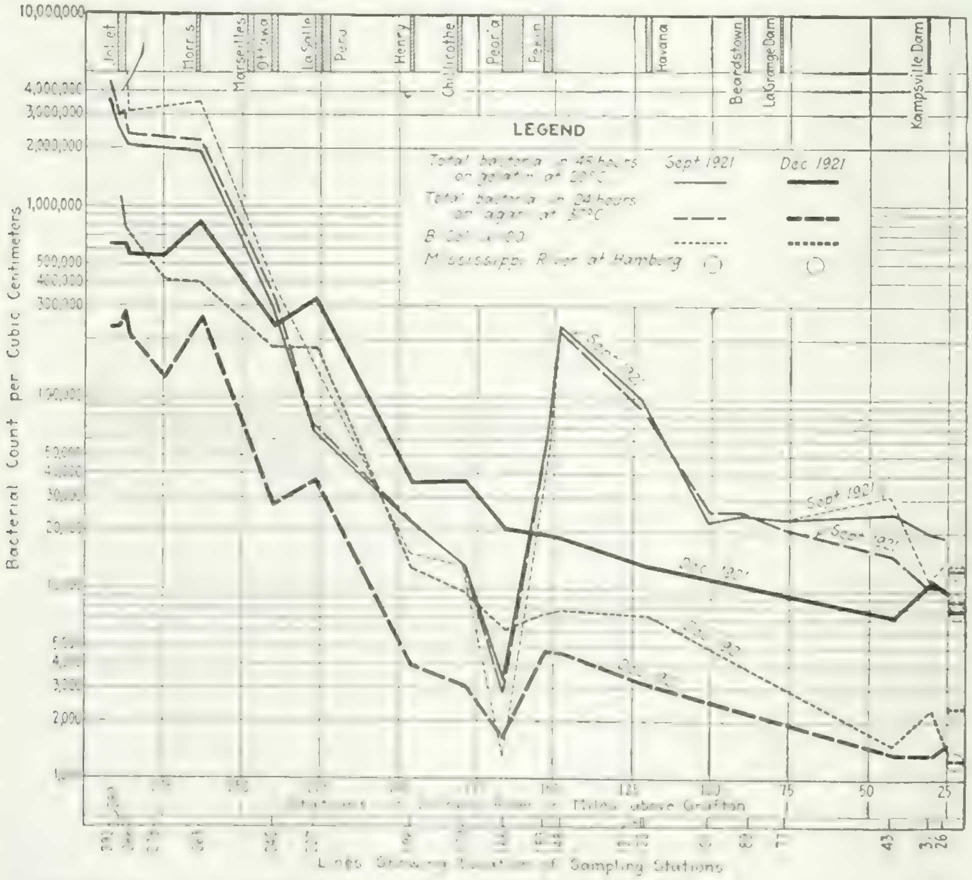
The plant was designed by J. A. Switzer, and built under his supervision. On his advice, all bids for the building of the plant were rejected, and the plant was built on force-account, under the superintendence of T. O. Hudson. The total cost of the plant was approximately 15 per cent less than the lowest bid received.

Studies of Natural Purification on the Illinois River

Public Health Service and Chicago Sanitary District Maintain Joint Laboratory—Summer Death Rate of Germs High

By J. K. Hoskins
Sanitary Engineer, U. S. Public Health Service

Bacterial pollution of the Illinois River and the Mississippi River at the mouth of the former are approximately equal. Upstream on the Illinois the winter and summer variations of pollution as measured by bacterial counts, dissolved oxygen and oxygen consumed



COMPARISON OF SUMMER AND WINTER BACTERIAL CONDITION IN ILLINOIS RIVER

are decidedly marked. These are some of the results coming out of the studies of pollution and natural purification of the Illinois River made by the U. S. Public Health Service in co-operation with the Sanitary District of Chicago. For such study, which is a continuance of the work done on the Ohio River, the Illinois River affords exceptional advantages by reason of its considerable length—nearly 300 miles—the gross pollution in its upper reaches immediately below the outlet of the Chicago Drainage Canal and its freedom from further considerable pollution except in the vicinity of Peoria, thus presenting long stretches in which the operation of natural agencies of purification may be observed. A further consideration of great importance is that for some years the Sanitary District of Chicago has carried on most thorough studies of the amount and character of the wastes discharged into the Drainage Canal and is thus enabled to furnish basic data which must otherwise be collected at great expense.

The study of the Illinois River was organized as a separate unit of the general organization for stream pollution investigations under the division of scientific research of the Public Health Service with an advisory board consisting of three consultants; Langdon Pearse, sanitary engineer of the Sanitary District of Chicago, Dr. E. O. Jordan, professor of bacteriology of the University of Chicago, and Dr. Stephen A. Forbes, chief of the State Natural History Survey of Illinois, and professor emeritus of University of Illinois, representing the fields of sanitary engineering, bacteriology and fresh water biology, respectively.

Headquarters and a main laboratory for the field studies were established early in 1921 at Peoria, located midway between the headwaters and mouth of the river. Three branch laboratories were equipped at Joliet, Beardstown and Kampsville, points to which samples can be delivered promptly from practically any section of the river. These laboratories, with the exception of the one at Beardstown, were operated for a full year, to record the effect of seasonal and other changes that might modify the phenomena of purification.

The bacteriological examination comprised total counts on gelatin at 20 deg. and on agar at 37 deg. C. and quantitative estimates of B. coli by fermentation tests. The most important item in the chemical examination is the determination of the dissolved oxygen present in each sample by immediate titration and of the biochemical oxygen demand as calculated from the oxygen loss in five days of incubation at 20 deg. Centigrade.

Since it appears that in studies of this character the value of frequent elaborate chemical analyses is not sufficient to justify their expense, composite samples covering a period of ten days and preserved with sulphuric acid are used for determinations of total nitrogen, free ammonia, Kjeldahl nitrogen, nitrogen oxides and oxygen consumed. Samples of

bottom sediment and of water from the surface and from mid-depth are collected regularly from selected stations for macroscopic and microscopic biological examinations, involving the measurement and identification of plankton forms.

In addition to the laboratory field work, supplementary observations of stream flow have been made in co-operation with the U. S. Geological Survey to determine the daily flow of the Illinois and all important tributaries. The times of flow from point to point throughout the river were calculated from stream flow data and cross-sectional areas taken from the river bed contour maps of the U. S. Army Engineering Corps.

During the summer months the total bacterial counts on agar at 37 deg. (24 hours) immediately below the drainage canal ranged from 2,000,000 to 5,000,000 per cubic centimeter, whereas in the winter months they have ranged from 100,000 to 300,000 (monthly averages). Since the volume of the Illinois River at stations 292-286 (see chart) is nearly constant, this indicates a wide seasonal variation in the total bacterial content of the sewage of the Sanitary District. Similar seasonal variations are noted in the gelatin count and B. coli. This is in accordance with observations at Cincinnati and Louisville on the Ohio River.

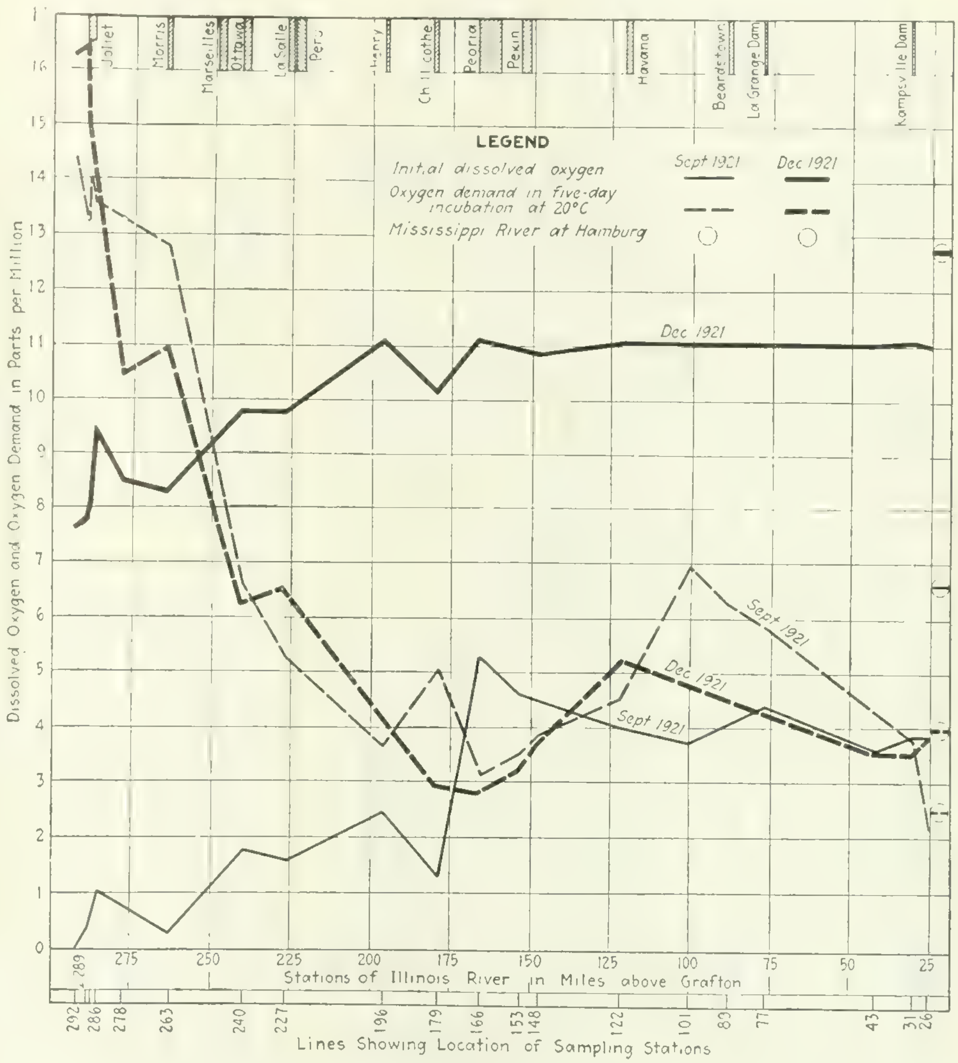
During the summer months the 20-deg. gelatin and the 37-deg. agar counts throughout the river are approximately equal, but with the onset of winter they diverge, the agar counts becoming much smaller than the gelatin counts. This likewise is in accordance with observations on the Ohio River.

The decrease in bacterial content from the outlet of the Drainage Canal to station 166, immediately above Peoria, is at all times very great, and is practically parallel in the agar count, the gelatin count and the B. coli. The decrease is absolutely and relatively much greater in summer than in winter. Dilution by tributaries is a very small factor in this decrease, which is largely due to death of the bacteria. From a bacteriological standpoint the river immediately above Peoria is not highly polluted—not more so than many streams draining rural sections.

The pollution resulting from wastes received in the Peoria district is very considerable in summer and the decrease below this point, though steady, is less rapid than in the upper half of the river.

In the upper river the oxygen demand greatly exceeds the supply as represented by the dissolved oxygen content, but in passing downstream from Joliet to Peoria the dissolved oxygen progressively increases and the biochemical oxygen demand decreases until the former exceeds the latter at a point well above Peoria, establishing an "oxygen balance." In summer the extent of oxygen recovery in passage through Peoria Lake (a large body of wide shallow water between stations 179 and 166) is remarkable; in winter it is less marked but noticeable. Below Peoria the oxygen demand increases gradually to a point just above Beardstown, with, in summer, a corresponding decrease in dissolved oxygen and a reversal of the oxygen balance. Although a distinctly measurable increase in oxygen demand below the urban district of Peoria is to be expected, this gradual increase over a distance of 50 miles is not yet fully explained.

As to observations so far made upon the Illinois River, it is impossible to correlate them in any fundamental way with observations on the Ohio, until they have been more thoroughly analyzed in relation to time-intervals, temperature and amounts of polluting wastes involved, but so far as may be judged at present the two sets of observations appear to check rather closely, justifying the expectation that, when taken together, they will give fundamental information regarding the laws of natural purification.



OXYGEN CONTENT SEPTEMBER AND DECEMBER SHOWS RATE OF RECOVERY

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

For Students and Practicing Engineers

REVIEWED BY O. H. AMMANN
Assistant Chief Engineer, the North River Bridge Co., New York City

A PRACTICAL TREATISE ON SUSPENSION BRIDGES: Their Design, Construction and Erection—By D. B. Steinman, A.M., C.E., Ph.D.; Consulting Engineer; M. Am. Soc. C.E., M.A.R.E.A.; formerly Professor in charge of Civil and Mechanical Engineering at the College of the City of New York. With Appendix: Design Charts for Suspension Bridges. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Limited. Cloth; 6 x 9 in.; pp. 204; 62 line cuts and halftones. $4 net.

The suspension bridge has received rather scant treatment in modern bridge literature, although it is one of the oldest and in some respects most meritorious types of bridge. This is explained partly by the fact that since the passing of the suspension bridge era few engineers have had the opportunity to become thoroughly acquainted with it and partly because it presents more complex and changeable economical and structural problems than other types. The appropriate degree of rigidity and safety, the most suitable type and proportions of the stiffening system, wire cables versus chains, are questions which admit of a wide range of opinion and will probably always remain in dispute. The publication of Dr. Steinman's book should therefore be welcomed as helping to revive interest in a type worthy of greater appreciation.

In the short space of 200 pages the author has covered the technical part of the subject with fair completeness, by confining himself to the most essential theory and to a concise discussion of the most important elements and details of design and construction. The book is therefore a useful manual, especially for the student or young engineer, who however, as he advances in his studies, will be obliged to consult more specialized books on theory and construction. For this reason a bibliography on suspension bridges would have enhanced the value of this book.

The reviewer would also have liked to see the purely technical and scientific side of the subject supplemented by considerations on the aesthetic value and treatment of suspension bridges. Bridge engineering still is, and ought to be, regarded as an art in the loftiest sense of the word, and the suspension bridge in particular offers opportunities for giving expression to that higher phase of bridge designing. The student and young practicing bridge engineer, for whom this book is primarily intended, cannot be too early and too strongly inspired with the value and necessity of beauty in bridge building as a manifestation of the human soul; and unless he is so inspired, he will find himself sooner or later second to his more idealistic colleague, the architect.

The book is divided into four chapters, the first and largest of which is devoted to the theory of stresses. In so far as it applies to the system of a cable with independent stiffening truss, the theory is complete, concise and easy of application, besides being supplemented by useful charts (in an appendix) which reduce the work of calculating stresses to a minimum. The author has properly selected a combination of analytical formulas with graphic influence lines as the most convenient and lucid form for determining the stresses.

The suspended truss or braced cable is treated very scantily. It is true that its treatment is, in the main, identical with that of the rigid arch. There are, however, certain influences, such as the anchorage, backstays, and towers, which call for modifications. The inclusion of typical influence lines and simplified formulas for quick preliminary proportioning of the suspended truss would have placed that type on a par with the stiffened cable and would have added to the usefulness of the book by helping the student in the study and economic comparison of the two types.

The theory in this book has quite properly been confined to that of the rigid structure, and reference is made to various treatises on the more exact theory of the flexible structure. Emphasis should have been laid upon the fact that the latter theory is indispensable in the final proportioning of more important bridges, so as to impress upon the mind of the student that he has to deal with a flexible structure, and that economic advantages may be derived by treating it as such. The French engineers fully recognize this fact in the construction of their semi-rigid types.

The second chapter describes and compares the various types of suspension bridges, their economic proportions and important details of construction. It is clear, concise and up-to-date, but here again the author has foremost in his mind the cable with independent stiffening truss. The economic proportions given apply almost exclusively to that type. Moreover, it should be emphasized that the best proportions are dependent upon so many variable factors—such as character and ratio of live load, relative strength and cost of materials, stiffening system, width of bridge, etc.—that any values based on certain assumptions can be only roughly approximate and that careful studies are necesary in each particular case. For this reason the reviewer would have preferred to see an outline of the fundamental conditions upon which the economic proportions are evolved, rather than the dictum of rules of limited applicability.

The author places the economical span limit of the suspension bridge for highway purposes as low as 400 ft., and thereby accords it, with full justification, a much wider field of application than is generally conceded by bridge economists, who limit its usefulness to spans of 1,000 ft. and over.

The author discriminates against the eyebar chain by the assertion of unequal stress distribution in the individual bars, and the unqualified statement that measurements have revealed such inequality to the extent of from 40 to 200 per cent variation from the mean stress. Such conditions, if general, would condemn not only chains for suspension bridges, but eyebar chords in trusses as well, yet such chords are generally conceded to be the safest members in a bridge. It is unthinkable that, in a properly designed chain, made with modern accuracy in workmanship and uniformity of material, the variations in stress can exceed a small fraction of the total stress. Certainly the same degree of uniformity cannot be realized in wire cables.

The third chapter illustrates in a few examples the

practical application of the theory of the subject and is thus helpful to the student. Instead of proceeding on the basis of given proportions and sections, it might perhaps have been more instructive to illustrate the evolution of a design from its inception, the preliminary dispositions and necessary modifications.

The fourth chapter is devoted principally to the erection of wire cable bridges, for which experience has furnished ample material. Brief consideration is also given to the erection of eyebar chains, for which, however, no modern data are available, since the only two prominent modern chain bridges, built in Europe, have been erected on falsework, a procedure which destroys the economic advantage of the chain bridge.

The book is illustrated with photographs and line drawings of a number of suspension bridges, built and designed, and their principal details. It can be recommended as a textbook for students and also as a reference manual for practicing engineers, who will find in it much useful material made readily available.

Construction Costs

Reviewed by Charles F. Dingman
President, Palmer Construction Co., Palmer, Mass.

HANDBOOK OF CONSTRUCTION COST—By Halbert Powers Gillette, Editor *Engineering and Contracting*, M.Am.Soc.C.E., M.A.A.E. New York: McGraw-Hill Book Co. Flexible binding; 5 x 7 in.; pp. 1734; illustrated. $6.

To one who has made more or less constant use of Gillette's "Handbood of Cost Data" since its publication in 1910 his newer work, entitled "Handbook of Construction Cost," is indeed a valuable acquisition. The new work, as is stated in its preface, is in no sense a revision of the earlier book but may more properly be called an extension of it. So we now have available two rather crowded volumes of data covering almost every conceivable kind of a construction operation.

While several pages of instructions are given as to the methods to be used in taking off quantities from plans, and in computing the necessary amounts of materials and applying unit costs, the volume could hardly be used as a textbook by one who was attempting to learn the science of estimating. Its field of usefulness is rather in the hands of the experienced construction-estimator who can, from a study of the plans, specifications and site of the work, determine the extent of all necessary operations to complete a given project. Such a man should be able to select, from the numerous separate operations reported, and the wealth of detail given in almost every instance, the information which is applicable to his present problems and, by making proper adjustments, deduce estimated unit costs that should closely approximate final actual results.

Like the earlier book, this one does not attempt to formulate a series of tables covering the possible daily or hourly production per man, per team, or per machine, on various individual operations. In fact, it is doubtful if it would be practicable to do so in view of the wide range of work covered by its contents. It does, however, record, with complete descriptions of local conditions, information as to wage-rates and material prices, the actual results obtained upon hundreds of operations, ranging from unloading stone from cars to the complete replacement of an old pile trestle by a new plate-girder bridge, the work being done under traffic.

Perhaps the most valuable chapters in the book are the first two, Engineering Economics and Prices and Wages. If contractors could be induced to pay more attention to the study of such principles as are laid down in these two chapters it is not likely that *Engineering News-Record* would have been able to report, as it did early this year, that 40 per cent of all the construction companies in the country made no net profits in 1921. Of these chapters, the first points out the distinctions between different classes of estimates and the principles that should govern their preparation and also calls attention to many items that may seriously affect the total cost of doing work and that are, nevertheless, given scant attention or no attention at all in preparing estimates. The second chapter contains a mass of statistical information having a bearing on or relation to the rise and fall of material-prices and wage-rates, from which are deduced a wage-level formula and a price-level formula that make it possible to calculate, with reasonable accuracy, the money costs that will apply at a given time.

One criticism that might be made is that the type-size is much too small for convenient reference or for quick searches through the contents for particular information. This, however, seems unavoidable, since it would no longer be a "hand-book" if the same amount of matter were printed in very much larger type.

Odors and Their Travel Habits

Reviewed by Robert Spurr Weston
Consulting Engineer, Boston, Mass.

SMELL, TASTE, AND ALLIED SENSES IN THE VERTEBRATES—By G. H. Parker, Sc.D., Professor of Zoology, Harvard University. [Series on Experimental Biology and General Physiology.] Philadelphia and London: J. B. Lippincott Co. Cloth; 5 x 8 in.; pp. 192; 37 illustrations. $2.50 net.

Prof. Parker discusses the nature of the organs of smell and taste, and their interrelation. He also gives the results of the latest researches into their anatomy and physiological functions. While the book has been written for readers interested in the biological sciences, it is of particular interest to engineers interested in odors and their travel habits.

There are two classes of substances which produce nasal stimulation, namely, irritants which act on the free ends of the trigeminal nerves and true odors which act on the terminals of the olfactory nerves. Certain irritating gases like ammonia have no true odor; a perfumed "smelling salt" may both irritate and produce an odor; such substances as the essential oils produce odors without irritation. Many tastes are really odors. Thus it is well known that vanilla cannot be "tasted" when the nose is held and the odoriferous particles are prevented from coming in contact with the olfactory region located behind the upper turbinated bone on each side of the nose, a region only about 6.2 sq.cm. in area. Many odors are not smelled because "sniffing" is usually necessary to bring the odoriferous particles in contact with the well-protected nerve ends On the other hand, certain substances may be detected when in extreme dilution,—as 0.00004 mg. of artificial musk in 1 liter of air.

Odors are classified by various systems of adjectives and their intensities as "detectable," "faint," "noticeable," "strong," and "very strong." It is interesting to note that the average concentration of various chemicals required to produce the effects described by these five adjectives vary in an almost true geometrical progression whose multiple is two.

Considerable attention is paid to the rapid fatigue of

the olfactories which explains why an all-night traveler in an emigrant coach smells nothing disagreeable in the morning and why new odors, like those produced by a newly-introduced industry, become less offensive as one becomes better acquainted with them.

Equally well treated is the sense of taste, although this sense is not particularly interesting to engineers. Each chapter contains a bibliography and the book should prove the best introduction to the study of these two senses.

General Relativity and the Engineer

REVIEWED BY GEORGE PAASWELL
Construction Engineer, New York City

THE THEORY OF GENERAL RELATIVITY AND GRAVITATION. Based on a Course of Lectures Delivered at the Conference on Recent Advances in Physics held at the University of Toronto in January, 1921. By Ludwik Silberstein, Ph.D. New York. D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 137. $2 net.

Dr. Silberstein's little book presents a mathematical treatment of relativity and is thus a difficult medium for the initial study of the theory. Taken in conjunction with, say, Eddington's "Space, Time and Gravitation," it furnishes a rather complete treatment of the subject. Though the engineer is not directly interested in theories of the structure of the universe, as is the scientist, he must find great profit in the development of a theory that promises a rational explanation of molecular action, since it is to the latter that one must look for the ultimate explanation of stress-strain relations.

Have Newtonian mechanics been superseded by Einsteinian mechanics? As a universally true interpretation of cosmic phenomena, yes. Several of the motions of the planetary system have never been explained by Newton; relativity has offered an explanation. Newtonian mechanics have failed to explain molecular phenomena; relativity mechanics give an explanation in complete harmony with experiment. In our everyday scientific work, on the other hand, Newton will continue to reign supreme, giving a plausible and completely satisfactory explanation of our ordinary static and dynamic phenomena. This apparent contradiction has a parallel in the fact that, despite the curvature of the earth, we are content in our local measurement to treat our restricted plot as a plane surface.

Briefly stated, relativity postulates that one cannot determine motion with reference to an absolute. Nature successfully thwarts our every attempt to determine such relative motion. All measuring or reference systems are thus purely relative and of equal value. Special or restricted relativity states simply that we cannot measure uniform motion with respect to the ether. This is a direct consequence of the failure of the Michelson-Morley experiment to determine such relative velocity. Since there must be some motion of the earth relative to the ether, the only explanation (Fitzgerald contraction) is that our measuring devices change in length with their relative motion.

To appreciate this strange effect, one must attempt a philosophic digression, and admit that our space and time distinctions are purely subjective. To a particle in motion there are four possible component directions, all of equal value, no one of which has any peculiar attribute. These are, forward and backward; up and down; before and after; right and left. Granting this four-co-ordinate location of a particle, we gravitate naturally to a conception (mathematically only) of four-dimensional space. Our senses cannot, of course, perceive such a space-time, but the Michelson-Morley experiment, as explained by the Fitzgerald contraction, shows that different sections of suggested space-time give different length measures, just as different sections of a three-dimensional body give varying cross-sections. In other words, our limited senses perceive this space-time in various three-dimensional sections only, and not as a four-dimensional entity. So much for the philosophy of relativity; the rest is essentially pure mathematics.

The fundamental postulates of the space-time are: (1) The interval of measurement between two events (corresponding to the distance between two points in our space) is the same no matter what reference system is used; this is merely an extension of our three-space invariant. (2) The velocity of light is the same to all observers, no matter in what system they are; the converse of this would permit the determination of the absolute motion. These two assumptions give sufficient data to build up the mathematics of this space. The Fitzgerald contraction leads to the Lorentz equations of transformation from one reference system to another. (When it is noted that the corrections to a length are of an order v^2/c^2 where v is the velocity of the moving body and c is that of light, it is seen how infinitesimal the correction is for the usual velocities other than electro-magnetic.) As a consequence of this relationship the four-dimensional space of relativity must satisfy conditions that do not make it a natural extension from our familiar Euclidean space but lead to what may be termed a hyperbolic space. Thus, in a natural extension of Euclidean space the element of length would be $ds^2 = dx^2 + dy^2 + dz^2 + dt^2$, while in the space required by relativity this length is given by an extension of the hyperbolic form $ds^2 = dt^2 - (dx^2 + dy^2 + dz^2)$.

General relativity removes the restriction of uniform motion and states that it is impossible to detect any form of motion, accelerated or uniform, with respect to an absolutely fixed reference frame. With the illustration of a falling elevator, one can substitute an accelerated reference system for the gravitational force. That is, in a field where there is no gravitation, one could, in a small portion of it, move a closed box along with an accelerated motion that would give every indication of gravity to those within it, and occupants of the box would have no way of distinguishing between true gravitation and the accelerated system. Gravitation effects are thus brought within the province of relativity by this principle of equivalence, and demonstrate that force fields themselves are but relative.

The fundamental postulates of general relativity are again: (1) The invariance of the space-time "interval" between two "events," and (2) the requirement that particles travel along a type of line called a geodesic, which is merely a line with the extended characteristic of three-dimensional space, "the shortest distance between two points." Thus the geodesic in a plane is a straight line; on a sphere, it is a great circle. These geodesics are themselves independent of any co-ordinate system. Such independent functions are termed invariants. These independent or invariant postulates lead to a form of differential element of interval which characterizes the space, whether free or in the presence of matter (a field of force). The relations between the coefficients of the differentials give

the new and general law of gravitation, in a brief symbolic form. Just as in two-dimensional surface the element of length is given by an expression $ds^2 = a\,dx^2 + b\,dx\,dy + dy\,c\,dy^2$ so in this four-dimensional "surface," the element of "length" is given by the ten-term expression $ds^2 = \Sigma g_{ik}\,dx_i\,dx_k$, where the summation extends over the values of one to four for both i and k and $g_{ik} = g_{ki}$. The relations between these quantities g form the general law of gravitation and determine the "curvature" of the new space, just as the relations between a, b and c determine the curvature of the two-space.

From approximations to the general gravitation or curvature symbols there are determined the expressions for the curvature of the light ray around the sun and the motion of the planet Mercury, which has received experimental confirmation. It is interesting to note that for small velocities the equations degenerate into the familiar Newtonian equations, in itself a satisfying confirmation of the validity of the Einstein formula.

The relations show that mass and energy are interchangeable (already proven in molecular electro-magnetic phenomena) and lead to a philosophic explanation that matter and energy are expressions of the way our senses perceive the curvature of the real space-time. Newton has given no explanation of matter and energy. Einstein attempts one.

A general knowledge of the nature of relativity and its methods, to the extent outlined in the preceding, should become part of the engineer's mental armament even though he makes no use of relativity conclusions in his practical work. Silberstein's book may be recommended to him as a guide in acquiring this knowledge, though as stated at the outset it is difficult.

Webb's Railroad Construction Revised

RAILROAD CONSTRUCTION: Theory and Practice—By Walter Loring Webb, M.Am.Soc.C.E., M.A.R.E.A., Assistant Professor of Civil Engineering (Railway Engineering) in the University of Pennsylvania, 1893-1901. New York: John Wiley & Sons, Inc. Flexible Binding; 4¼ x 7 in.; pp. 845 including two hundred pages of logarithmic tables; halftones and line cuts. $5.

Railroad engineers are so familiar with "Webb" that it is quite unnecessary to describe in detail the vast extent of ground that it covers. The seventh edition contains numerous corrections and revisions to make it conform to the decisions at the recent conventions of the American Railway Engineering Association. The more important of these are in the chapters and relate to the subjects mentioned below. In Chapter III, shrinkage of embankments and the subsidence of subsoil; VIII, the laws governing the life of ties and the development of substitutes for wooden ties; IX, present status of rail specifications, testing, life of rails, failures, intensity of pressure, and rail wear; X, rail joints and causes of failure; XII, water tanks and the principles of their construction; XIII, yards and terminals —which chapter was almost rewritten; XVI, train resistance, resistance of cars and switches; and a new chapter, XXV, which deals with static and dynamic stresses in track, rails, ties, and ballast.

South American Experiences of an Engineer

SIX YEARS IN BOLIVIA: The Adventures of a Mining Engineer —By A. V. L. Guise. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 243; halftone plates. $7.

Superintendence of a tin mine, building a road and rebuilding a suspension bridge, transporting steel plates and other metal work and machinery for a dredge over the mountains and down torrential streams, erecting the dredge and finally operating it in a gold dredging enterprise that did not pan out supply the background for this interesting book. The volume contains much about the life, work, laziness, whims and superstitions of native Indians, as also about men and women of other nationalities encountered in Bolivia and Peru. Native animals, vegetation, foods and drinks are also described. Good halftones are effectively used. The book is a worthy addition to the reminiscences of other mining engineers noted in these columns within the past two or three years. It raises anew the question: Why do not civil engineers do more such autobiographical writing as has been so ably done by mining engineers of late?

Completion of a Brilliant Work

THE OUTLINE OF SCIENCE: A Plain Story Simply Told—Edited by J. Arthur Thomson, Regius Professor of Natural History in the University of Aberdeen. With 40 Colored Plates and 800 Illustrations in Black and White [in the entire four volumes]. Vol. IV. New York and London: G. P. Putnam's Sons. Cloth; 7 x 11 in.; pp. 867-1194. $4.50 a volume.

The brilliant style and interesting subject matter that have characterized the earlier portions of this work continue throughout the concluding volume. (The earlier volumes were noted in these pages as follows: I, July 20, p. 115; II and III, Oct. 19, p. 666). The fourth volume opens with a notable chapter on Bacteria by Sir E. Ray Lancaster. Sections follow on The Making of the Earth and the Story of the Rocks, the Science of the Sea, Electric and Luminous Organisms, the Lower Vertebrates, The Einstein Theory, Biology of the Seasons, What Science Means for Man (by Sir Oliver Lodge), Ethnology, Domesticated Animals, The Science of Health and Science and Modern Thought (the latter by the Editor). A classified bibliography and an index to the entire work close the volume.

It will be seen that the same illogical arrangement of contents as was noted in our review of Vol. II and III continues to the end, but this does not lessen the interest of the work nor materially affect the value of the subject matter, since the real function of the four volumes is to lead as many people as may be out of the humdrum of daily life and the ruts of specialization.

The section on the Einstein Theory seems well suited to give the general reader a fair conception of the nature of the theory. The article on The Science of Health deals admirably with personal hygiene. At least a few paragraphs on public health might have been of great influence and value.

The broad conceptions of science presented by Sir Oliver Lodge, and also by the editor in his concluding chapter, deserve wide reading by all who, like the engineer, are in danger of being blinded by specialism. And right here is one of the chief elements of value of these four volumes: They afford that larger view, not merely of science, but of life and humanity as well, that is essential to the rounding out of a man and the continued stimulus against mental stagnation which all specialists need, be they engineers, chemists, manufacturers, merchants or farmers. To have produced 1,200 pages of text and illumined the text with 800 illustrations, all well designed and wrought to serve the purpose of awakening, informing and leading on to more detailed reading all classes of scientists and "the man in the street," is an achievement deserving the chorus of commendation for Professor Thomson and his associates that has been raised by "The Outline of Science."

Material Handling

REVIEWED BY HAROLD T. MOORE

Industrial Engineer, Day & Zimmerman, Philadelphia

BELT CONVEYORS AND BELT ELEVATORS—By Frederic V. Hetzel, M. Am. Soc. M. E., M. Franklin [illegible]. New York: John Wiley & Sons, Inc. Cloth; 6 x 9 in.; pp. 333; halftones and line cuts. London: Chapman & Hall, Ltd. $5 (25s. net).

My acquaintance with the author of this book dates from 1901-03 when I was employed as a draughtsman by the Link Belt Co. and Mr. Hetzel was chief draughtsman. Later, Mr. Hetzel became chief engineer of the company named, which position he held for thirteen years. His outstanding qualifications include thoroughness and a remarkable memory for facts, figures and formulae, with a genius for analyzing and solving in a practical and economical way all problems in material handling and conveying. He is, therefore, eminently qualified to write authoritatively on the subject of this volume.

His new book is a thorough and practical treatise and presents for the general use of engineers and manufacturers specialized information and working formulae which are not included in trade catalogs and not widely known outside of the material-handling field. The book covers recent developments in both American and European practice. The information is impartially presented with no "axe to grind" and points out the merits of equipment for a particular service without attempting to boost the product of any favorite manufacturer.

The principles and reasons underlying the design, applications and service of belt conveyors and belt elevators for different classes of materials are fully discussed. The book is well illustrated with detail drawings, photographic views and charted curves. Tables of sizes, capacities, power consumption and other useful data are present in convenient form for engineers or manufacturers who have handling problems to solve. The text is concisely written, with frequent cross-referencing as well as mention of other sources of information. The book is a worthy and useful contribution to current technical literature.

The Municipal Bridge of St. Louis

THE MUNICIPAL BRIDGE OF ST. LOUIS: A Record of Municipal Effort. By William E. Rolfe, Associate to the President of the Board of Public Service, St. Louis, and Lucius H. Cannon, Librarian, Municipal Reference Library. St. Louis: Public Library. Paper; 7 x 10 in.; pp. 32; 1 halftone and 1 line cut. 15c.

When a great engineering structure is finished, those for whom it is built and who may naturally be expected to have the most pride in it more commonly ignore and forget about its noteworthy character than record the fact. There was a commendable habit, in years gone by, to issue a descriptive monograph upon the completion of a great bridge or dam or similar work of engineering skill. In recent years the custom has died out, but the authorities of the city of St. Louis have revived it with the issuance of a modest little pamphlet entitled "The Municipal Bridge of St. Louis: A Record of Municipal Effort." The authors, William E. Rolfe and Lucius H. Cannon, confine themselves to a bare matter-of-fact listing of the tedious chain of events from the first conception of the project of a "free bridge" to the final completion of its approaches—long after the bridge itself had been erected. The pamphlet is worth the attention of at least three classes of men: Bridge engineers, because the great double-deck spans of this structure mark one of the forward steps of the bridge constructor's art; municipal and other public service engineers, because of the complex problem of planning for both highway and railway service which the case presented; and all persons interested in civic progress, because there has rarely been so striking a case of the long continued wrestling of a large city with a railroad problem where all the corporate railroad interests were arrayed against the municipal purpose. There is a profound lesson in the case, too, in the fact that after this ambitious project to kill off the railway charge on all passengers and freight for crossing the Mississippi River, the so-called "bridge arbitrary," the charge is still maintained, and the project in this respect is apparently a failure. But it is likely that the bridge will live to fulfill its mission nevertheless.

Brown's Gas Directory Enlarged

BROWN'S DIRECTORY OF AMERICAN GAS COMPANIES and Gas Engineering and Appliances Catalog: Statistics of Gas Companies in the United States, Canada, and the more important companies of Mexico and South America; also Collected, Consolidated and Standardized Cataloged Data of Gas Equipment, Appliances and Supplies, with Indexes of Both Firms and Products — 1922 Edition. Compiled, Edited and Published Annually by Robbins Publishing Co., Inc., C. E. Reese, Editor, New York City. Cloth; 9 x 12 in.; pp. 966. $10; $7.50 to gas companies.

To the well known Directory, published annually since 1887, there has been prefixed what the publishers aptly describe as a catalog of catalogs containing needed information "about the products of every important manufacturer selling to gas companies," with the "material arranged systematically" and cross-indexed. This catalog fills about half of the volume. There follows statistical and descriptive information, with names of officials, of city gas plants, by-product coke-oven plants, and natural gas companies. Holding and operating companies are next inserted, after which come financial reports for the holding and operating companies and for manufacturing companies in the larger cities; the personnel and meeting dates of (1) state utility commissions and (2) gas associations. The volume concludes with a consolidated membership of all the gas associations, alphabetically arranged. The work as a whole is creditable. The only addition we would suggest is a reasonable amount of summary of the gas statistics, partly by states and partly by character of works and equipment.

Lecture Material on Water Supply

A LITTLE BOOK ON WATER SUPPLY—By William Garnett M.A., D.C.L., Formerly Fellow of St. John's College, Cambridge. Cambridge: University Press. Cloth; 6 x 9 in.; pp. 144; halftones and line cuts.

Outside England, and perhaps within, the chief value of this book seems to lie in its condensed descriptions of the existing water-supply systems of London, Birmingham, Manchester and Glasgow, and its historical accounts of the water supplies of London and of ancient Jerusalem. Besides presenting material relating to specific water supplies, the author outlines the main elements of a water-works system, including sources and modes of supply, water treatment, pumping plants, reservoirs and distribution systems, and gives some idea of the factors affecting quality. The object of the volume is educational, both general and in public hygiene. It seems to go into detail unnecessary to either purpose and to be inadequate as regards the relations between water supplies and public health and out of date as to some of the examples of notable water-

works cited. Thus, the two Croton aqueducts and the New Croton Dam are described, but the far more notable Catskill Aqueduct and reservoirs, in use now for a number of years, are not mentioned.

Publications Received

New Books and Revised Editions

THE BUILDING LABOR CALCULATOR—By Gordon M. Tamblyn. Denver, Colorado: G. M. Tamblyn, flexible binding containing 58 loose-leaf sheets. $5; monthly service $5 extra.

Tables of constants, generally including examples for computing the cost of labor in all principal building operations, such as excavation, carpentry, masonry, concrete work, interior finish, heating and plastering. The monthly service offered at an additional charge affords a constantly growing and revised note book on building labor costs.

THE CONTROL OF QUALITY IN MANUFACTURE—By George S. Bradford, Consulting Engineer, M.Am.Soc.M.E., Society of Naval Architects and Marine Engineers, Society of United States Naval Engineers. New York: Ronald Press Co. Cloth; 6 x 9 in.; pp. 404; illustrated. $5.

DIE BISHERIGEN ERGEBNISSE DER HOLZPRUFUNGEN IN DER MATERIALPRUFUGSANSTALT AN DER TECHNISCHEN HOCHSCHULE STUTTGART—Von R. Baumann. Berlin: Julius Springer (for the Vereins deutscher Ingenieure). Paper; 8 x 11 in.; pp. 139, with portfolio of plates.

DIE TRAGFAHIGKEIT DER PFAHLE—Von Dr.-Ing. Heinrich Dörr, Karlsruhe. Berlin: Wilhelm Ernst & Sohn. Paper; 7 x 10 in.; pp. 68; 61 figures in the text.

ERFAHRUNGSERGEBNISSE ÜBER TROCKENBAGGERBETRIEBE: Verwendungsfähigkeit der heute gebräuchlichsten Trockenbaggergeräte und Transportmittel für den Kanal- und Eisenbahnbau und die Erfahrungssätze, die sich aus dem Vergleich der unter den verschiedensten Verhältnissen arbeitenden Trockenbaggerbetriebe ergeben—Von Dr.-Ing. Joachim Rathjens. Zweite neubearbeitete Auflage. Berlin: Wilhelm Ernst & Sohn. Paper; 9 x 12 in.; pp. 128; halftones, line cuts in text and folding plates.

Experience with a variety of equipment for the handling of heavy earthwork in the dry is here reviewed by a construction engineer of twelve years' service with various canal and railroad construction enterprises. The book is divided into three sections, of which the first describes the ordinary plant for dry excavation treating, (1) of the construction and capacity of various types of plant, (2) of the appropriate transport equipment and (3) special equipment for the handling of spoil. The second section presents in graphic and tabular form analyses of progress and cost data for various types of plant and the third section is devoted to a co-ordination and comparison of the data presented in the second part.

HANDBUCH FÜR EISENBETONBAU—In Vierzehn Banden.—Herausgeben von Dr. Ingeniur F. Emperger, Oberbaurat, Regierungsrat in Patentamt in Wien. Zehnter Band: Die Künstlerische Gestaltung Der Eisenbetonbauten. Bearbeitet von E. Von Mecenseffy. Dritte Neubearbeitete Auflage. Paper; 7 x 10 in.; illustrated, chiefly with halftones.

Rewritten and enlarged edition of a unique illustrated review of the artistic development of reinforced-concrete construction.

HISTORY OF THE BARGE CANAL OF NEW YORK STATE—By Noble E. Whitford, Assoc.M.Am.Soc.C.E., Senior Assistant Engineer, State Engineer's Department. Albany, N. Y.: State Engineer and Surveyor. Cloth; 6 x 9 in.; pp. 610; halftones.

HÜTTE. Hilfstafeln zur (1) Verwandlung von echten Brüchen in Dezimalbrüche. (2) Zerkegung der Zahlen bis 10,000 in Primfaktoren—Herausgegeben vom Akademischen Verein Hütte E. V. Third Edition. Berlin: Wilhelm Ernst & Sohn. Paper; 5 x 7½ in.; pp. 83.

INTRODUCTION TO THE CALCULUS—By William F. Osgood, Ph.D., LL.D., Perkins Professor of Mathematics in Harvard University. New York: Macmillan Co. Cloth; 5 x 7½ in.; pp. 449; illustrated. $2.90.

An enlarged revision of the author's "First Course in the Differential and Integral Calculus," published in 1921, "intended alike for the engineer or the physicist and for the student of pure mathematics," but essentially a college textbook.

THE MECHANINCAL HANDLING AND STORING OF MATERIAL—By George Frederick Zimmer, A.M.Inst.C.E. New York: D. Van Nostrand Co. Cloth; 8 x 11 in.; pp. 804; halftones and line cuts. $15.

QUESTIONNAIRE AND SCORE CARD APPLICABLE IN CHOOSING A COUNTRY PROPERTY—By Dr. William Paul Gerhard, Consulting Sanitary Engineer, 17 West 42nd St., New York City. Paper; 5 x 7 in.; pp. 11. 30c.

SEAGOING AND OTHER CONCRETE SHIPS—By N. K. Fougner, C.E., M.Am.Soc.C.E., Medlem Norsk Ingenieur Forening, Assoc.Inst.N.A. London: Henry Frowde & Hodder & Stoughton. Cloth; 6 x 10 in.; pp. 216; halftones and line cuts. Postpaid, 22s. American price, $7.

SICHERUNGSANLAGEN IN EISENBAHNBETRIEBE—Auf Grund gemeinsamer Vorarbeit mit Dr.-Ing. M. Oder, weiland Professor an der Technischen Hochschule zu Danzig, verfabt von Dr.-Ing. W. Cauer, Geh. Baurat, Professor an der Technischen Hochschule zu Berlin. Mit einem Anhang Fernmeldeanlagen und Schranken von Dr.-Ing. F. Gerstenberg, Regierungsbaurat, Privatdozent an der Technischen Hochschule zu Berlin. [Handbibliothek für Bauingenieure Herausgegeben von Robert Otzen.] Berlin: Julius Springer. Boards, cloth back; 7 x 10 in.; pp. 459; 484 figures in text and 4 folding plates.

An exhaustive review of modern practice in railroad signaling and safety appliances, including telephone service. Special emphasis is laid upon German practice, although there are included also brief descriptions of the characteristic features of foreign installations. The book is richly illustrated with line drawings and photographs that present in the greatest detail the various devices that enter into the signaling system.

STORES AND MATERIALS CONTROL: Including Procurement by Manufacture and by Purchase—By Madison Cartmell, A.B., Consulting Industrial Engineer, Assoc.M.Am.Soc.M.E., Member National Association of Cost Accountants. New York: Ronald Press Co. Cloth; 6 x 9 in.; pp. 459; line cuts. $4.50 net.

ZUR BESTIMMUNG STROMENDER FLUSSIGKEITSMENGEN IM OFFENEN GERINNE: Ein neues Verfahren—Von Dipl.-Ing. Oskar Poebing, Betriebsleiter des Hydraulischen Institutes der Technischen Hochschule München. Berlin: Julius Springer. Paper; 7 x 10 in.; pp. 56; 24 line cuts.

In what the author claims to be a new device for determining the flow of water in open channels the horizontal movement of a pivoted grid of small rods is recorded in terms of velocity.

Reports and Pamphlets in Various Fields

ANTISEPTIC TREATMENT OF SLEEPERS IN INDIA—By R. S. Pearson, C.I.E., Forest Economist. Technical Paper 231, Office of Chief Engineer (J. H. White) with the Railway Board, Simla, India. Paper; 8 x 13 in.; pp. 34; 1 diagram and 16 halftone plates. Rs. 1-4, from Superintendent Government Printing, 8 Hasting St., Calcutta, India.

That preservative treatment of railway ties in India will in a few years become an established industry is the author's prediction, based on ten years of experimental work with various timbers and processes. Creosote, petroleum oils, arsenic and zinc chloride with creosote were applied in open tanks and under pressure. Full-cell treatment is advocated in preference to open-cell treatment.

ASPHALTIC PAVING MIXTURES: Their Materials and Proportioning with Details of Plant Inspection—By W. J. Emmons, Professor of Highway Engineering, Agricultural and Mechanical College of Texas. College Station, Tex.: Texas Engineering Experiment Station. Paper; 6 x 9 in.; pp. 46.

BUDGETING FOR BUSINESS CONTROL—By Arthur Lazarus, Chief of the Cost Accounting Bureau, Fabricated Production Department. Washington, D. C.: Chamber of Commerce. Paper; 6 x 9 in.; pp. 51.

Gives reasons for budgeting, general methods and specific examples, the latter from operating concerns.

THE CHARACTER AND FUNCTIONING OF MUNICIPAL CIVIL SERVICE COMMISSIONS IN THE UNITED STATES—Report of the Committee on Civil Service Governmental Research Conference of the United States and Canada. William C. Beyer, Chairman, Committee on Civil Service, 1417 Sanson St., Philadelphia, Pa. Paper; 6 x 9 in.; pp. 103.

A general survey of American Civil Service Commissions, their powers, method of selecting members; with notes on civil service control abroad and employment administration in private industry and a recommended plant for reconstituting civil service commissions.

COMMERCIAL STATISTICS, 1921—Compiled by Statistical Division, Board of Engineers for Rivers and Harbors. Washington, D. C., Chief of Engineers, U. S. A. Paper; 6 x 9 in.; pp. 1326.

DEPRECIATION OF PUBLIC UTILITY PROPERTIES: Its Relation to Fair Value and Changes in the Level of Prices—By Henry Earle Riggs, M. Am. Inst. Consulting Engineers, M.Am.Soc.C.E., etc., Professor of Civil Engineering, University of Michigan. New York and London: McGraw-Hill Book Co. Cloth; 6 x 8 in.; pp. 211. $2.

FINANCIAL STATISTICS OF CITIES HAVING A POPULATION OF OVER 30,000: 1921—Washington, D. C.: Bureau of the Census. Paper; 9 x 12 in.; pp. 157.

FINANCIAL STATISTICS OF STATES, 1921—Washington, D. C.: Bureau of the Census. Paper; 9 x 11 in.; pp. 41.

Covers 30 of the 48 states (others failing to report); gives receipts and expenses, assessed valuation, taxes levied, indebtedness and assets; contains analyses by state departments.

IRRIGATION CANAL HEADWORKS—Lahore, India: Public Works Department, Irrigation Branch. Paper; 8 x 13 in.; pp. 19; folding plates of line drawings.

Designed for the guidance of officers in the Punjab Irrigation Branch; text by F. V. Elsden, executive engineer.

IRRIGATION PRACTICE AND WATER REQUIREMENTS FOR CROPS IN ALBERTA—By W. H. Snelson, A.M.E.I.C., Senior Irrigation Specialist. Ottawa, Ont.: Reclamation Service. Paper; 7 x 10 in.; pp. 59; line cuts, halftones and insert.

MANUFACTURED GAS, 1919—Washington, D. C.: Bureau of the Census. Paper; 9 x 12 in.; pp. 25.

MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH: Report for 1920-21—Boston. Cloth; 6 x 9 in.; pp. 386.

PAPERS ON HIGHWAY SUBJECTS—Before the Recent Conference on Education for Highway and Highway Transport Engineers, as follows: (1) Co-operation versus Competition between Motor Truck and Railroad Transportation, by W. H. Lyford, Vice-President, Chicago and Eastern Illinois Railway, Chicago. (2) Highways and the Taxpayer, by A. J. Brosseau, President, Mack Trucks, Inc., and Member of Highways Committee, National Automobile Chamber of Commerce. (3) Sending the Highway to School, by George M. Graham, Vice-President, Chandler Motor Car Company, and Member Highway Committee, National Automobile Chamber of Commerce. (4) Text Books and Overalls, by C. C. Hanch, Vice-President, Lexington Motor Car Company and Vice-President, National Automobile Chamber of Commerce. Reprinted as separate pamphlets by the National Automobile Chamber of Commerce, Inc., 366 Madison Ave., New York City. An abstract of Mr. Lyford's paper appeared in *Engineering News-Record*, November 30, page 933.

RESISTANCES TO THE TRANSLATION OF MOTOR VEHICLES—By T. R. Agg, Highway Engineer, Iowa Engineering Experiment Station and Professor of Civil Engineering, Iowa State College. Ames, Iowa: Engineering Experiment Station. paper; 6 x 9 in.; pp. 32; halftones and line cuts.

An account of methods and results of traffic resistance tests made at Ames, Iowa, up to the beginning of active field work in 1922. An article by Prof. Agg on this general subject appeared in *Engineering News-Record*, Dec. 7, 1922, p. 982.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

More on Comparative Heights of Dams

Sir—Those responsible for the Barcelona Company's work have always considered the Camarasa Dam second to the Arrowrock. The greater height recently claimed and discussed in your columns is based on measurements to the bottom of the cutoff ditch—about 97 meters (318 ft.). The height to the crest from the general level of the sloping bedrock is about 92 meters (302 ft.).

If the height from the lowest point of the cutoff ditch were to be accepted as a measure of the real height of a dam, the Talarn dam of the same company is still higher, this distance being over 104 meters (341 ft.); the dam is actually about 84 meters (276 ft.) from crest to general level of bedrock, and has never been claimed to be more than fifth among the higher dams of the world.

The accepted height of a dam should be that measurement, usually from the crest to the general level of base, which determines the computation of maximum stresses. A measurement to the lowest point of a cutoff or to the bottom of a pothole is hardly acceptable as a fair basis of comparison.

Mexico, D. F., Dec. 4. A. W. K. Billings.

(Permanent address, Toronto, Ont.)

[First it should be noted that in the article by Mr. Ranney, noted below, which is largely the basis of the previous discussion of the general subject of dam heights, Mr. Billings is given as advisory engineer on the Camarasa Dam.

Earlier figures and discussions of this subject may be found in *Engineering News-Record* of the present year, as follows: Aug. 17, pp. 260 and 280, (1) article on the Camarasa Dam, by Willis Ranney, engineer of construction, and (2) review of seventh edition of Wegmann's "Dams"; Nov. 2, pp. 728 and 758, (1) editorial on "How High Is a Dam," and (2) letter from Edward Wegmann, "Which Is the Highest Dam"; Nov. 30, p. 946, letter from D. W. Cole, formerly engineer on the construction of the Shoshone and Lahontan Dams, U. S. Reclamation Service, entitled "A Dam Is as High as It Dams," in which Mr. Cole suggests two standards, "extreme height" and "effective height."

Mr. Billings sends cross-sections and profiles (not reproduced here) of the Camarasa and Talarn Dams, in Spain, discussed in his letter. From these and from a legend on a small cross-section in Mr. Ranney's article it appears that the extreme height of the Camarasa Dam (crest to the lowest point in the excavation, which is beneath the downstream side or the toe of the dam) is 101.6 meters or 333.33 ft. There is no similar legend on the Talarn drawings, but as nearly as can be scaled the height from the crest to the "bottom line of final upstream cutoff wall trench for sealing off dam foundation" is 106 meters or about 347.75 ft. Mr. Billings seems to have taken the general level of this cutoff wall instead of the lowest point as the base from which he computes his "over 104 meters (341 ft.)." The extreme height of the Arrowrock Dam was reported as 351 ft., when under construction; Wegmann gives it as 348.5; the latest report of the U. S. Reclamation Service gives it as 349 ft. The parapets are variously reported as 4 ft. high. The parapets of the Camarasa and Talarn Dams appear to be 3 to 4 ft. high. The parapets are not included in the extreme heights just given.

It would appear that (using Mr. Cole's "double standard") in "extreme height" the Arrowrock Dam is very closely followed by the Talarn, while in "effective height" the Talarn is well in the lead of Arrowrock, whatever its relation may be to other dams.

As to Mr. Billings' advocacy of "general level of base" as the datum of a dam, what is "general level"? Is it a mathematical average, and if so of what?

The whole matter of relative height comes back, as we said in the editorial already mentioned, to the purpose of the comparison, from which viewpoint there may be several heights for any one dam. When comparisons are attempted it is essential that the standards be the same.

Finally, anyone who will carefully examine the drawings of a number of dams, will be surprised to find how difficult it is to take off dimensions for accurate comparisons of their heights by the various standards that may properly be used. This is likely to be true of drawings made in one office at or near the same time. When many offices and dates are involved the difficulties and uncertainties become even greater.—Editor.]

Hoboken Water Rates Not Increased

Sir—Referring to an item in your issue of Dec. 14, p. 1043, headed "Higher Water Rates in Hoboken for the Hackensack Water Co.," may I ask you to kindly make the following correction:

The item states that the New Jersey State Supreme Court has referred back to the Board of Public Utility Commissioners of that state for revision upwards of a rate decision estimated to produce $913,785 of revenue in Hoboken for the Hackensack Water Co. This is incorrect. The figure mentioned is the estimated gross annual revenue for the entire system of the Hackensack Water Co. to be derived from rates fixed by the Board in its order and decision dated June 30, 1922, based on an average for the years 1920-21. The system embraces 46 municipalities, including the City of Hoboken.

Following the decision of the Board, dated June 30, 1922, the company appealed to the State Supreme Court, asking for an upward revision of rates for all districts except the City of Hoboken. The Hoboken rate was not involved in the appeal or in the decision. Waldo S. Coulter,

New York City, Dec. 16. Consulting Engineer.

Wire-Mesh Fencing Helps to Check Erosion

Sir—The article entitled "Bridge Protected from Shifting Channel" on p. 884 of the Nov. 23 issue of *Engineering News-Record* has an especial interest, as I had a very similar problem where a river was cutting away the bank, around a similar bend, immediately above a railway bridge consisting of two 100-ft. spans; the only difference being that the channel was of gravel formation instead of alluvial soil. By building flexible log-crib groins on top of a brush and wire mattress, laid on bed of river, an eddy was set up during flood time which caused a deposit of silt and boulders, thus rebuilding the eroded portion of the bank. On the earthwork approaches to the bridge, riprap and derrick rock originally were laid, but, as in the case mentioned in above article, this soon disappeared, having been carried away by the flood. I then laid a mattress of No. 9 woven-wire fencing (which is supplied in rolls about 60-in. wide) with brush for a foundation, and built up boulders and derrick rock on top of this to riprap the upstream side of the embankment. I completed the work by stretching similar wire fencing along face of riprap. This successfully withstood the action of flood as the material was all held in place by the wire, and the undermining of the foundation was checked by the mattress.

I have, with complete success, used the same type of wire fencing where the action of river had started to undermine foundations; and I note in your issue of June 8, 1922, p. 946, that in "Fighting the Mississippi Flood at Oldtown," the erosion of levees was finally checked by using 1-in. mesh chicken wire covered with two layers of cotton bagging. This appears to emphasize the usefulness of flexible wire-mesh in connection with river work. Many of the failures recorded have been caused by use of heavy reinforcing wire which is not sufficiently flexible to adapt itself to the outline of the eroded surface.

I always keep on hand a supply of wire-mesh fencing where sudden flood damage is likely to occur and it has never failed to give satisfactory results in an experience of over fifteen years, especially when used in conjunction with brush, trees or branches.

Victoria, B. C., Dec. 7. R. W. Macintyre.

Air Photos as Plane-Table Sheets Aid Mapping

Sir—In his article, "Air Photos as Plane-Table Sheets Aid Mapping," in *Engineering News-Record* of Oct. 5, 1922, p. 552, Major H. C. Fiske makes the statement that the total cost of producing the map (covering 33 sq.mi.) which he submitted to you was about $1,500. We also find that a field party of 12 men was on the ground for 38 calendar days. This figures out at $40 per day, nearly, for the field party alone, and allows a daily average of $3.33 per man to provide wages, meals, accommodation and other field necessaries. It takes no account, however, of airplane work, plotting, drawing, printing and other essentiais.

As $3.33 per day for each man seems to be nearer to the minimum than the average for a survey party, and there appear to have been more men employed than the 12 already mentioned, not to mention the extras referred to above, the question your readers would like to have an answer to is: How can it be figured out that $40 per day will cover the *total* cost of such a survey? P. J. BARRY,

Winnipeg, Canada, Nov. 29, 1922.

[Mr. Barry's letter was submitted to Major Fiske, whose reply follows.—EDITOR.]

Sir—The object of my article which appeared in *Engineering News-Record* of Oct. 5 was to demonstrate, if possible, that the maps produced by our methods which included the use of aerial photographs are at least as good as, if not a little better than, the general run of maps prepared by ground methods alone and commonly accepted as standard. Costs were mentioned only to indicate that these are not excessive as compared with those of the old methods. With a view both to being brief and to keeping attention focused on the main object of the article, i. e., the generally satisfactory character of these maps, the large and important subject of costs was limited to one brief paragraph of only eight lines. When this paragraph is dissected it is clearly not consistent and since the point has been raised the seeming inconsistency should be explained.

The salaries paid the twelve men varied from $175 to $54 per month, the cost of subsistence being included in this amount. The party of twelve began work on the sheet in question on March 24 and finished on April 30, a period of 38 calendar days. The inference from the paragraph as written and published is clearly that these twelve men spent all of these 38 calendar days on this sheet and on this sheet alone. This inference is, however, not correct and I must apologize for not having been more explicit. As a matter of fact, the efficient prosecution of the field work of this party required, during this time, considerable field work to be done on other sheets at intervals by various members of this party. The published cost was figured from time actually spent by each member of the party on this particular sheet and was the equivalent of about 30 days (or a little less) for the entire party of twelve men. The total cost of about $1,500 includes then the total cost of the field work on this sheet, also the office costs and the estimated cost of the aerial work on these 33 square miles. The word "about" stands for a variation of something less than $100.

In order to forestall further queries it might be well to invite attention to the fact that in the December *Proceedings* of the American Society of Civil Engineers there appears a paper on this same subject by G. H. Matthes of this office in which, among other detail, he gives an estimate of cost of this work at $61 per square mile. The cost per square mile figured from my article in the *Engineering News-Record* comes to about $45.50. My article was written in June and relates to work done on one sheet prepared in March and April. Mr. Matthes' article was written in September and gave a summary of all the work done from the beginning up to that date. The work upon which he estimates is, we think, distinctly better than what we were able to do in April and more than justifies the additional estimated cost. At the same time we have no apologies to make for either the work or the estimate of April. The use of aerial photographs, etc., in map making is so new a process and so little experience along this line has yet accumulated that anything like an exact discussion of cost is difficult in the extreme. Such, at least, is the experience of this office and of other agencies, including some private concerns who have entered this field, with whom we have been brought in contact. But though costs may be variable it does not by any means follow that they are high as may be gathered from the following case.

Some time ago the chief engineer of the Alabama Power Co., having become interested in this subject, visited this office to learn in some detail what we had been doing along this line. He was so favorably impressed that he then sent some of his engineer assistants here to examine thoroughly into our methods, costs, etc. The final result is that this company is about to adopt the use of aerial photography in connection with the mapping of something like 500 sq.mi. of territory. I anticipate that this company will use substantially the same methods as those worked out last winter and spring on the Tennessee River. If this method is adopted by them it will certainly be because the officials of this company have satisfied themselves that they will in this way obtain a more satisfactory map at a smaller expenditure of time and money than could be secured by ground surveys alone, but I doubt if they would like to commit themselves to any advance estimate of actual cost.

To my mind a just conclusion at this time is that because of the newness of this method and the constant experiments which need to be tried out, cost discussions are for the present quite premature. Nevertheless, within the limits of the experience had on the Tennessee River we are satisfied that maps equal or superior to those made by ground surveys alone can be made quicker and cheaper by the use of aerial photographs. HAROLD C. FISKE,

Major, Corps of Engineers, U. S. Army.

Chattanooga, Tenn.,
Dec. 12, 1922.

Meters and Master Meters on Water-Works

Sir—Technical publications for the last few years have stressed the importance of metering the services on all water-works systems. This is an important subject and the writer firmly believes in 100 per cent metered systems.

The water-works fraternity, however, should be reminded occasionally of the metering of their supply lines. It recently was called to my attention that a western city voted a bond issue for over a half million dollars for improvements to its water-works system and the engineer employed to design this system had absolutely no record of the amount of water used by the city per day nor any information as to hourly or seasonal variations in the use of water. This information could have been obtained by means of a Venturi meter, a pitot tube or several other instruments. The cost of an installation of this kind could undoubtedly be saved, many times over, in the redesigning of the new system, if the data which would have been furnished by a Venturi meter had been available.

Water-works men should remember that their system is not 100 per cent metered until they can check the flow through their supply lines, and submains as well as services.

Salt Lake City, Utah, Dec. 5. C. E. PAINTER.

Test Duration of Fires in Various Occupancies

Experimental work has been begun at the Bureau of Standards to determine the length and intensity of fire exposure likely to occur in various occupancies, information needed for proper selection of the structural elements of buildings with regard to degree of fire resistance. The first test has been completed. It was made on a one-story brick and concrete building 16x30 ft. fitted up to represent office occupancy. In this case, temperature readings showed that the fire was somewhat more severe than a one-hour standard fire test. The influence of the dimensions of the room on intensity and duration may be studied more fully in further tests.

NEWS OF THE WEEK

New York, Desember 21, 1922

Await Advance Report of Coal Commission

Chairman Forecasts Drastic Proposals for Industry—Not to Mediate in Adjustment of Wages

Washington Correspondence

While Jan. 15 hangs over the President's Coal Commission like the sword of Damocles, it is believed that enough data can be analyzed to permit of a preliminary report that will have weight with the industry, as well as with the public. Machinery such as the commission must set up, is ponderous. It takes a long time to get it in working order, but, once in operation, a great deal can be accomplished in a short time. Chairman Hammond illustrates the situation by stating that the commission now is getting the "miners' eye," referring to the fact that some time must be spent underground before the human eye adjusts itself to the darkness of a mine. Then too, the efficiency of the commission, he admitted, has been improved since the members, latterly, have provided themselves with gas masks.

Chairman Hammond states most emphatically that the commission's report will not be a "wishy-washy affair." It will contain some rather drastic suggestions, as it is believed that bold surgery is necessary, if the source of the ills of the coal industry are to be reached.

Will Avoid Wage Mediation

It was emphasized by Mr. Hammond and by Dr. Smith, in verbal statements to the Washington correspondents on Dec. 16, that the commission will not undertake anything that can be interpreted as mediation in wage scales. That is the responsibility of the operators and the mine workers, it was said, and while the commission will use its moral influence to induce them to get together and will emphasize to both operators and mine workers the far-reaching consequences likely to follow another strike, it will do nothing more than to submit to Congress facts and conclusions.

Over-expansion in the coal industry, Mr. Hammond stated, is not confined to the producers. Both wholesalers and retailers, he declared, complain because there are too many engaged in the wholesaling and retailing of coal. This condition adds greatly to the burden that the consumer must bear, Mr. Hammond said.

Since the large number of organizations engaged in jobbing and retailing coal results in much duplication and the aggregate of needless overhead is large, it is not difficult to point out superfluous additions to the selling price, but it is difficult to suggest means whereby the eliminations can be made so that the wholesalers and retailers may be reduced in number.

Quebec Province Lets Contract for $12,000,000 Hydro Dam

The Provincial Government of Quebec has awarded a contract to the Quebec Development Co. for the construction of a dam at the Grand Discharge from Lake St. John, the headwaters of the Saguenay River, for the development of 200,000 electrical hp. The cost of the project is estimated at $12,000,000 and work will commence as soon as possible. It is expected that the work will consume two or three years.

According to an announcement made by Premier Taschereau of Quebec the Grand Discharge dam is the initial step in a large project for the development of 1,000,000 hp. of electrical energy.

50-Ft. Section of 12-Ft. Wood Pipe of Hydro Plant Collapses

The 12-ft. wood-stave pipe of the Salmon River plant of the Niagara, Lockport & Ontario Power Co. collapsed for a length of approximately 50 ft. on the evening of December 6. This collapse was caused by a large collection of surface ice on the screens at the pipe intake. There had been a strong wind during the day which had broken up the ice on the pond. Upon taking an extraordinary draft of load much of this ice was sucked under and lodged on the screens, causing the pipe to collapse.

A 6-in. air valve was located in the pipe within 200 ft. of the break. Telltales show that this valve opened, but evidently it was not large enough to relieve the suction.

Repairs were effected within a week. There was no interruption to service on the company's system.

Another Bridge at Minneapolis Is Being Planned

Minneapolis is planning construction of a new bridge over the Mississippi River, making the tenth public bridge over the river in the city. The structure will be of concrete, 2,800 ft. long, with approaches, and will extend from Cedar Ave. and Second St. on the west side to University and Tenth Aves., Southeast. Plans now being made by N. W. Elsberg, city engineer, provide for two main spans of 280 ft. each, and one 100-ft. span on each side, bent-and-beam construction to be employed for the rest of the length. The width will be 60 ft., including a 40-ft. roadway. The cost is estimated at around $900,000, and work will be done by day labor under direction of the city engineering department. Construction is expected to begin within a few months, and three years may be required for completion.

Plans have been completed, also, for a concrete bridge over Minnehaha Creek, at Nicollet Ave., to cost about $250,000. It will be 823 ft. long and 60 ft. wide.

Countervailing Duties on Cement Declared Against 10 Countries

Washington Correspondence

Although cement is on the free list of the new tariff act, the Treasury Department has declared countervailing duties on cement imported from ten countries. The action is in accordance with the proviso of the cement paragraph which reads:

"Provided, that if any country, dependency, province or other subdivision of government imposes a duty on such cement imported from the United States, an equal duty shall be imposed upon such cement coming into the United States from such country, dependency, province or other subdivision of government."

The countervailing duties, declared on the basis of the foreign tariffs set forth in the order, conversion to be at current rates of exchange, are:

Canada, 8 cents per 100 lb.; France, 0.60 paper francs per 100 kilos for rapid setting and 0.90 paper francs for slow setting; Germany, 0.50 gold marks per 100 kilos; Italy, 1.125 gold lire per 100 kilos for quick hardening cement and 1.75 gold lire per 100 kilos for other cement; Japan, 0.30 gold yen per 100 kin; Mexico, 0.01 silver pesos per kilo; Norway, 0.20 gold crowns per 100 kilos; Poland, including Danzig, 1,000 paper marks per 100 kilos; Sweden, 0.60 gold crowns per 100 kilos; British Virgin Islands, 3s. 9d. per 400 pounds.

Until the figures of imports since the new tariff act became effective Sept. 22 are made available the effect of the countervailing duties will be difficult to estimate. Compilation of imports has been greatly delayed. Unofficial reports to the Department of Commerce and the Customs Division of the Treasury Department regarding the volume of cement imports are conflicting. Several domestic producers have called attention to imports from Canada and the first countervailing duty ordered was directed against that dominion.

Kansas City Water Commission Held Illegal Body

By a decision of the Supreme Court of Missouri the Kansas City Water Commission, which was to have expended the proceeds of an $11,000,000 bond issue for extensions and improvement of the water supply, has been held to be an illegal body. The main contention was that the personnel of the board was named in the ordinance voted upon, thus permitting no choice on the part of the voters. An application of the commission to the City Council to authorize the sale of $2,000,000 worth of bonds to start the work has been held up for several months but the money was immediately made available when the court decision was handed down automatically putting the water-works back into the hands of the existing Fire and Water Board.

N. Y. Port Authority Seeks Aid of Commerce Commission

Following conferences between the Port of New York Authority and the Interstate Commerce Commission the latter body has summoned the twenty railroads entering the port to show cause why they should not co-operate with the Port Authority in carrying out its comprehensive plan for the unification of the port facilities.

Since its organization last spring the Port Authority has been developing plans for a co-ordination of the transportation facilities of New York harbor and has been trying to obtain the voluntary co-operation of the carriers in carrying out these plans. It now announces that it has exhausted its efforts in this direction and that it deems it necessary to invoke the assistance and co-operation of the I.C.C.

Hearings will be held at times and places to be designated by the commismission, after which it is expected that appropriate orders will issue. News reports indicate that the roads are not over friendly to the proposal and it is quite possible that the hearings may give rise to an open opposition.

Science Body To Hold Special Engineering Sessions

The Engineering Section of the American Association for the Advancement of Science, known as Section M., of which F. M. Feiker, vice-president of the McGraw-Hill Co., Inc., is chairman, has arranged a special program for the annual meeting to be held this year at the Massachusetts Institute of Technology, Dec. 26-30.

Speakers who will appear at this meeting and their subjects are:

Dr. J. B. Tyrrell, of the A.I.M.E., Toronto, Can., "Growth of the Mining Industry in Canada"; Dr. Ira N. Hollis, president of Worcester Polytechnic Institute, "Progress and The Engineer"; Dr. C. F. Scott, professor of electrical engineering, Yale University, "New Phases of Engineering Education"; and Harrington Emerson, of the F.A.E.S., "Prevention of Waste in Industry." This session will be held Friday afternoon.

In addition to the program for Section M a joint session has been arranged with Section K, (section on Social and Economic Sciences), for the evening of Dec. 29, at which Calvin W. Rice, secretary of the American Society of Mechanical Engineers and delegate to the recent International Engineering Congress at Rio de Janeiro, will deliver an illustrated lecture on engineering development in South America.

On the morning of Dec. 29, Section M and Section K will hold a joint session with a special group of speakers on the "Engineer's Relation to the Conservation of National Resources." The following is the program:

"Conservation and Industrial Waste," by John T. Black, State Health Commissioner, Hartford, Conn.

"The Federal Water Power Policy and its Results," by O. C. Merrill, secretary, Federal Power Commission, Washington, D. C.

"Conservation of Power," by William S. Murray, New York City.

"Problems of Flood Control," by Brig.-Gen. Harry Taylor, in charge of government flood control work, Corps of Engineers, U. S. A., Washington.

The Engineer in Public Life

W. A. STANFIELD

Topeka, Kans., selects the commissioner of its Water and Light Department by popular vote. In 1919 the electorate chose an engineer, W. A. Stanfield, for this post, and gave their endorsement of his 2-year administration of the department's affairs by re-electing him in 1921. Commissioner Stanfield was born in Topeka in 1876. He has come up to his present position through the ranks, having started work as machinist's apprentice at Lawrence, Kans., in the shops of the Consolidated Barbed Wire Co. In 1897 he became connected with the American Steel & Wire Co. of Joliet, Ill., and two years later went to Newport News, Va., as erecting engineer on government shops. After a period as testing engineer with the Santa Fe R.R., he helped organize the Machinist Electric Co., and served as mechanical engineer of that organization.

In his capacity as water commissioner Mr. Stanfield has been instrumental in securing the approval by a 6 to 1 majority of a $535,000 water and light bond issue. Under his administration the electric light and water departments have been consolidated and the city has built a 10,000,000-gal. per day filtration plant placed in operation this year.

Engineering Societies to Honor New Italian Ambassador

Prince Gelasio Caetani, Italian Ambassador to Washington and an engineer by profession, will be the guest of the American Engineering Council of the Federated American Engineering Societies at a dinner in his honor to be held in Washington on Jan. 12 in connection with the annual meeting of the council.

Plans have been made also for a dinner in honor of Prince Caetani to be tendered by the National Engineering Societies in New York probably late in February. The new ambassador was graduated from the School of Mines of Columbia University in 1903, after which he engaged in mining work in this country until he returned to Italy on the outbreak of the war.

C. A. Emerson, Jr., to Join Staff of Fuller & McClintock

C. A. Emerson, Jr., chief of the Engineering Division of the Pennsylvania Department of Health, has resigned his position to join the staff of Fuller & McClintock, consulting engineers, New York City, in an office to be opened in Philadelphia in January. Mr. Emerson has been with the Pennsylvania State Department of Health since 1910, as principal assistant engineer, acting chief engineer and chief engineer.

E. J. Kelly Elected Chief Engineer of Chicago Sanitary District

E. J. Kelly, South Park Commissioner, Chicago, and a consulting engineer, has been elected chief engineer of the Sanitary District of Chicago by the board of trustees. H. P. Ramey, acting chief engineer during the absence on leave of A. W. Dilling, the chief engineer, has been appointed assistant chief engineer. Edward F. Moore, Mr. Ramey's predecessor, has been made chief operating engineer.

Up to two years ago when Mr. Kelly retired from the position of chief engineer and entered private practice he had been in the service of the district in various engineering capacities for twenty-six years. In 1915 he was made assistant chief engineer of the Sanitary District of Chicago and in that year was appointed a member of the Illinois Waterways Commission, which was to undertake an 8-ft. waterway from the Chicago drainage canal at Joliet to the Illinois River at La Salle.

Mr. Kelly will retain the appointive office of South Park Commissioner, as it carries no salary.

Mr. Ramey has been in the service of the Sanitary District of Chicago since his graduation from the University of Michigan in 1907. From 1908 to 1910 inclusive he was in the office of the chief engineer, on hydraulic design. In 1910 he was on construction of channel work, sewers, bridges and the north half of the North Shore channel, and in 1911 worked on the construction of draft tubes for and the installation of the 6,000-hp. water-wheel unit at Lockport powerhouse. He was made acting chief engineer of the Sanitary District in August, 1922.

Mr. Moore, a former business agent of the Hoisting and Portable Engineers' Union, was appointed assistant chief engineer of the Sanitary District in 1921. He studied at De Pauw University and from 1916 to 1921 was a member of the Chicago Board of Examining Engineers. He has worked for several years with Chicago contractors; included among whom were the Foundation Co. of Chicago, John Griffith & Sons Co., and Newman Co. For two years he was employed on the Mayfair shaft of the Wilson Ave tunnel.

To Study Detroit Transit Needs

A committee of five engineers is to study the rapid-transit needs of Detroit. The four names thus far announced are C. W. Hubbell, formerly city engineer of Detroit; Willard Pope, vice-president, the Canadian Bridge Co.; H. W. Alden, vice-president, Timken-Detroit Axle Co., and, as chairman, Sidney D. Waldron, a former vice-president of the Packard Motor Co. An appropriation of $50,000 for the study has been made. The needs of the proposed metropolitan district will be considered.

Awards Contract for Sinking Narrows Tunnel Shaft

Contract for the sinking of the Brooklyn shaft of the Narrows tunnel between Brooklyn and Staten Island was awarded on Dec. 15 to Patrick McGovern, Inc., whose bid of $494,538.75 was the lowest of seven submitted at the opening on Nov. 24.

Cantilever Plan Recommended for Highway Bridge Over Hudson River at Poughkeepsie

Report to Citizens' Committee Proposes High-Level Through Bridge of Seven Spans to Cost $5,000,000

ENGINEERING reports on the project of building a highway bridge over the Hudson River at Poughkeepsie have just been rendered to a local citizens' committee, Theodore D. Pratt reporting on traffic and George W. Goethals & Co. on structural design. The reports urge the construction of the bridge as being needed by present traffic demands and still more so by the traffic of the future, and recommend a through cantilever design for a high-level bridge of seven spans, five of which would be 540 ft. long. The structure as designed would cost over $5,000,000; the estimate totals $4,898,976, exclusive of land, easements, and interest during construction.

From a traffic survey Mr. Pratt finds that there is at present an average summer traffic over the Poughkeepsie ferry of 1,200 vehicles per day. Between New York and Albany (where the first highway bridge is located) there are nine ferries, at Nyack, West Point, Newburgh, Poughkeepsie, Kingston, Saugerties, Catskill, Hudson, and Coxsackie, of which, however, five are unimportant, with small traffic, and the other four (at Tarrytown, Newburgh, Poughkeepsie, and Kingston) are inadequate for the demand. Both local and through traffic requires to be cared for, the former comprising the movement of agricultural produce and fruit grown in the district west of the Hudson to the cities on the east bank. Comparison is made of the three locations said to be the most suitable bridge sites in the central section of the Hudson River, namely at Anthony's Nose, at Poughkeepsie, and at Crum Point (four miles above Poughkeepsie), and the Poughkeepsie site is reported to be the most favorable both topographically and because of leading direct to a city. A highway bridge at Poughkeepsie would also have strategic importance in case of war, the report states.

A cantilever structure, as shown in the illustrations herewith, is recommended by George W. Goethals & Co. and Henry Goldmark, consulting engineers reporting on the structure. It is the result of a study of a suspension design, and through and deck cantilever designs. War Department requirements make it necessary to place piers in line with the piers of the Central New England railroad bridge, half a mile above the selected bridge site. This would necessitate a 1,620-ft. main span for a suspension bridge, which in view of cost and traffic requirements is stated to preclude further consideration of this type.

The design recommended is for a through riveted cantilever bridge of five main spans, with about 140 ft. clearance above high water and trusses 30 ft. apart center to center, providing a 24-ft. roadway and two sidewalks of 8 ft. each. The main spans are 540 ft. long, and the east and west anchor arms 300 ft. and 180 ft. respectively, making a total length of steel structure of 3,180 ft., flanked by 1,100 ft. of earth fill and concrete arch approach on the east bank, and 250 ft. of earth-fill approach on the west bank. The trusses would have a maximum depth of 77 ft. A total of 6,338 tons of steel is estimated for the superstructure. The piers would be open-well piers sunk 120 ft. to gravel directly overlying rock. The substructure cost is estimated at about $3,000,000 and the superstructure cost at about $1,100,000. Together with about $400,000 for the approaches and a 10 per cent allowance for cost of engineering and supervision, the estimated total becomes $4,898,976. Real estate and interest on construction are not included. The possibility of working out a more economical foundation with the use of piles protected against scour is suggested. The report finds that such a bridge may be built ready for traffic in twenty-four months.

The project is being promoted by the Hudson Valley Bridge Association, made up largely of Poughkeepsie citizens, and aims to secure the construction of the bridge by the state as a free bridge. A bill providing for the construction by the state has already been prepared and is to be introduced into the legislature shortly.

PROPOSED HUDSON RIVER HIGHWAY BRIDGE AT POUGHKEEPSIE, LOOKING DOWNSTREAM; ABOVE, A PIER DETAIL

No [illegible] point in this distance. The site of the proposed bridge is [illegible]

France to Keep State Telephones

News cables from France carry a denial by the Minister of Posts and Telegraphs of the report that the government intends to turn over to a private company the control of its telephone system. This suggestion has been made from time to time but it has not yet won the approval of the present Minister or of the Chamber of Deputies.

Another Pennsylvania Bridge Destroyed by Auto

A 70-ft steel span over Bushkill Creek near Tatany, Pa., was destroyed on Nov. 25 by the impact of a passenger automobile, which struck one of the intermediate posts of the bridge. The post was knocked out and the span collapsed, falling 10 ft. to the creek bed. According to a local account, the automobile was "considerably damaged." A similar accident, which destroyed a 100-ft. span near Tyrone, was noted Nov. 23, p. 905.

A. A. E. to Hold 1923 Meeting in Norfolk, Va.

The ninth annual convention of the American Association of Engineers will be held May 7-9, 1923, in Norfolk, Va.

Names Sub-Committees on Fees and Services of Engineers

Specific problems are being taken up this year by the committee of the American Association of Engineers on services and fees of practising engineers. L. E. Ayres, chairman of the committee, has outlined the work as follows and obtained approval for carrying it out from the board of directors:

To sub-committee 1 is assigned the task of preparing rules of practice. The plan is to have the rules prepared by engineers of wide reputation who are held in high esteem by professional men everywhere with the idea that their preparation and publication will be as important an achievement as was the code of ethics prepared by the late Isham Randolph and published by the association. The personnel of the committee is as follows: Henry E. Riggs, chairman; George W. Fuller, C. W. Hubbell and Daniel W. Mead.

A second sub-committee headed by H. S. Kleinschmidt will extend and elaborate the schedule of fees heretofore prepared by the general committee.

Sub-committee 3, with W. A. Artingstall as chairman, will study problems arising out of the practice of public employees engaging in private practice.

The function of a fourth sub-committee, of which J. W. Cunningham is chairman, will investigate problems involved in connection with the federal government taking over in increasing measure engineering service, having especially in mind the work of the engineering staff of the U. S. Reclamation Service.

Ohio River Improvement Is Progressing Favorably

As a result of the unusual extent of favorable weather, the amount of work done on the slack water navigation improvement of the Ohio River has exceeded all expectations. The objective being sought is to provide a minimum depth of 9 ft. from Pittsburgh to the mouth of the Ohio. A 9-ft. channel already exists from that point to the Gulf of Mexico, through the Mississippi.

From Pittsburgh to Dam 26, a distance of 278 miles, a reliable depth of 9 ft. throughout the year has been provided. From Dam 26 to Louisville eight dams have been completed and six dams are under active construction. When those dams will have been completed, the 9-ft. depth will be made continuous to Louisville. It already is possible to move the coal fleet from the Kanawha and other tributaries through that section at low water by releasing water from the completed pools. This is at the expense, however, of continuous navigation.

Below Louisville two dams have been completed and two are under construction. Seven dams and possibly an eighth are to be constructed in that section. Since there is naturally greater depth in that section, navigation can be maintained through it at low water even now. The work has reached a point where each year will make for much more satisfactory navigation conditions at low water. Four years hence, it is believed the river will have been made a very satisfactory stream for navigation purposes, but the project is not likely to be accomplished before 1930.

Would Have Railroads Mine Coal

Washington Correspondence

One of the most reactionary suggestions, that has been made to the President's Coal Commission, has come from a prominent source, generally regarded as being radical. The suggestion is that the coal mines should be turned over to the railroads to operate. The opinion is expressed that since the railroads use thirty per cent of the coal, since it constitutes forty per cent of the total tonnage they haul, and since transportation is the most important single element entering into the instability of the coal industry, the railroads could operate the mines more effectively than could the government or individual operators.

"Tech" Alumni Join in Greeting to President Stratton

President S. W. Stratton, newly-elected head of Massachusetts Institute of Technology, was the guest of honor at an All-Technology dinner held at the Hotel Biltmore, New York, on the evening of Dec. 16, in connection with the annual meeting of the Technology Clubs Associated on Dec. 15 and 16. The dinner was held under the joint auspices of that organization, the M. I. T. Alumni Association and the Technology Club of New York.

Greetings to President Stratton were extended by Harry J. Carlson, president of the Alumni Association; Arthur T. Hopkins, president of Technology Clubs Associated; Robert Starr Allyn, president of the Technology Club of New York; James T. Monroe, secretary of the corporation of M. I. T.; and Dean Henry Talbot, on behalf of the faculty. Telegrams were read from "Tech" men all over the country. His reply was broadcast by radio for the benefit of all "Tech" men east of the Mississippi. In referring to the work of the Bureau of Standards in connection with the development of radio broadcasting, President Stratton announced that in the near future the wave-length allotted to amateurs will probably be extended.

Indian Railway Asks Bids for Bombay Electrification

Bids for overhead equipment, distribution lines and car equipment for the electrification of the suburban railway system at Bombay are invited by the Great Indian Peninsula Ry. Co. The proposed work was outlined briefly in *Engineering News-Record* of Sept. 21, p. 485. Merz & McLellan, London, are the consulting engineers. Bids are to be sent to the company's offices at 48 Copthall Avenue, London, England, before Jan. 9.

Ship 8,500-Ton Cargo of Steel by Ohio-Mississippi Route

News dispatches from Pittsburgh announce that the first attempt to ship steel on a large scale by river is now on. A cargo of 8,500 tons of pipe, structural shapes and bars, in ten barges has been sent by the Carnegie Steel Co. from Pittsburgh down the Ohio and the Mississippi to New Orleans. Deliveries are to be made en route at Evansville and St. Louis. The rivermen expect to complete the trip in twenty days.

I.C.C. Announces Further Hearings on Railroad Consolidations

Hearings in the matter of railroad consolidations will be resumed before the Interstate Commerce Commission in Washington, on Jan. 17, 1923. Evidence will be received with respect to carriers which, under the tentative plan, should be considered in connection with the following proposed systems as there outlined, or in connection with such alternative systems as may be proposed:

System No. 13—Union Pacific-North Western—Union Pacific, including the St. Joseph & Grand Island, Oregon Short Line, Oregon-Washington R.R. & Navigation Co.; Los Angeles & Salt Lake; Chicago & North Western, including the Chicago, St. Paul, Minneapolis & Omaha; Lake Superior & Ishpoming; Wabash lines west of the Mississippi River.

System No. 16—Santa Fe—Atchison, Topeka & Santa Fe, including the Gulf, Colorado & Santa Fe; Colorado & Southern, including the Fort Worth & Denver City; Denver & Rio Grande, Western Pacific, Utah Railway, Northwestern Pacific, Nevada Northern.

System No. 17—Southern Pacific-Rock Island—Southern Pacific Company, Nevada Northern; Chicago, Rock Island & Pacific, including the Chicago, Rock Island & Gulf; Arizona & New Mexico, El Paso & Southwestern, San Antonio & Arkansas Pass, Trinity & Brazos Valley, Midland Valley, Vicksburg, Shreveport & Pacific, Chicago, Peoria & St. Louis.

Because of the inability of certain respondents tentatively included in Systems No. 14—Burlington-Northern Pacific and No. 15—Milwaukee-Great Northern to prepare evidence forming part of their main affirmative cases in season for presentation during December, no assignments for western hearings during that month have been made. These respondents are invited to present their further evidence at the hearing commencing on Jan. 17. Respondents named in Systems No. 18—Frisco Katy Cotton Belt and No. 19—Chicago-Missouri Pacific have been notified to be prepared to make their main affirmative cases at Washington on short notice at any time after January, 1923.

N. Y. Railroad Club Celebrates Fiftieth Anniversary

More than 2,000 attended the golden jubilee dinner of the New York Railroad Club held at the Hotel Commodore in that city on Dec. 12. Addresses dealing with current problems of railroad management and with the record and service of the club in the railroad field were made by John J. Cornwell, ex-governor of West Virginia and now general counsel, B. & O. R.R.; and George A. Post, chairman of the railroad committee, Chamber of Commerce of the United States. William G. Besler, president of the C. R. R. of N. J., presented a silver cup to retiring President John A. Droege. F. T. Dickerson, secretary and treasurer, C. R. R. of N. J., is president of the club, and H. H. Vreeland, vice-president of the Interborough Consolidated Corp., acted as toastmaster.

Civil Service Examination

UNITED STATES

For the United States civil service examinations listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Valuation Engineer and Associate Valuation Engineer—vacancies in the technical staff of the Income Tax Unit of the Bureau of Internal Revenue, Treasury Department, Washington, D. C., on oil and gas and coal mining at $3,600 to $4,000 a year for the valuation engineer and $3,000 to $3,600 for the associate valuation engineer. Applications must be filed with the Civil Service Commission, Washington, D. C., before March 1, 1923.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7 to 9, 1923.

The New York Section of the American Society of Civil Engineers, at its meeting of Jan. 10, 1923 in the Engineering Societies Building, New York City will discuss the "Operation of the Panama Canal." It is expected that the subject will be presented by Governor Jay J. Morrow of the Canal zone and that there will be on hand to discuss it representatives of the steamship companies that use the canal.

The Texas Water Works Association will meet in Dallas, Jan. 15, 1923, and hold a six-days' short course for water-works operators. This course has been given for several years and will be the second held in Dallas. E. E. Sands, John B. Hawley, J. M. Powell, C. M. Adams, Dr. R. V. Davidson and others will be on the school faculty. Most of the work which is of a highly practical nature will be given at the new White Rock filtration plant.

The Wichita Falls Technical Club composed of members of the technical and associated professions at Wichita Falls, Texas, has been formed with 85 charter members, civil, electrical, mechanical, and chemical engineers, geologists, architects, contractors, and public utility men compose the personnel of the club. Following are the officers: Julian Montgomery, president; R. A. Thompson, 1st vice-president; A. M. McPherson, 2nd vice-president; A. H. Douglass, secretary-treasurer.

The Providence Engineering Society and the American Institute of Electrical Engineers held a joint meeting in Providence, R. I., Dec. 19, at which was given an address by Admiral William S. Sims, U. S. Navy, resigned, on "The Relationship of the Navy and the Merchant Marine."

Personal Notes

W. V. BUCK, assistant state highway engineer, Kansas Highway Commission, has tendered his resignation to take effect Jan. 1, 1923. Mr. Buck is to enter the automobile business at Newton, Kansas.

R. C. HAM, county engineer of Ford County, Kansas, has resigned to accept the position of county engineer of Jefferson County, Kansas.

CHARLES H. WINDHAM has been elected city manager of Long Beach, Calif., by the city council, to succeed Charles Hewes, recalled by the voters ten days ago. At the time of his election Mr. Windham was postmaster and he had formerly been mayor of Long Beach.

ROBERT L. E. WARD, formerly with Weiland Engineering Co. of Canon City, Colo., is now employed with the Southern California Edison Co. as construction foreman on the Laguna-Bell substation at Los Angeles.

W. E. BAKER, formerly assistant supervisor at Derry, Pa., for the Pennsylvania R.R., has become supervisor for the Pennsylvania R.R. at Youngwood, Pa.

J. P. KEENEY, chief engineer at the Millville plant of the Northern Virginia Power Co. for the past year, has resigned, his resignation to be effective Jan. 1.

V. L. MORRIS has been made engineer of the plant department of the Western Electric Co., Chicago, Ill. Previous to this work he was field engineer for the Worden-Allen Co.

ROBT. F. HAMILTON of Pocatello, Idaho, has been elected secretary-treasurer of the Idaho chapter of the American Association of Engineers, succeeding E. F. AYRES, who has resigned.

T. O. CANNON, formerly a field engineer with the Southern Power Co., has become associated with J. E. Sirrine & Co., civil engineers of Greenville, S. C.

WALTER G. CALDWELL, for the past three years highway engineer of Waukesha County, Wis., has resigned to enter into private practice. His resignation becomes effective Jan. 1. He will open an engineering office in Waukesha.

GEORGE D. CAMP, and ERNESTO GOMEZ ARZAPALO have opened an office at Isabel la Católica 51, Mexico, D. F. for the practice of civil engineering and contracting.

J. A. ADAMSON, until recently district engineer in the New York office of Lockwood, Greene & Co., has been appointed manager of the New York office of the John W. Ferguson Co., engineers.

R. H. GEORGE, president of George Construction Co., Philadelphia, has acquired from J. E. Greenwood his interest in the George Construction Co. and all equipment of the Greenwood Engineering Co., and will continue the business of constructing conduits, cables, substations, street lighting and electrical construction.

R. R. WATTS, former resident engineer for the Kentucky Department of State Roads, has been appointed assistant division engineer with headquarters at Covington, Ky.

G. R. BODE, formerly engineer and estimator for the Austin Co., of Philadelphia and New York, has become engineer with the Milwaukee Bridge Co., Milwaukee, Wis., on structural steel work.

H. WHITTEMORE BROWN, until recently research engineer with The Housing Co., has been made head of the department of building construction at Hampton Normal and Agricultural Institute, Hampton, Va.

W. B. EVELIN, a construction foreman and superintendent for more than twenty years and until recently concrete superintendent with the E. W. Foley Contracting Corp., has been made estimator and concrete superintendent for F. H. Wells, contractor of Gloversville, New York.

J. LOUIS BARRAS recently resigned from the vice-presidency of Mellon & Stewart, contractors of New York and other cities, to start his own company, the Barras Construction Corp., New York, to specialize in the construction of large office buildings and apartment hotels.

Obituary

CYRUS ZIMMERMAN, for many years city engineer of Lebanon, N. J., died Dec. 10 at Elizabethtown, N. J.

JULIAN GRIGGS, who from 1893 to 1906 was city engineer of Columbus, Ohio, and from 1906 until his retirement from active service in 1918 was with the Toledo & Ohio Central R.R., died in Columbus Dec. 4 at the age of 74 years. During his administration as city engineer the present sewage disposal plant, the storage dam and the city filtration plant of the Columbus water-works were constructed. Previous to that work, Mr. Griggs was division engineer for the Norfolk & Western R.R., and he was at one time consulting engineer for the city of Lancaster, Ohio, and chief engineer for the Scioto Valley traction line. For several years he was president of the Columbus Engineers' Club, and he was a member of the American Society of Civil Engineers.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

More Suggestions—

For Better Equipment and Repair Parts Service

Manufacturer Tells Contractors How Some Mistakes in Sending Orders Can Be Avoided

IN LAST week's issue was begun a discussion of "Better Equipment Maintenance and Repair Parts Service." Its object is to show how some of the misunderstandings between maker and user of construction machinery can be avoided. This week's contribution is a recital of experiences by a manufacturer of wheeled scrapers, dump-cars, road-graders, plows and similar equipment used in highway construction and earth excavation:

From the Western Wheeled Scraper Co. Aurora, Ill.

WE CERTAINLY appreciate this opportunity for the improvement of our service. We ourselves are conducting a systematic educational campaign in our own factory in order to have various parts known and designated *by number* instead of by the local slang of the shop. If contractors, in ordering, will use the part numbers and descriptions given in our price list, instead of the local slang terms of the field, it will improve the service wonderfully.

All orders for parts come first to our Shipping Department, whose members are careful, intelligent and conscientious men—but not mind-readers. When an order is not understood the customer must be asked for information and the shipment is delayed in consequence. Usually the information needed could have been sent with the order in the first place.

Why Orders Are Misunderstood

Like all other machinery, Western equipment has been improved from time to time. If, therefore, an order comes in for some part for a "12-yd. Western dump-car" which the customer has bought from someone else, not the factory, we either have to ask for additional information or guess at the type of car unless the name of the original purchaser is given with the order; then we can look at our records and find out. If a contractor cannot give the name of the original purchaser, he should give us the pattern number of the part required; it will be found on all castings.

Mention of a few misunderstood orders will serve to suggest the remedy:

We recently received this order: "Send wheels for little Western grader." We sent front wheels, owing to the fact that the contractor originally had purchased a machine without front wheels for use with a tractor. We felt justified in assuming that he now wished front wheels to equip the machine for team use. Back came a telegram, "I want rear wheels, hind wheels, back wheels. Dammit." If the customer had used any of the terms mentioned except "dammit" in the first place, we should have known what to send.

Township officials, who purchased a Western blade-grader perhaps ten years ago, frequently send for some part without further information. Sometimes they call the machine a "scraper," thereby adding to the confusion and delay.

One construction company wrote on Oct. 4: "Kindly send us six only castings for Mogul wagons. RUSH." Instead of rushing, we had to wire for more specific information and after an expiration of seven weeks have received no reply. The "rush" evidently is over.

A contractor ordered "one share for four-horse plow," leaving us to guess which one of several plows he referred to.

Another order was for "one front wheel with both wheel boxes and one large cog wheel for turntable." It seems evident that the machine is a road-grader on account of the "turntable," but whether the Midget, Little Steel Western, Aurora Reversible, Special Aurora, Western, Special Western, No. 10 or No. 20, we have no means of knowing.

Parts for Old Models

"Send two skeins and two boxes for Studebaker wagons" writes another, ignoring the fact that the Studebaker Corp. had been making many types of wagons prior to our purchase of their business. In ordering wagon parts the customer should give the exact measurement of boxes and skeins; whether right or left skeins are desired; and, when ordering axles, the tread, type and size of axle.

> ***What Manufacturers Said in Last Week's Discussion***
>
> Order repair parts by catalog number.
>
> Keep nuts set up tightly.
>
> Inspect equipment daily.
>
> Use lubricants recommended by manufacturer.
>
> Anticipate wear of parts.
>
> Overhaul machines and order repair parts in winter.
>
> Specify job location for repair parts shipments.

We received an order for 16 to 18 "blades," to go by express, took a chance and sent "bits." Our price list refers to the cutting edge as "bits" and the moldboards as "blades."

Some contractors have many sizes of Western dump-cars—12-yd., 8-yd., 4-yd. and perhaps smaller ones. What are we to do, except wire for information and wait, when an order comes in from them for "journal boxes for Western cars?"

Telegraphic orders are regarded by us as rush orders. We assume that the contractor is in a hurry or he would not telegraph, and we ship the part ordered as soon as we can get it out—the same day, if possible. A day or two later, after the shipment has gone, the letter of confirmation arrives, which often includes some part not mentioned in the telegram at all. Extra expense and delay result.

We are co-operating with a committee of the Associated General Contractors of America to remedy this difficulty. This joint committee of the A. G. C. and manufacturers is working out a standard form for ordering parts. We are hoping that the work of the committee and the informative campaign of *Engineering News-Record* will result in the benefit of all concerned.

> ***Hints for Contractors in Ordering Equipment Parts***
>
> *From this week's discussion:*
>
> Shipping clerks are not mind-readers. Make orders specific.
>
> Include *all* items in original order, if by telegraph,—not in confirmation by mail.
>
> Local slang terms of the field are often unintelligible.
>
> Specify clearly type of equipment for which parts are needed.
>
> This week's discussion also cites eight typical cases of misunderstood orders.

Next Week: Experiences of the Sullivan Machinery Co., Chicago.

Explosives Used on Construction

During the month of September, 1922, according to W. W. Adams, statistician of the U. S. Bureau of Mines, the following quantities of explosives were used on railway and other construction work: Black blasting powder, 27,442 kegs; high explosives, other than permissible, 2,347,960 lb.; permissible explosives, 6,650 lb.

For the nine months, January to September, inclusive, the figures for railway and other construction work are: Black blasting powder, 210,748 kegs; high explosives, other than permissible, 16,133,239 lb.; permissible explosives, 92,837 lb.

Motor Car and Truck Output for 11 Months, 2,344,000

Motor vehicle production reports presented Dec. 13 at the monthly directors' meeting in New York of the National Automobile Chamber of Commerce show the total output for 11 months of this year to be 2,344,000. This exceeds the record full year's business of 1920 which reached the mark of 2,205,000. The November output of 232,000 cars and trucks was within 5 per cent of October, and was twice the volume of the same month last year.

Useless Metal Lath Weights Eliminated at Conference

Makers and Users, With Aid of U. S. Department of Commerce Discard 133 Varieties

REDUCTION from over eighty varieties to ten of expanded flat metal lath and from more than seventy to seven in ⅜-in. expanded rib lath now being used extensively in the building industry, was recommended recently at a conference of metal lathe manufacturers, users and distributors held at the Department of Commerce under the auspices of the Division of Simplified Practice.

The results of a survey of the excess and useless weights of metal lath, made by the Metal Lath Manufacturers' Association, were used as a basis for eliminations, and retention. The adoption of the following recognized standards of weight in this commodity during the year July 1, 1923, to July 1, 1924, was recommended by the conference:

FLAT EXPANDED LATH
(Lb. per Sq. Yd.)

Painted Steel	[illegible]	[illegible]
2.2	2.2	
[illegible]	2.5*	2.5
[illegible]	[illegible]	
[illegible]	3.4	3.4

[illegible] IN. RIB EXPANDED LATH
(Lb. per Sq. Yd.)

2.5		...
[illegible]	3.0*	...
[illegible]	3.8*	
4.8	4.8	.

*The conference urged that every effort [illegible] to a single intermediate weight. This to be [illegible] ference.

Tolerance to be not greater than plus or minus 0.1 lb. per sq.yd.

The conferees are of unanimous agreement that adoption of the recommended standard weights, which will amply supply the needs of construction, by the industry as a whole, will result in the greatest benefit to manufacturers, distributors and users.

A second conference on sheet lath was scheduled for Dec. 18, at the William Penn Hotel, Pittsburgh, Pa.

International Construction Exposition at Antwerp

A permanent international construction exposition, constituting a fair of the construction industry, will be opened this month in Antwerp, Belgium, according to an announcement in a recent issue of *[illegible]*.

The exposition will include the following sections: construction materials, casings, pavements, marbles and granites; central heating, ventilation, contractors' and builders' materials and tools; motors, elevators, lifting apparatus; furniture and furnishings; sanitary fixtures, plumbing specialties, brass fittings and special installations for hotels, cafés and restaurants; woodwork, doors, framework, windows; high grade woods; electricity and lighting fixtures; kitchen furniture and hardware.

The exposition rooms, built especially for the purpose, comprise 7,000 sq.m. of floor space, and, besides this, there are a hundred small rooms for offices and sales rooms of exhibitors.

The headquarters address is 102-106 rue de Pélican, Antwerp.

Centrifugal Process of Casting Pipe Shown in New Film

MEMBERS of the New York Section of the American Water Works Association, at a meeting in New York City Dec. 6, were shown the various steps in the method of manufacturing cast-iron pipe by the de Lavaud centrifugal process employed by the U. S. Cast Iron Pipe & Foundry Co. of Burlington, N. J. The explanation of details by John D. Capron, representing the manufacturers, was facilitated by the showing of an industrial motion picture made for the company by the Pathéscope Co. of America, Inc.

For the de Lavaud centrifugal process the plant consists of a cupola, a revolving water-cooled molding machine, an annealing furnace and a dipping vat. The molten iron flows from a ladle into a water-cooled cantilevered trough which projects into the revolving mold from the forward end of which iron discharges in a stream in the plane of revolution. During the pouring the revolving mold moves at a uniform speed along friction rollers, thus insuring an even thickness of metal in the cast pipe. In contact with the cool revolving mold the iron solidifies in a few seconds and shrinks from the mold sufficiently to be withdrawn by a special hook engaging the spigot end.

For pipe made by the centrifugal process the manufacturers claim many advantages over sand-cast pipe. The metal has a finer grain, is free from blow holes and develops far greater strength, thus making it possible to supply a lighter weight pipe to withstand the same water pressure called for by the thicker sand-cast pipe.

According to tests cited by Prof. Peter Gillespie, of the University of Toronto, in a recent paper before the American Water Works Association, the tensile strength of the machine-made cast-iron was 37,000 lb. per square inch as against 60,000 lb. for the sand-cast iron. The modulus of rupture in cross bending for the former material was 64,000 lb. per square inch and for the latter 34,000 lb. per square inch.

Business Notes

WORTHINGTON PUMP AND MACHINERY CORP., New York, announces the following changes in the personnel of its organization: E. T. Fishwick, formerly sales manager, has been made vice-president in charge of sales, to succeed F. H. Jones, vice-president, resigned. J. E. Sague, vice-president, resigned, has been succeeded by William Goodman, formerly assistant to the vice-president. James C. Barnaby, formerly plant engineer of Staten Island Shipbuilding Co., has been placed in charge of certain engineering work in the Diesel oil engine division of the company.

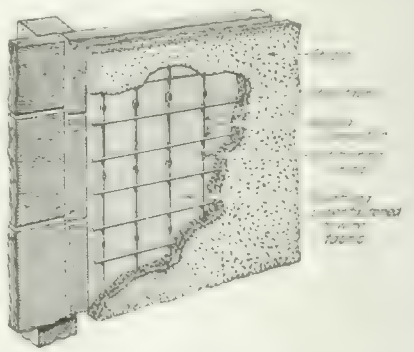
A. Y. [illegible] of the Lehigh Portland Cement Co., Chicago, arrived in New York City Dec. 11 after completing a 35,000-mile voyage around the world in the 98-ft. motor boat "Speejacks." Mr. Gowen's voyage, which took 15 months, is the first that has been made around the world in a motor boat. His exploit is being hailed by the daily press as one of the greatest feats of navigation history. He was accompanied on the trip by his wife and a crew of ten men.

OLIVER CROSBY, for 40 years managing partner and chief engineer of the American Hoist nd Derrick Co., St. Paul, Minn., died Dec. 8. He was born at Dexter, Me., Jan. 29, 1856, and in 1876 was graduated from the University of Maine. In 1882 he opened a small machine shop in St. Paul, and four years later this business was organized as the American Hoist and Derrick Co. This company has always been under Mr. Crosby's immediate supervision and its line of hoists, railroad ditchers, logging cranes and locomotive cranes and wire-rope clips is known throughout the world. The 50-ton jib crane at the government dry dock No. 1, Balboa, Canal Zone, Isthmus of Panama, used for placing turrets, guns, boilers, etc., in vessels, was built by his firm. Mr. Crosby was the inventor of the Crosby clips for splicing wire cables. He was a member of the American Society of Mechanical Engineers and the Engineers' Society of St. Paul.

Equipment and Materials

Paper-Backed Wire Fabric for Stucco Work

A combined reinforcement and base for stucco work, consisting of galvanized steel fabric to which is fastened a backing of saturated rope fibre waterproof paper, has just been announced by the National Steel Fabric Co., Pittsburgh. Its field of application in-



cludes all types of clay, brick, stone and tile structures, both new and old, interior plastering, bathroom and porch concrete, and composition floor construction.

The reinforcement is manufactured from No. 14 gage cold-drawn galvanized welded steel wire, developing a tensile strength of 60,000 lb. per square inch. The paper, which is attached to the fabric by means of crimps, holds the plastic material in place until it sets. An advantage claimed for this feature is that no material is wasted in keys or in droppings from the front or back of the fabric and no unnecessary forms are called for.

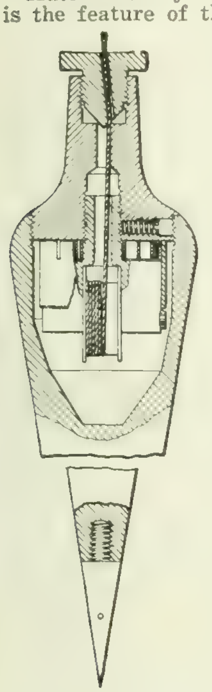
The paper backing serves also to insure automatically the proper thickness of plastic material to meet various specifications. The crimps are forced through the paper backing which is securely locked to the fabric by means

of galvanized steel wires threaded through the crimps. This permits the steel in the fabric to rest above the face of the paper so that the mesh becomes embedded when the plastic material is applied. The crimps also make the fabric self-furring and hold it at a uniform distance from the background. The accompanying sketch indicates the use of this material.

The wire fabric is manufactured in two styles, a 2 x 2-in. mesh with equal reinforcing value in all directions, and a 2 x 4-in. mesh designed for less severe strain, particularly for interior plastering. The weight of the fabric in the two styles noted is 2.75 and 2.25 lb. per square yard, respectively. The manufacturers state that the new stucco fabric requires 10 per cent less material than wood lath and 25 per cent less material than metal lath. With paper backing the material is manufactured in sheets 8 ft. x 48 in. packed 18 to the bundle, containing 64 sq.yd.

Self-Adjusting Plumb-Bob

Automatic adjustment to any height is the feature of the plumb-bob, illustrated herewith, manufactured by the A. S. Aloe Co., St. Louis, Mo. The main part of the mechanism is a tension drum inside the plumb-bob on which a braided Irish linen cord is wound. By a slight turn of the cap on top of the bob the cord may be held or released for adjustment of the length of the line, and when not in use it can be entirely wound up and held under the instrument. This feature is claimed to be a decided advantage over the old type of equipment without the automatic feature. The bob is of brass casing with removable steel point.



Metal Dump-Bodies Repaired by Oxy-Acetylene Process

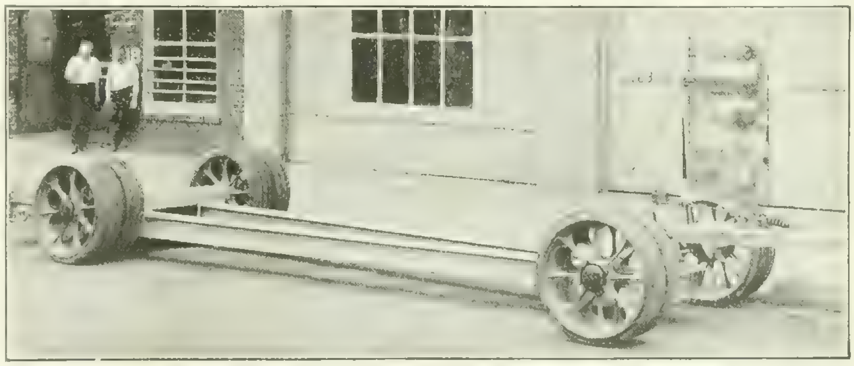
One of the everyday practical uses of the oxy-acetylene process for heating, according to the Linde Air Products Co., New York, is in the contracting field where steam shovels are used for excavating. Sometimes the shovel strikes the bodies of trucks in the process of loading them, and when this occurs the steel sheets and frames are often so badly bent as to seriously affect the serviceability of the truck. The damage is usually on the rear portion of the body and consists of deformed angle-iron frame and sheet at the point of impact.

Whether bent in or out, the angle iron and sheet can be straightened without removing the rivets by heating the bent sections to a dull red with a welding blowpipe, when it is comparatively easy to restore frame and sheathing to their original alignment and form.

Rubber-Tired Trailer Speeds Moves of Steam Shovel

To reduce time lost in making moves from one job to another the Bucyrus Co., South Milwaukee, Wis., has designed and built to the order of E. Schelling, of Los Angeles, a special rubber tired trailer for its 30-B revolving steam shovel. The work on which this shovel has been used is, for the most part, basement excavation jobs at widely separated points, calling for a greater degree of mobility in the excavating equipment than is the case where larger yardages are involved.

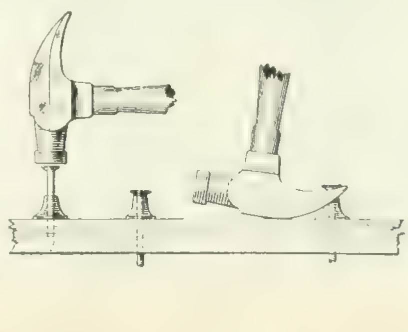
The general design of the trailer is indicated in the accompanying photograph. To load the shovel, which is mounted on crawler treads, onto the trailer a pin on the front trucks of the trailer is removed, the trucks pulled out of the way and the front of the I-beams allowed to rest on the ground. The shovel is then run under its own power a few feet backward onto blocking at either side of the trailer I-beams. The front trucks of the trailer are put in position and coupled up, after which the crawlers are propelled forward and the truck pulled forward at the same time until the weight of the shovel is transferred to the trailer. When loaded the base of the shovel rests on the trailer I-beams with the crawlers overhanging at either side, clearing the ground by about 6 in. The shovel can be loaded in this manner in about 15 minutes.



In addition to the mobility furnished by the trailer in making moves from one small job to another, the device overcomes the objection in some cities to moving heavy machines on crawlers over paved streets.

Collar Makes Nail Pulling Easy and Saves Lumber

A small metal collar which is slipped onto a nail before driving has been developed by the Precision Metal Workers, Chicago, to hold the head of the driven nail away from the board and thus allow the claw of a hammer to grasp its head easily. The accompanying sketch indicates the use of the device. The "Pull-Easy" nail collar, as it is called, is recommended by its manufacturers for use by contractors on the ground that, particularly on form work, it prevents splitting the wood when a nail is withdrawn, makes possible the repeated use of lumber and thereby effects a substantial saving. Another advantage for the collar is the time saved by it in tearing down nailed scaffolding or concrete forms.



The collar is made in three sizes, one for use with 6 to 10d. nails; the second for 10 to 20d. nails; and the third for 20 to 60d. nails.

Publications from the Construction Industry

Steam Shovel—MARION STEAM SHOVEL CO., Marion, Ohio, announces in an illustrated circular a number of new features on its Model 21, ¾-yd. revolving shovel, although the basic design has not been altered. Attention is directed to the new rigid crawler trucks provided with a power steering arrangement entirely controlled by the operator from the cab without outside assistance. Other mountings include a four-belt flexible type of truck, traction wheels with either steel or rubber tires, and railroad wheels for standard or narrow-gage track. A liberal use of manganese steel is made in this model, for the dipper front, bevel propelling gears, and shipper pinions. Boiler tubes are electrically welded. The shovel may be converted into a dragline, clamshell, or orange-peel excavator, or into a material-handling crane. When long reach and high dump are required high-lift equipment can be supplied. Steam, electric or gasoline power may be specified. A feature of the new model is its rigidly connected dipper, which is fastened solidly to the dipper handle to eliminate all wear of adjusting bars, pitch braces, and pins.

Pine Floors—SOUTHERN PINE ASSOCIATION, New Orleans, in a 22-p. illustrated booklet gives detailed directions for the laying, finishing and care of Southern pine edge grain floors, together with a general discussion of the qualities of this flooring. The information is intended for architectural engineers, builders, lumber dealers and consumers, and covers floors for hotels, apartment houses, office buildings, schools, armories, churches, factories, and theatres.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Production Gains Seen in November Totals

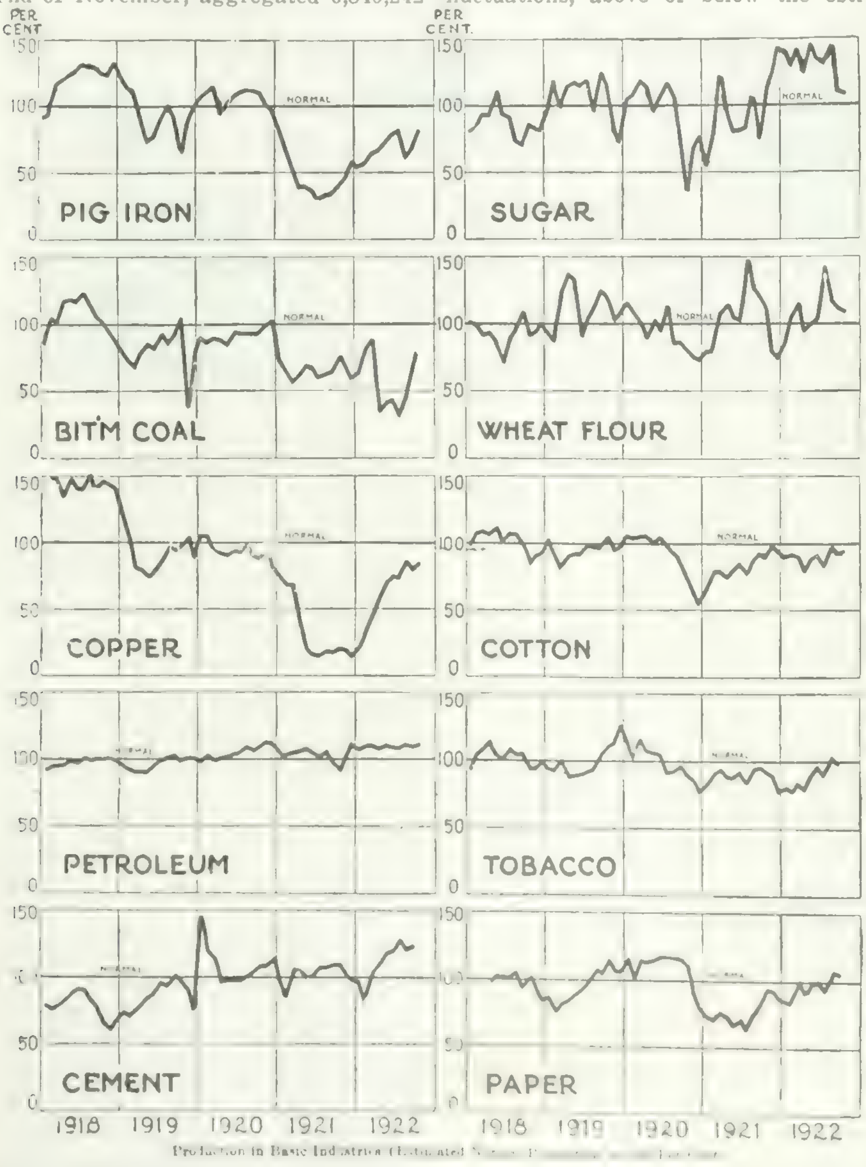
Many Basic Commodities On Increase—Lumber and Cement Dropped Slightly During Month

While November was a month of increased production schedules in many basic industries, particularly in iron and steel, the output of lumber and cement decreased perceptibly.

Pig-iron production during November totaled 2,849,703 tons, the largest output since December, 1920. Average daily output increased from 85,092 tons, the rate for October, to 94,990 in November. Steel ingot production for November, amounted to somewhat more than 2,889,297 tons, an increase of 0.5 per cent over the preceding month. Unfilled steel tonnage, on the books of the United States Steel Corporation, at the end of November, aggregated 6,840,242 tons, against 6,902,287, for the four weeks preceding.

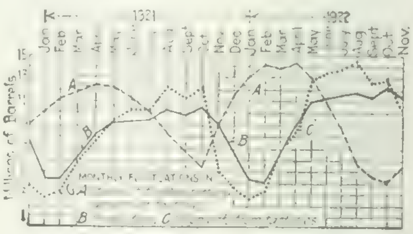
Latest lumber production figures show a drop of about 4 per cent, in four [illegible] with the [illegible] output for October.

The accompanying chart shows the fluctuations, above or below the estimated normal, in the production of ten basic commodities, over a period of four years.



Production in Basic Industries [illegible]

Cement produced in the United States during November, according to the Geological Survey, totaled 11,349,000 bbl., a drop of over 7 per cent from the preceding month.



PRODUCTION IN PERCENTAGES OF ESTIMATED NORMAL

([illegible] 100 per cent)

Commodity	May	June	July	Aug.	Sept.	Oct.
[illegible]	4	1 0	1 4	1 9	61	94p
[illegible]	41	43	32	46	72	75p
[illegible]	73	79	82	61	68	83
[illegible]	81	82	79	70	74	85
Copper, U. S. mine	70	75	75	86	80r	84p
Tin deliveries	92	90	75	77	92	103
[illegible]	51	53	60	59	62	75
[illegible]	111	110	110	112r	111	112p
[illegible]	119	120	128	121	123	126
[illegible]	100	104	142	117	112r	109
Meat slaughtered	108	112	99	109	105	103[illegible]
[illegible]	146	135	131	144	110	108
[illegible]	88	92	84	97	92	95
Wood pulp	108	110	105	105	102	..
Tobacco consumption	91	97	90	103	99	88
Paper (total)	100	100	93	107	105	.
Gasoline	96	101	109	103	104	
[illegible]	116e	116[illegible]	103[illegible]	126	121e	131

* Seasonal variation not allowed for. r—Revised. p—Preliminary. e—Estimated.

Anthracite coal mined during October reached 8,530,000 tons, according to the Federal Reserve Agent at New York, or almost twice the September output. Shipments from the mines were about 2,000,000 tons under the amount produced, and transportation facilities of railroads were taxed to capacity. The current production rate of coal is approximately, 11,000,000 tons, or about the peak of November, 1920.

The accompanying table, prepared by the Federal Reserve Agent, shows production for the last six months, expressed as percentages of estimated normal production.

Car Shortage Easing Up With Decline in Loadings

Requisitions for freight cars over and above the current supply totaled 133,786 cars on Nov. 30, according to reports received up to Dec. 12, by the American Railway Association. This means that the car shortage has decreased 18,781 cars since Nov. 23. The box car shortage was reduced 11,569 cars, leaving a deficit of 67,468; while the demand for coal cars in excess of supply totaled 42,848, or a reduction of 835 within the same period. At the same time, 5,595 surplus freight cars of various classes and in good repair were reported; representing an increase of 289 cars within the week. Car loadings for the five weeks (Nov. 4 to Dec. 2) during 1920, 1921 and 1922 were as follows:

LOADINGS OF REVENUE FREIGHT

Week	1922	1921	1920
Dec. 2	84[illegible]	741,849	882,604
Nov. 25	[illegible]	673,465	803,701
Nov. 18	969,094	790,363	889,138
Nov. 11	953,909	755,777	927,586
Nov. 4	994,827	837,576	915,615

Bond Sales for Eleven Months Heaviest in Thirty Years

Further contraction in long-term municipal bond sales occurred during November. Total value of disposals for the month amounted to $38,604,352, against $66,650,779 in October and $97,364,782 in September. A decrease of 68 per cent is shown when November sales are compared with $119,688,617, the value of disposals during the corresponding period in 1921, according to the *Commercial and Financial Chronicle*.

Short-term securities, issued during November, amounted to $37,301,291, of which $31,675,000 were issued by New York City.

Sales for the eleven months of this year, totaled $1,014,060,328, as against $988,301,613 for the same months in 1921; an amount vastly greater than for any similar period during the last thirty years.

Included in the prominent issues of the month were: Providence, R. I., $2,500,000 4s. at 97.16, a basis of about 4.15 per cent; Omaha School District, Neb.., $2,500,000 4½s at 99.18, a basis of about 4.48 per cent; Hillsborough County, Fla., $1,500,000 5s at 101.68, a basis of about 4.86 per cent; Birmingham, Ala., $1,000,000 5s at 103.32, a basis of about 4.78 per cent; St. Paul, Minn., $1,000,000 4s and 4½s at par.

Of the forty-four representative issues listed in the accompanying table, ten sold at par, twenty-nine, above and five below par; the yields ranging from 4.24 to 5.98 per cent, with one issue in Canada at 6 per cent.

Rates varied from 4¼ to 6 per cent. All those issued in New England drew from 4¼ to 4½ per cent. Rates between 5½ and 6 per cent applied on all disposals in the far Western States. Canadian issues all sold at 5½ and 6 per cent. Southern bonds ranged between 5 and 6 per cent, with the majority drawing from 5 to 5½ per cent.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 317 to 328, are the following:

Hotel, Chicago, Ill., for J. W. and E. J. Stevens, $1,500,000.

Hotel, Jackson, Miss., for J. L. Ware, prop., Edwards Hotel, $1,000,000.

Clubhouse, Newark, N. J., for B. P. O. E., $1,000,000.

Clubhouse, Dallas, Tex., for Dallas Athletic Club, $1,250,000.

Secretary of Labor Proposes Plan To Reduce Unemployment

Proposals for the prevention of future unemployment crises and for the reduction of the normal number of workless men in the country, were put forth by Secretary of Labor James J. Davis in his annual report, recently made public. Secretary Davis suggested that the workman himself, in order to meet periods of depression, should be willing to accept employment at trades, other than those in which he is usually engaged. On this point he said: "The lesson of the past year seems to be not so much a problem of an actual dearth of employment but rather one of inability of the American workmen to adjust themselves to

REPRESENTATIVE PUBLIC BOND SALES DURING NOVEMBER, 1922

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Maturity	Dated	Purchased By
Missouri	Road	$5,000,000	4½	99.56	4.73	1923 25	Dec. 1, 1922	Kuhn, Loeb & Co., of New York and others.
County								
Bergen, N. J.	Road, Bridge, Hospital	808,000	4½	100 62	4.42	1923–41	Dec. 1, 1922	Lamport, Barker and Jennings, Inc., New York.
Clay, Ind.	Road	26,600	5	101 167	4.77	1924–33	Nov. 6, 1922	Thos. D. Sheerin & Co., Indianapolis.
Cumberland, N. J.	Road improvement	511,000	5	100.017	4.99	1923–27	Dec. 15, 1922	M. M. Freeman & Co., Philadelphia
		42,000	5	101.19	4.67	1923–29		
Cuyahoga, O.	Road improvement	89,196	5	100.309	4.94	1923–32	Oct. 1, 1922	Guardian Savings & Trust Co., Cleveland
Kossuth, Ia.	Drainage	187,300	5¼	101.01	5.08	1926–32		White-Phillips Co., Davenport.
Miami, Ind.	Gravel roads	40,620	5	101.25	...	1923–32	June 6, 1922	J. F. Wild & Co., Indianapolis.
Pulaski, Ind.	Road	7,000	5	101.15	4 78	1924–33	Nov. 15, 1922	J. F. Wild & Co., Indianapolis.
		8,000	5	101.05	4.80	1924–33		
St. Louis, Mo.	Road	1,000,000	4½	98.81	4.63	1927–42	Dec. 1, 1922	Kauffman-Smith-Emert & Co., Inc., and others.
Sandusky, O.	Road improvement	63,000	5½	102.06	5.057	1923–31	July 1, 1922	A. T. Bell & Co., Toledo.
Summit, O.	Sewer	65,000	5	101.114	4 85	1926–38	Oct. 1, 1922	Richards, Parish, Lamson, Cleveland
Union, N. J.	Road and bridge	132,000	4¼	100.031	4.24	1924–46	Dec. 1, 1922	J. S. Rippel & Co., Newark, and others.
Yakima Co., Drainage Dist., Wash.	Drainage	28,000	6	100	....	......	Nov., 1922	Bond, Goodwin & Tucker, Seattle.
Township								
Barton, Ont., Canada	Improvements	15,870	5½	98.80	....	1932	Dec. 4, 1922	Houser, Wood & Co.
		10,000	5½	98.36	....	1942		
Municipality								
Ashland, O.	Street improvement	23,800	6	107.83	4.75	1924–32	Nov. 1, 1922	Weil, Roth & Co., Cincinnati.
Atlantic City, N. J.	High school	1,425,000	4½	100	....	....	Nov., 1922	Geo. B. Gibbons & Co., New York.
	Park and Fire Dept.	1,375,000	6	100	....	....		
Attleboro, Mass.	Bridge	30,000	4¼	101.03	4.28	1923–37	Dec. 1, 1922	Parkinson & Burr, Boston.
Bloomfield, N. J.	School	253,000	4½	100.61	4.44	1923–46	Nov. 15, 1922	H. L. Allen & Co., New York.
	City improvement	141,000	4½	100.01	4.49	1928	Nov. 15, 1922	Bloomfield Trust Co.
Bristow, Okla.	Park	40,000	6	103.19	....	....	Nov. 1922	Taylor-White Co., Oklahoma City.
	Waterworks	60,000						
	Storm sewer	70,000						
	Sanitary sewer	40,000						
Burlington, N. J.	Temporary improvement	10,000	5	101 90	4 67	1928	July 1, 1922	M. M. Freeman & Co., Philadelphia.
	Water	20,000	5	103.50	4.56	1923–42	May 1, 1922	Sinking Fund Comm.
Charleston, W. Va.	Street and incinerator	490,000	5	100	....	1952	July 1, 1922	State of West Virginia.
Chesapeake, O.	Sidewalk	1,400	6	100	....	1929	Nov. 10, 1922	J. A. Cassady and others.
Covington, Va.	Water supply	130,000	5	100	....	1952	Jan. 1, 1922	Rosenstile-Ellis Co., Cincinnati.
Dakota City, Drainage Dist., Neb.	Ditch	75,000	6	100	....	....	Dec. 4, 1922	State of Nebraska.
Defiance, O.	Grade crossing elimination	45,124	5	101.137	4.90	1924–52	Sept. 1, 1922	Detroit Trust Co., Detroit.
Drew, Miss.	Waterworks	25,000	6	100.72	....	....	...	A. K. Tigrett & Co., Memphis.
Dunkirk, N. Y.	Street improvement	2,598	4½	100	..	1923–31	Dec. 1, 1922	D. S. Wright, Dunkirk.
Excelsior Springs, Mo.	Bridge and park improvement	14,000	5	100.62	.	1942	Dec. 1, 1922	Guaranty Trust Co., Kansas City.
Grafton, O.	Sewer	40,588	5½	101 26	5.23	1923–32	Oct. 1, 1922	Milliken & York Co., Cleveland.
Hallstead, Pa.	Street improvement	20,000	4.6	100			Sept. 1, 1922	First National Bank, Hallstead.
High Point, N. C.	Municipal building	250,000	5¼	102.93	5.01	1925–52	Dec. 1, 1922	American Trust Co., Charlotte.
Iowa Park, Tex.	Sewer	5,000	6	103 25			Nov. 1, 1922	Breg, Garrett & Co., Dallas.
Lansing, Mich.	Lighting and power	410,000	4¼	99 199	4 50	1935–42	Jan. 2, 1923	R. L. Day & Co., Boston.
	Waterworks extension	135,000	4½	99.199	4 50	1937–45		
	Sewer	450,000	4½	99.199	4 50	1925–29		
Lenoir, N. C.	Street improvement	225,000	5½	100 21	5 48	1924–41	Nov. 1, 1922	A. T. Bell & Co., Toledo.
Memphis, Tenn.	Water	1,200,000	4½ and 5	100.19	4 86	1927-62	July 1, 1922	W. A. Harriman & Co., Inc., and others, of New York; Old Colony Trust Co. and others, of Boston, and G. H. Walker & Co., St. Louis.
	Hospital	77,000				1925–49		
	Street improvement	582,000				1925–49		
	Sewer	100,000				1925–49		
	River terminal	252,000				1927–62		
	Improvements	750,000				1923 27		
Passaic, N. J.	General improvement	632,000	4½	101 60	4 35	1923–54	Dec. 1, 1922	R. M. Grant & Co., New York.
Pelham Manor, N. Y.	Drain	28,500	4½	101 09	4 39	1927–45	Dec. 1, 1922	Geo. B. Gibbons & Co., Inc., New York.
Reidsville, N. C.	Street improvement	300,000	5¼	100 36	5 23	1925–43	Sept. 1, 1922	R. M. Grant & Co., Inc., New York.
Sea Cliff, N. Y.	Incinerator	25,000	5	103 53	4 60	1924–43	Dec 15, 1922	Geo. B. Gibbons & Co., Inc., New York.
Swedesboro, N. J.	Water	57,000	5	101 36	4 89	1924–61	Dec. 1, 1922	Swedesboro National Bank.
Wayne, Okla.	Waterworks	25,000	6	100		.....		Taylor-White Co., Oklahoma City.
Zephyrhill, Fla.	Waterworks, Street	37,500	6	100 13	5 98	1933–53	Jan 1, 1923	Prudden & Co., Toledo and American State Bank of Zephyrhill.
Port Credit, Ont., Canada	Paving	65,000	5½		6.00	1923–52	Aug. 14, 1922	C. H. Burgess & Co., Toronto.
Cumberland, Ont., Canada	Drainage	2,700	6	100		1927	Nov. 5, 1922	S. A. Lough.

changing circumstances. We recognize that the exalted place of our craftsmen has been attained through specialization, but in specializing we seem to have lost sight of the fact that there are other lines of employment than those habitually followed. I would be the last one to suggest that skilled craftsmen should undertake to become so-called 'Jacks of all trades,' but I would urge upon every idle workman that when there is inactivity in his trade he use every effort to adapt himself to some other line of work. Manifestly, the skilled workman can, if he will, do work of some other kind, but my experience has been that too often when idleness is forced upon him he rejects the thought of other employment for one or several reasons. He may not be able to secure as high wages in other employment; he may be under the impression that the secondary employment will lose him prestige."

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 7; the next, on January 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.14	$3.95	$4.40	$3.02½	$3.15	$3.85	$3.25	$3.80	$3.50
Structural rivets, 100 lb.	3.85	4.60	—5.25	3.75	4.00	4.80	4.75	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.04	3.85	—3.45	2.92½	3.05	3.62½	3.35	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	+52.50%	45%	59½%	57–5%	41%	39.2@51.8%	40%	30.00
Cast-iron pipe, 6 in. and over, ton	+55.30	+46.32	+55.50	51.67	+54.66	+64.11	53.50	+53.50	55.00
Concreting Material:									
Cement without bags, bbl.	+2.60@2.70	2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd.	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd.	1.00	1.32	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.10	1.65	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59.00	36.00	40.00	52.00	40.75	39.75	35.00	23.50	+90.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.13½	1.85	2.50	1.40	1.40	2.70	1.75	.2.80	11.00
Common brick, delivered, 1,000	+20.20@23.50	11.50	+10.90	11.00	18@19	12.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0796	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1230	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	+.93	+1.00	1.05	.95	+1.01	1.08	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	......	....	.50@.55	.56¼	.50@.60	......
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 10c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5⅓ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.92). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Cast-iron pipe up 50c. per ton at Birmingham mills; advance reflected in similar rise in warehouses throughout the country, due to increasing firmness of coke and pig-iron prices. Steel quotations, for first quarter, tending upward; with indications of better stability. Reinforcing bars firm at $2 per 100 lb., Pittsburgh. Improvement in inquiry for structural shapes; $2 per 100 lb. firmly adhered to on all business involving ordinary tonnages. Quotations of $1.90@$1.95, however, frequently apply on large tonnages. Attractive plate business for first quarter deliveries placed at minimum of $1.90 @$1.95, with maximum of $2. Plate demand moderate; confined mostly to car builders. Atlanta steel pipe discounts advanced 1.45 points, from 53.95 per cent, on 6.-in. black, to 52.5 per cent during week; market particularly strong on wrought pipe.

Cement prices firm in most cities; slightly higher in New York, with quotations at $2.60@$2.70 as against $2.60 per bbl., without bags. Brick up $1 in Dallas and $2 per M in New York. Quoted at $17@$20 in the latter city, in comparison with $15@$16 per M, wholesale, during last week.

Raw linseed oil up 1c. in Minneapolis; 3c. in New York and 4c. per gal. in Atlanta. Advances attributed to continued firmness in flaxseed market.

British Columbia fir advanced sharply in Montreal. Quotations reached $90 on structural timbers, as against $50 per M ft. b.m., one month ago. Lumber market quite firm throughout the United States.

Building construction program temporarily halted in Seattle district due to snows and freezing weather. Logging camps and lumber mills closed, for the present, throwing thousands of men out of employment.

A building trades controversy, in New York City, resulting from the refusal on the part of the International Laborers' Union, affiliated with the A. F. of L., to use materials handled by members of the Independent Union, has been amicably settled by the amalgamation of the two laborers' unions. New difficulties, however, have arisen from the threat recently made by the Masters' League of Cement Workers to refuse all agreements with the three independent cement workers' unions, should the latter join the International body. A fight is also under way to establish a State Trade Commission to act as arbitrator in all labor disputes. This measure, however, is vigorously opposed by the unions.

Volume 89 New York, December 28, 1922 Number 26

Engineering News-Record

A CONSOLIDATION OF ENGINEERING NEWS AND ENGINEERING RECORD, WITH WHICH IS INCORPORATED THE CONTRACTOR

E. J. MEHREN, *Editor*

The First Issue of the New Year

IN its first issue of each new year *Engineering News-Record* has followed the policy of indicating the trend of progress in those fields of civil engineering and construction in which outstanding developments have occurred. It has also suggested, where possible, the course of future activities. The Jan. 4 issue is planned in accordance with this policy.

ONE of its features will be a group of articles on the **Labor Situation,** covering labor shortage, seasonal employment, apprenticeship, and immigration.

A wide range of interest will be covered by other articles. The **Mississippi River Floods** will receive extensive treatment and an article on **Irrigation** will discuss the Government's responsibility for developing the remaining arid lands in the West.

Traffic Control in cities will be among the chief topics of interest, and there will be a review of the year's developments in **Concrete Design.**

Hydro-Electric Practice on the Pacific coast will be reflected in a comprehensive review of the year's developments.

There will be a survey of progress during 1922 in **Construction,** supplemented by an article which will cover improvements made in **Construction Equipment and Materials.**

IT is impossible to give here an adequate summary of the issue. For the busy engineer, contractor, and manufacturer it will present concisely a survey of major developments in the fields of civil engineering and construction.

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Engineering News-Record American Machinist
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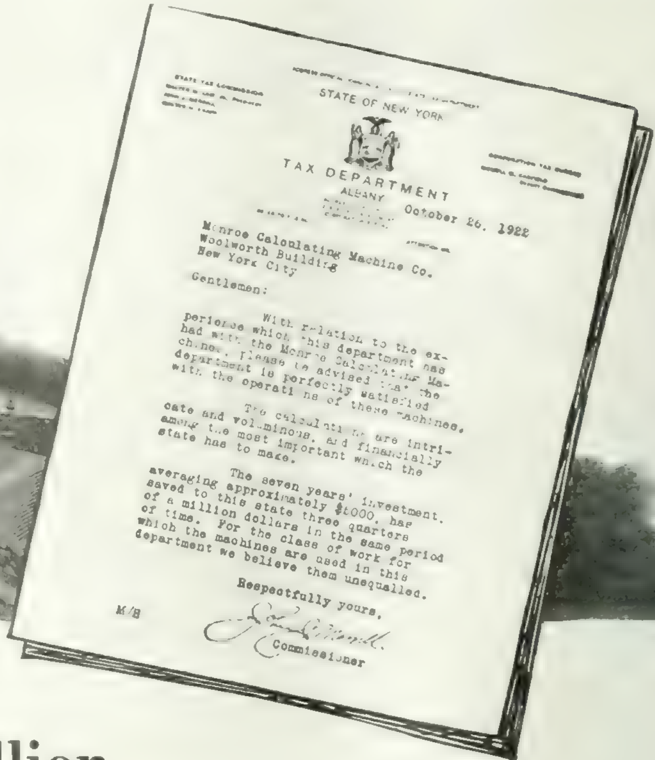
The annual subscription is $5 to any part of the United States, Canada, Mexico, Alaska, Hawaii, the Philippines, Porto Rico, Canal Zone, Cuba, Honduras, Nicaragua, Peru, Colombia, Bolivia, Dominican Republic, Panama, Salvador and Shanghai, China. Extra postage to other countries $4 (total $9 or 38 shillings). Single copy, 25 cents. Change of Address—When change of address is ordered the new and the old address must be given. Notice must be received at least ten days before the change takes place. Printed in U. S. A.

Published Weekly. Entered as second-class matter April 11, 1917, at the Post Office at New York under the act of March 3, 1879.

Member Audit Bureau of Circulations. Member Associated Business Papers, Inc.

CIRCULATION OF THIS ISSUE, 31,599 COPIES



STATE OF NEW YORK

TAX DEPARTMENT

ALBANY

October 26, 1922

Monroe Calculating Machine Co.
Woolworth Building
New York City

Gentlemen:

With relation to the experience which this department has had with the Monroe Calculating Machines, please be advised that the department is perfectly satisfied with the operations of these machines.

The calculations are intricate and voluminous, and financially among the most important which the state has to make.

The seven years' investment, averaging approximately $5000, has saved to this state three quarters of a million dollars in the same period of time. For the class of work for which the machines are used in this department we believe them unequalled.

Respectfully yours,

M/B

Commissioner

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How $5000.00 Saved Three-Quarters of a Million

IN the above letter, the Tax Commissioner of the State of New York tells how an investment of $5000.00 in Monroe Calculating Machines resulted in a saving of three-quarters of a million dollars.

And not alone New York State. Within the past month the Illinois State Highway Department made an additional installation of nine Monroes—itself a splendid tribute to Monroe service.

The Monroe has proved itself of great value to the engineering profession in every phase of its figure-work, whether computing level-readings and areas, figuring estimates, payrolls or costs, or working on the complicated calculations of laboratory tests and formulae.

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Lower Bids With More Profit

WRITING Carney in your plans is writing profit on your books. Thousands of contractors know that Carney enables them to make lower bids and to give their clients a better job with more profit to themselves.

To those who have never used Carney, this may seem impossible. The following economies show why you can make lower bids.

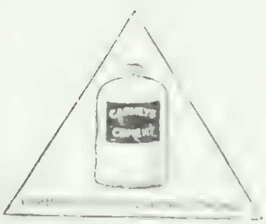
The first cost of Carney is less. You have no lime to buy, for Carney does not require lime in mixing. There is no slacking of lime. The simple formula, "One part Carney — three parts sand — no lime," prevents mistakes and makes mixing easy.

Mixing Carney requires less labor and is quicker. There is no waste for left-over mortar can be used the next day by re-tempering with water. Carney lays approximately 1000 bricks to the barrel. Men work faster on the wall because Carney is more plastic and smoother working.

On top of these advantages Carney builds a stronger wall. The mortar becomes harder than the brick or tile it joins. Thus it is that Carney enables you to submit lower bids, get more contracts, and build a better wall—all with more profit.

It Will Pay You to Investigate

It will pay you to investigate a cement with the advantages given above. Let us send you the Carney Catalog for your files.



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Mankato, Minn.

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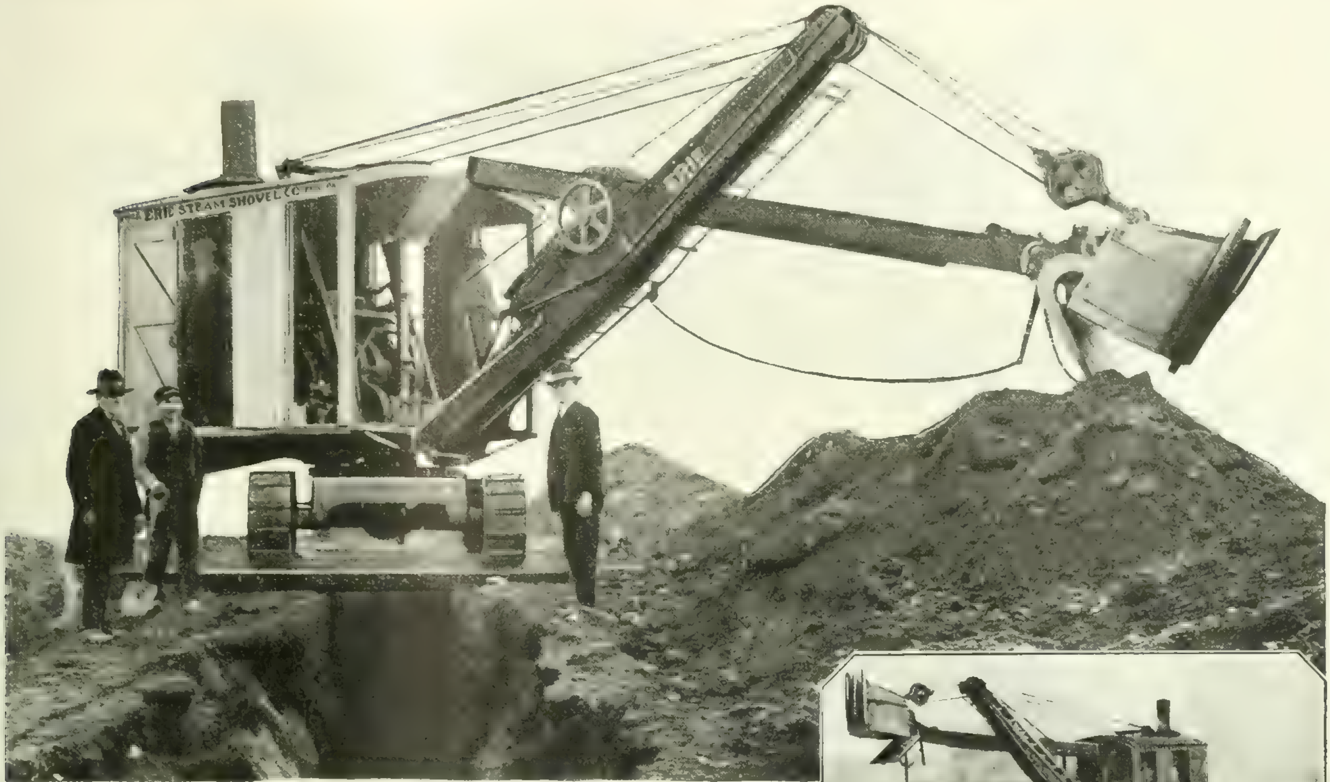

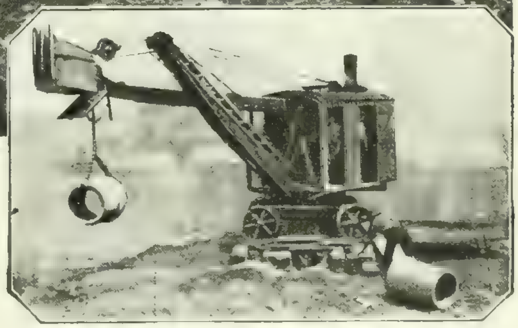

"Our 13-ton 'A' ERIE

did the excavating, laid the pipe, and backfilled

on this storm sewer contract,"—

Sweeney Bros., Scranton, Pa.

"While we dug ahead a short distance with the **ERIE**, the men prepared the trench for the pipe right behind the shovel. We would then swing the ERIE around to lay the pipe, which the men promptly jointed. Then the ERIE continued digging, dumping the excavated material upon the pipe laid. We got very satisfactory results with but very few men for the entire operation."— Sweeney Bros., Contractors, Scranton, Pa. (Owners of 5 **ERIES**).

As another contractor expresses it: "We have found that the **ERIE** is the best all-around trenching machine on the market."— **Austin B.** Cable, Pres., The Cable Co., Canton, O. (Owners of **5 ERIES**).

If you have trench work, cellar work, road grading— it will pay you to investigate the "A" ERIE. It is economical in first cost and operating cost; for work in its class, it has many advantages over a heavier machine. *Write us for full information.*

In order to handle all three operations as the machine goes along— digging the trench, laying the pipe and backfilling— you have to move the shovel over the excavated trench. When you strike soft and crumbly material like that shown in these two photos, you are mighty lucky if you have an "A" ERIE, weighing only 13 tons. The light weight prevents cave-ins and saves a lot of trouble. And the "A" has plenty of power for digging trench through stiff clay; easily handles large boulders.

For maximum output, or unusually hard digging, use the "B"

In material like hard shale, stiff clay or hardpan, the 20-ton "B" ERIE gives excellent output. Used for quarry work, cellars, coal stripping, road grading, as well as trench work.

For very deep trench or wide ditch digging—

either the 13-ton "A" ERIE or the 20-ton "B" ERIE can be easily and quickly changed over to a locomotive crane to handle a clamshell bucket. Also gives excellent results handling a dragline bucket for digging drainage ditches, dredging, etc.

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ERIE Steam Shovel Co. Erie Pa.

Ransome mixed the concrete

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117 Wall Street
New York June 9, 1922
File 2016

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147 Milk Street,
Boston, Mass.

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Throughout the construction period of two years, during which time your firm had charge of the engineering design of the boiler house and coal handling facilities and the construction of the entire plant, you have rendered a service to this Company marked by skill, efficiency and co-operation of a pronounced character, and we take this opportunity of congratulating you upon your part in this great enterprise and know that you share our pride in its completion.

Yours very ~~truly~~,

Vice-President

A letter received by Stone & Webster, as constructors, at completion of the great Baltimore Refinery of The American Sugar Refining Company pictured below.

STONE & WEBSTER
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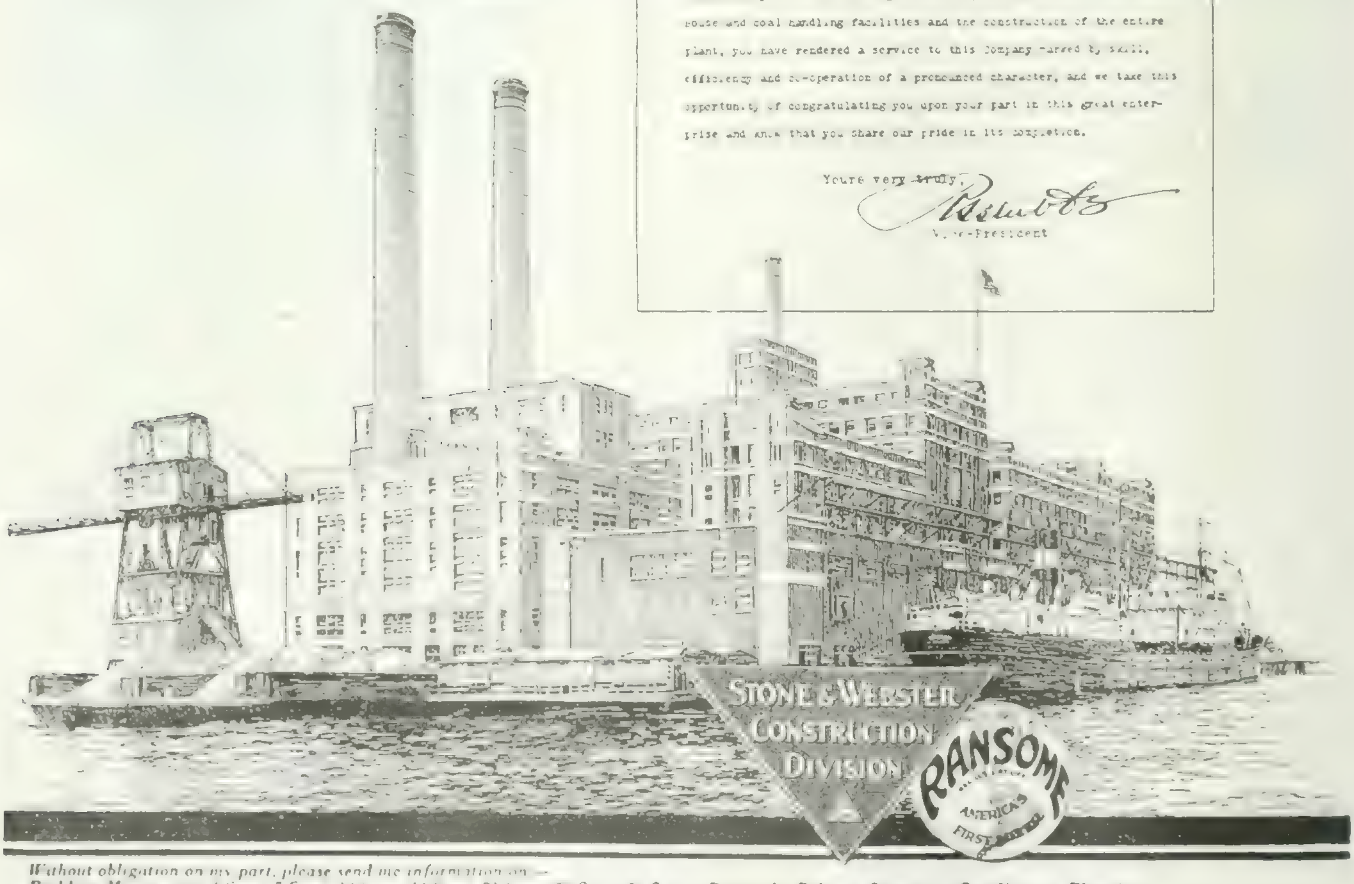

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RANSOME CONCRETE MACHINERY CO.

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Every Marion Revolving Shovel can be changed into orange peel or clamshell crane, or dragline excavator. Attachments are interchangeable and can be easily added in the field.

Are You Satisfied—
With Your Present Operating Costs?

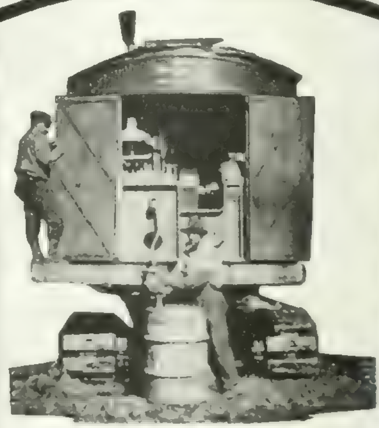
Perhaps you are—but yet your shovel operations maybe costing far more than they should. To make sure, check your records with the cost data we have compiled on our new electric and gasoline-electric shovels.

One owner writes that he saved from $12.00 to $15.00 a day on a grading job—another tells us his total daily cost for both labor and fuel was $14.50 (just about the cost of the operator and fireman on a steam machine) —still another says the additional operating time each day increased his output fifteen percent, there being no time lost coaling up or waiting on steam.

Such savings as these are easily possible with Marion Electrics and Gasoline-Electrics. When you buy one of these shovels you get a decidedly practical and efficient machine—one that will make you more money than any other shovel of similar size and type now on the market.

Consider the Many Advantages of This New Type

Less fire risk.
No fireman required.
No boiler feed water to supply.
Fast and flexible as a steam shovel.
Will do anything a steam shovel can do.
Can be operated at less cost.
Engine cannot be stalled.
No complicated and sensitive frictions to adjust.
Can be handled by any operator familiar with a steam shovel.



Taking on Fuel

On a Marion Gasoline-Electric this requires only a few minutes time. Supply tank is located under the engine and holds sufficient gasoline for a full day's run. Compare this with the "coaling up" of a steam machine, especially in wet and muddy places or in isolated localities far from the source of fuel supply.

Marion Electric and Gasoline-Electric Shovels are fully described in Bulletin A-301

Request from you will bring a copy promptly.

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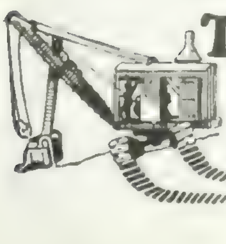
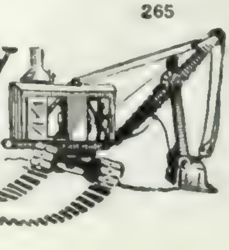


The Marion Steam Shovel Company
Marion Ohio.



Marion Crawler Trucks Make Hard Going Easy

Austin Draglines have been developed from the Contractor's View-Point of a Practical Machine

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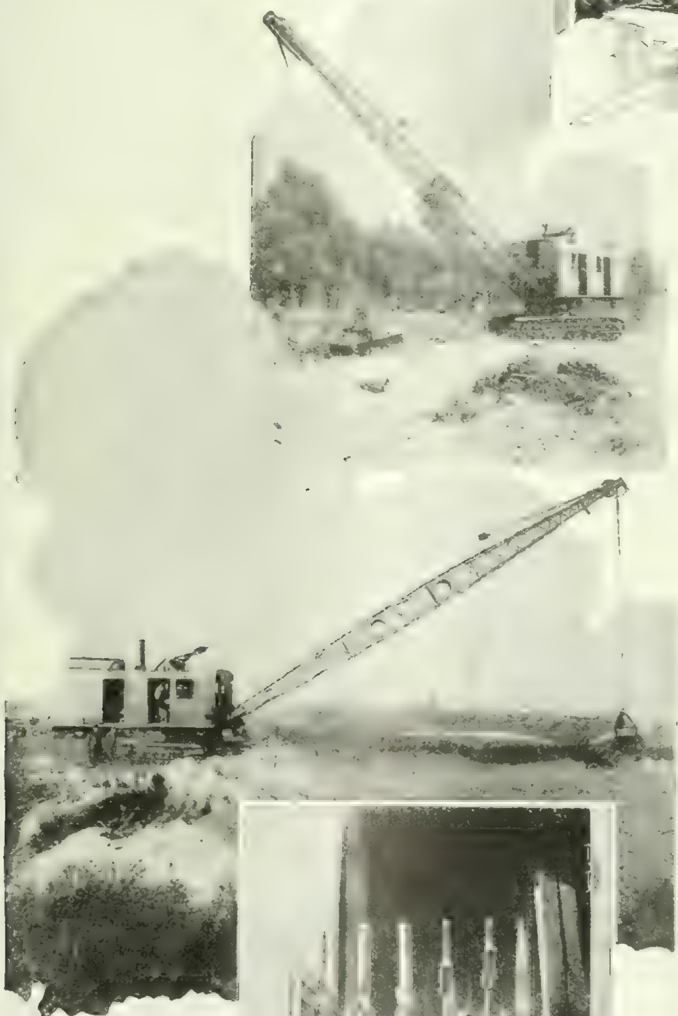

The completeness of design makes Austin draglines an asset.

Aside from the variation in weight of the machines, which is due to increased size of parts, the design of all Austin Draglines is standard.

The standardization of design has been brought about through repeated successful operation of machines on the job.

They are fast and smooth in operation.

The graduated valve, air or steam control, on sizes No. 6 and larger, increases their handling efficiency—as well as the yardage production.

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"MOVES THE EARTH—MIXES THE CONCRETE"

They Stand the Gaff!

A-W GRADERS are built to last, and the large number of 20- and even 30-year-old machines still in active service testifies that they do. No matter what your requirements, there is a model somewhere between the 1000-pound Midget and the 10,500-pound No. 20 that will meet them perfectly.

A distinctive feature of the line is the wide range of adjustments found on all of its members. Take the above photograph as an illustration. How many other graders could cut such a perfect back slope without the use of a special back sloper attachment?

It Was Easy for This Austin Mammoth!

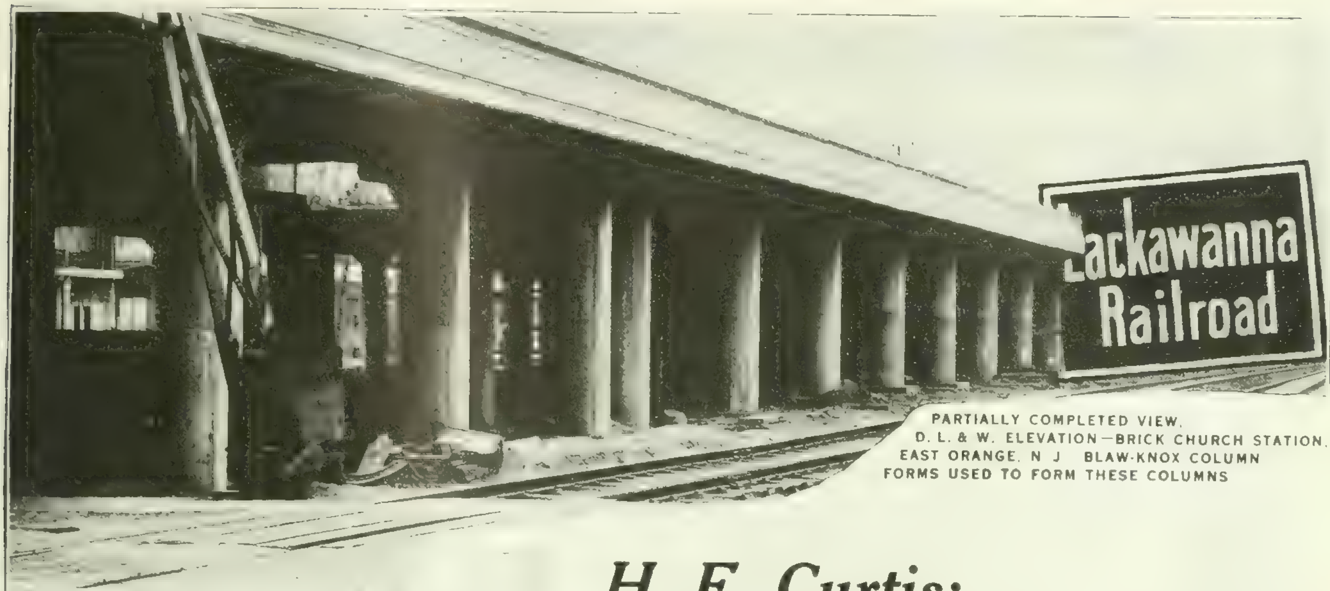
"Signs of Better Roads," our latest catalog, illustrates and describes the entire A-W line of road-making and maintenance machinery. Ask us for a copy.

The Austin-Western Road Machinery Co.

CHICAGO, ILLINOIS

Branch Warehouses and Service Stations:

Albany, Atlanta, Billings, Columbus, Dallas, Denver, Fargo, Jackson, Miss., Kansas City, Mo., Little Rock, Los Angeles, Louisville, Nashville, New Orleans, New York City, Oklahoma City, Philadelphia, Portland, Ore., Richmond, Salt Lake City, San Francisco, St. Paul, Wahoo, Neb.



PARTIALLY COMPLETED VIEW.
D. L. & W. ELEVATION—BRICK CHURCH STATION,
EAST ORANGE, N. J. BLAW-KNOX COLUMN
FORMS USED TO FORM THESE COLUMNS

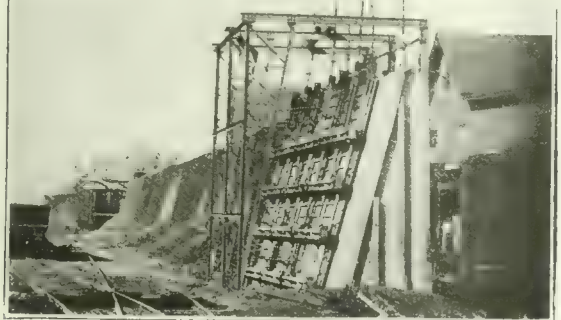
H. F. Curtis:
Blaw-Knox Steel Forms Show a 50% Saving

H. F. Curtis is using Blaw-Knox Steel Forms on the D. L. & W. elevation work at East Orange, N. J. This includes the construction of retaining walls and a concrete viaduct 75 ft. wide, 1,080 ft. long, supported by 230 round concrete columns. The long experience of Mr. Curtis in connection with engineering achievements of this character renders his opinion of special value. He says—

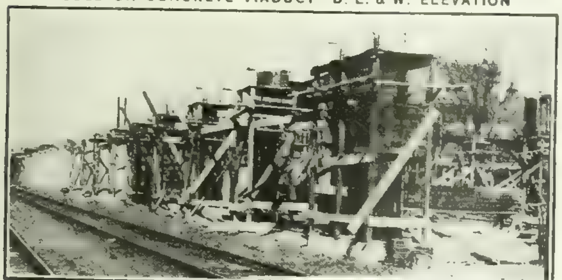
> *"On the above work I have and am still using the Blaw System of Steel Forms and by the use of these forms I have effected a saving over wood forms which I have used on previous work of this nature. I might add that the use of steel forms on my work has made a saving of 50% over wood forms."*

Mr. Curtis is enthusiastic about Blawforms because they prove their practical value and saving at every turn. Blaw-Knox Form Engineers will develop forms for you and prove their savings conclusively.

There is no job too big or too complicated for Blawforms to handle. Write for our catalog illustrating the work Blawforms have done.

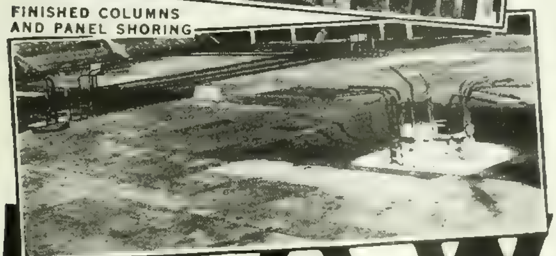


BLAW-KNOX TRAVELING STEEL WALL FORM
USED ON CONCRETE VIADUCT—D. L. & W. ELEVATION



BLAW-KNOX STEEL COLUMN
MOLDS AT WORK

FINISHED COLUMNS
AND PANEL SHORING



BLAW-KNOX
ROAD BUILDER'S EQUIPMENT
STEEL FORMS FOR CONCRETE
SECTIONAL STEEL BUILDINGS
CLAMSHELL BUCKETS
STRUCTURAL STEEL-PLATE WORK
TRANSMISSION TOWERS
WATER COOLED FURNACE APPLIANCES
FORGE AND HAMMER WELDING

BLAW KNOX

TRADE MARK BLAW-KNOX REG. U.S. PAT. OFF.

PITTSBURGH, PA.
601 Farmers Bank Bldg.

COMPANY

New York-Chicago-Detroit-Baltimore
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MORE THAN STERLING ON SILVER Sterling

– more Efficient because they Wheel Easier.

SAVE TROUBLE

Good wheelbarrows eliminate troubles on a building job, where poor ones cause plenty of extra grief, delay and expense.

Self-Lubricating Wheels
Riveted Legs

Two good reasons why Sterling Wheelbarrows stand up well under all conditions. Yes, and there are many more exclusive improvements which make "Sterling" a safe investment and give you real wheelbarrow efficiency.

Wheels 50% Easier.

Write for the Sterling Catalog

Sterling Wheelbarrow Company

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NEW YORK
BOSTON
CLEVELAND

DETROIT
CHICAGO
ST. LOUIS

CANADIAN AGENTS-MUSSENS LIMITED, MONTREAL, TORONTO, WINNIPEG, VANCOUVER


KOEHRING
the Heavy Duty Mixer
Yardage, remember— first goes into the mixer!
The charging skip on a concrete mixer starts with heavy load from dead weight and elevates at high speed. Terrific strains throughout the mixer, unless the frame and super structure have heavy duty construction. Less strain on the Koehring because the Koehring skip cables get a more perpendicular "pull" —and the Koehring skip goes to the high charging angle that shoots material into the drum in a swift, clean slide, without need for pounding skip against the frame.
Koehring Heavy Duty Construction matches the operating speed of the Koehring paver—the fastest paving unit.
Capacities:
Construction Mixers: 10, 14, 21, 28 cu ft. mixed concrete. Write for Catalog C—8.
Pavers: 7 10, 14, 21, 32 cu ft. mixed concrete. Write for Catalog P 8.
Dandie: Light mixer, 4 and 7 cu ft. mixed concrete; power charging skip, or low charging platform. Light duty hoist. Write for Catalog D—8.
KOEHRING COMPANY
MILWAUKEE. WISCONSIN
KOEHRING HEAVY DUTY K

SMITH MIXERS

Confidence

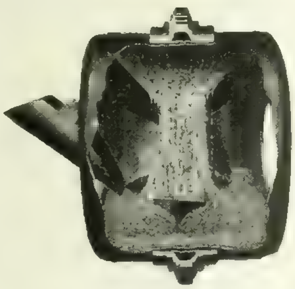
The confidence the public has in the strength of concrete structures—foundations, bridges, dams, etc., is really a blind confidence.

But the confidence the construction man has is to a great extent a result of his knowledge of the permanent concrete mixed in his Smith Mixers.

Construction men are aware of the responsibilities they are shouldering,—hence the desire to be sure of the best concrete mixing on their contracts.

Smith Mixers are made for the smallest and largest jobs. In all, the design insures thorough mixing.

Good Concrete and Speed



Users of Smith Mixers make speed because the aggregate when dumped into the drum is properly taken care of by the revolving buckets, and the "end-to-center" mixing action keeps the mix where it should be.

Also, many contractors have standardized on Smith Mixers, their working crews becoming more expert and efficient, and requiring less supervision,—both of which mean better coordination and steadier concrete production. Ample reserve is provided in the Smith power plant.

THE T. L. SMITH COMPANY

1154 *32nd Street, Milwaukee Wis.*

New York Office and Warehouse [illegible]

[illegible]

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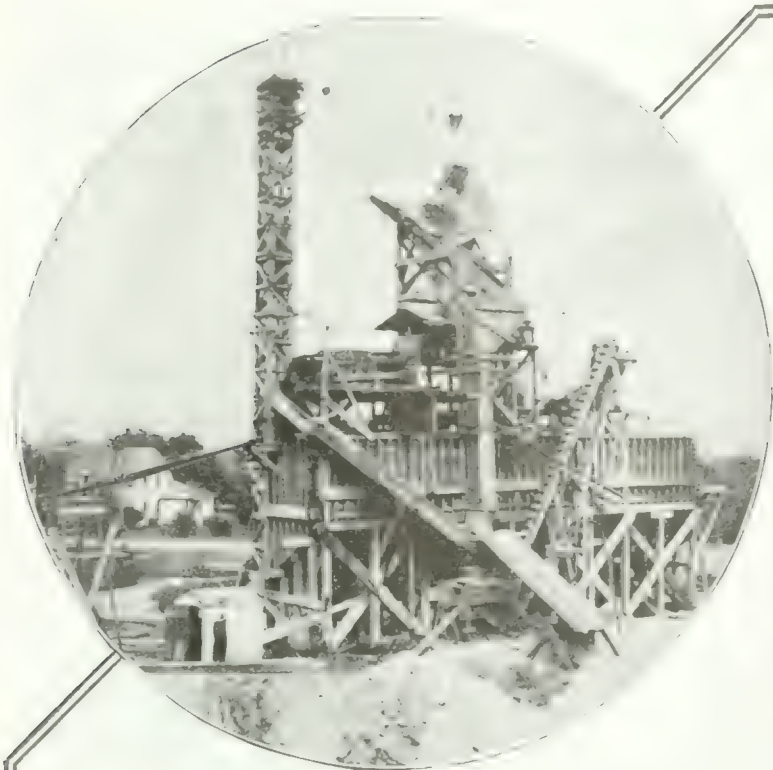

Telsmith Solves a Gravel-Washing Problem

A little story illustrating the value of reliable engineering counsel in designing gravel handling plants.

In 1920, the City of Red Wing, Minnesota, owned a gravel pit, equipped with quite a large storage bin, a good drag-line outfit, a worn-out jaw crusher and a totally inadequate dry-screening plant. Mr. William Geisheker, city engineer, consulted the Telsmith agent in St. Paul. Mr. Geisheker furnished a drawing of this plant as it stood; and Telsmith engineers prepared plans and specifications for the re-construction of the plant. To secure an output of 20 cu. yds. of washed gravel per hour, the following new equipment was recommended:

Telsmith Primary Breaker, No. 3 size, manganese equipped;
Telsmith Plate Feeder, 16 in. x 5 ft.;
Telsmith Heavy Duty Washing Screen, 32 in. dia. by 12 ft. long;
Telsmith Sand Tank, No. 5 size.

It's a mean job to revamp an old plant, rectifying the errors in an earlier design to sort out the good material from that which is worthless and fit in new machinery into an old structure. Telsmith did the job well. The Red Wing plant has now been operating for two years. It has produced excellent results under difficult conditions.

We don't yearn for "patch jobs," but we cite this one just to illustrate what Telsmith can do when necessary. Good machinery plus a thorough knowledge of gravel plant practise—that's a hard combination to beat. We are here to serve you—to furnish you modern machinery and reliable engineering counsel. Glad to send you our Catalog No. G-P-1 (Gravel Pit equipment) and Bulletin No. 155 (Telsmith Crushers). No obligation.

SMITH ENGINEERING WORKS

3198 LOCUST ST., MILWAUKEE, WIS.

Canadian Representatives, Canadian Ingersoll-Rand Co., Montreal, P. Q.

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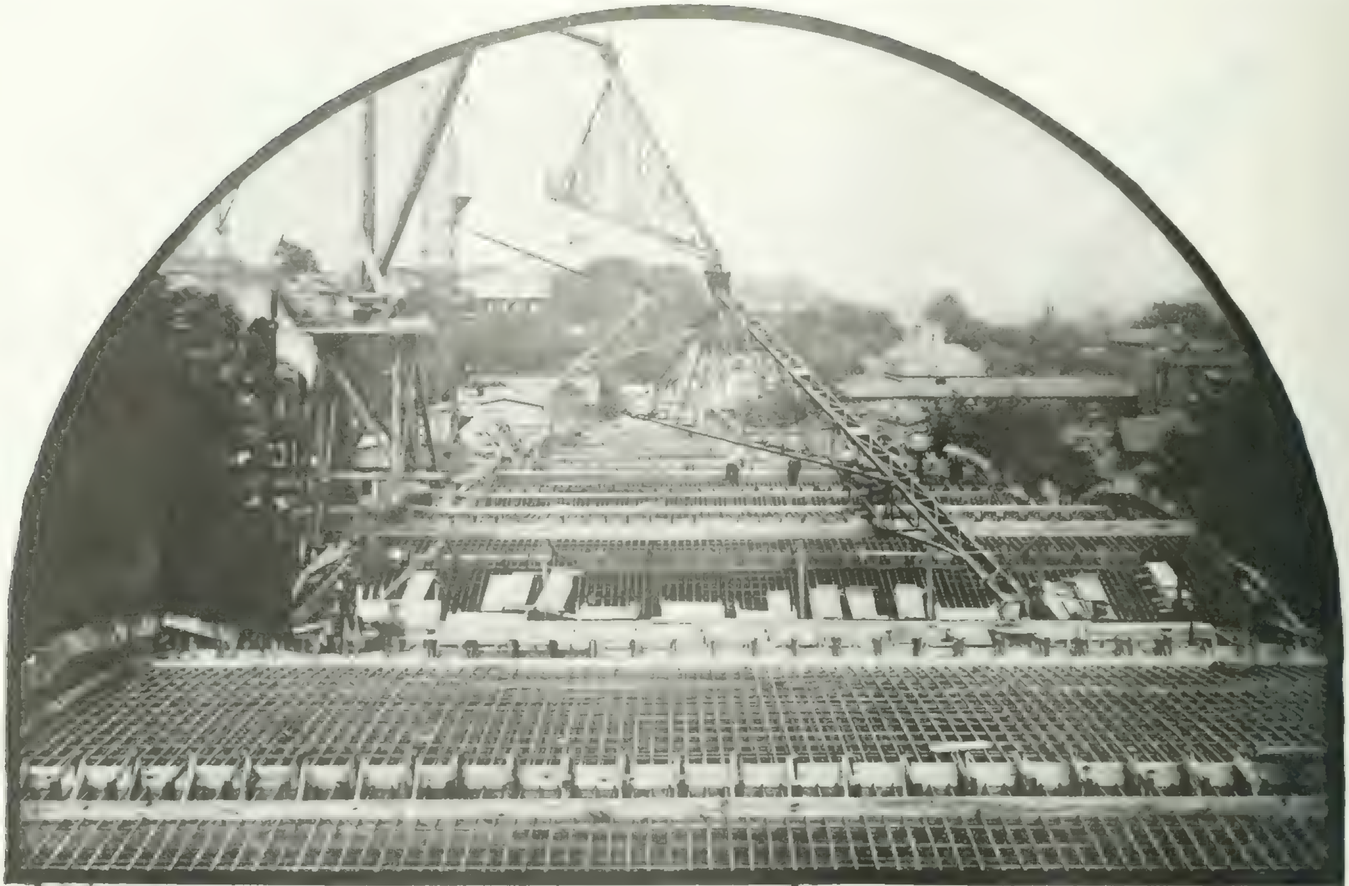

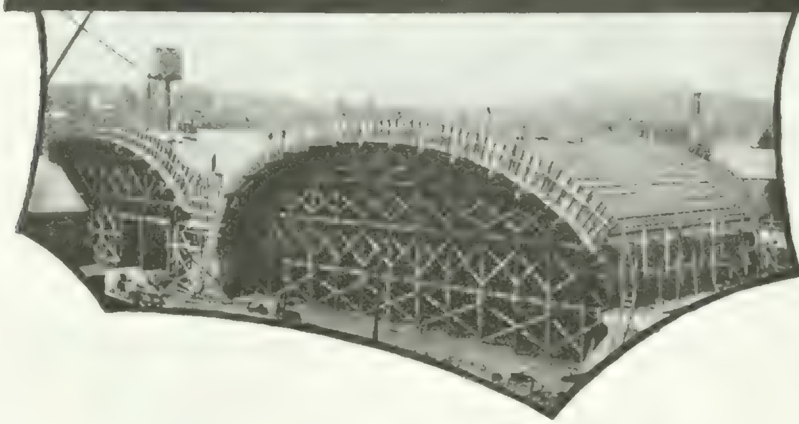

Courtesy, Rogers & Hagerty, Inc., Contractors

Bethlehem Reinforcing Bars on "Hill to Hill Bridge," Bethlehem, Pa.

Bethlehem Reinforcing Bars *for* Concrete Construction

BETHLEHEM STEEL COMPANY—*General Offices:* BETHLEHEM, PA.

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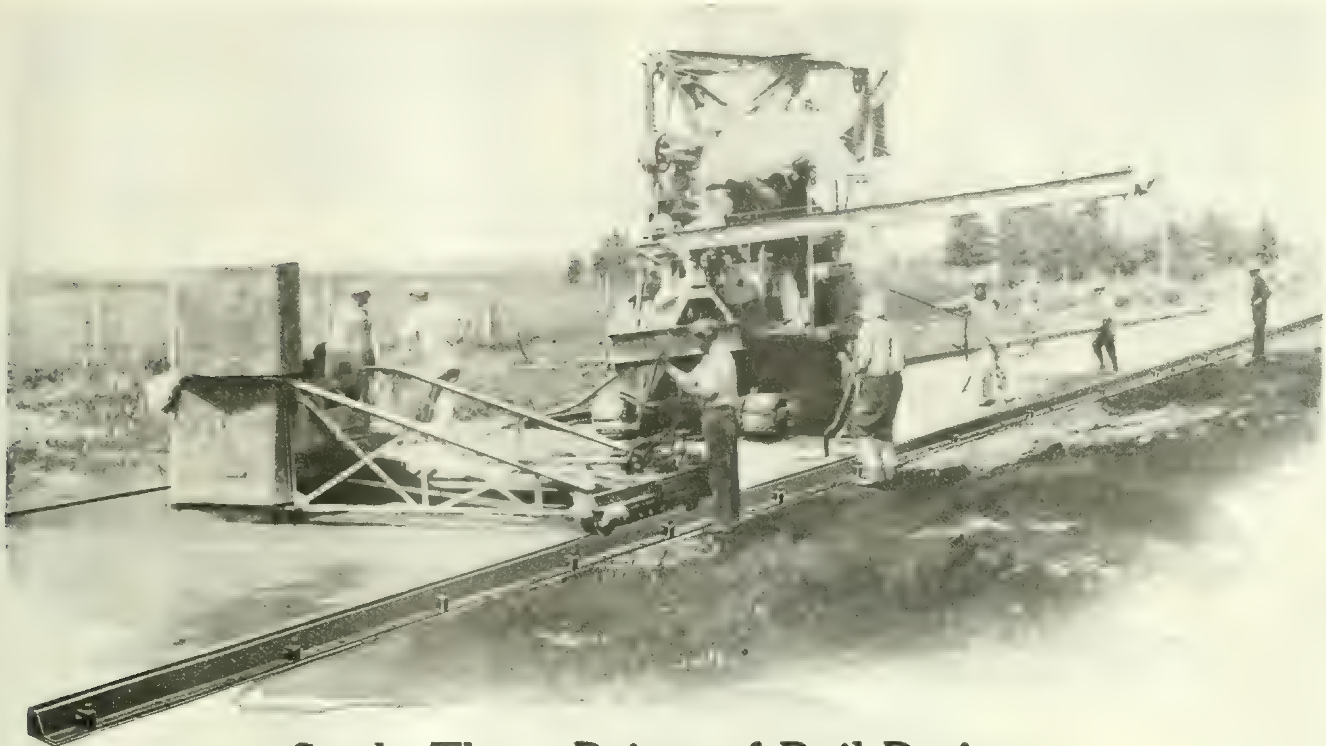
BETHLEHEM



Study These Points of Rail Design

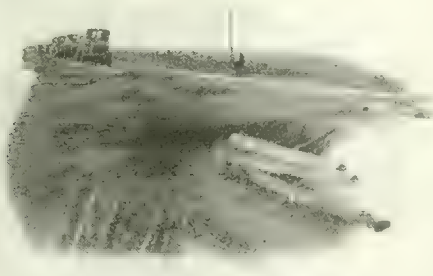
DOMINANT strength—sturdiness adequate to the most punishing work—came to the road rail field with Metaform. The tube-like, continuous web construction of Metaform Road Rails offers not merely increased strength, but old-type strength literally multiplied.

Metaform superiority rests not alone on the ability of these rails to come through job after job with absolutely no sign of deterioration—but on their handiness, the speed with which they can be laid, aligned and stripped.

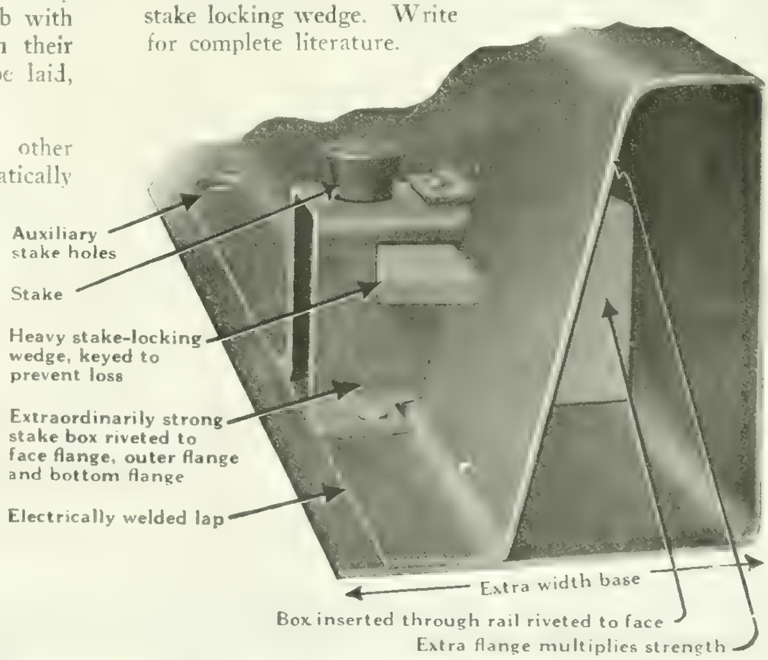
Metaform design eliminates pedestals and other jointing devices. But the rail-ends automatically lock into a husky joint that helps make a set-up solid as a railroad track. Rails may be removed instantly, at any point in the set-up, to form side-roads.

Study the points of construction shown below. Note the continuous web—lapped, riveted and welded. The tremendously stout stake box, with non-losable stake locking wedge. Write for complete literature.

METAL FORMS CORPORATION
1445 Booth St. Milwaukee, Wis.



Sections can be instantly opened for side roads



Metaform Road Rails

Dutch Boy Red-Lead

Preserving your steelwork

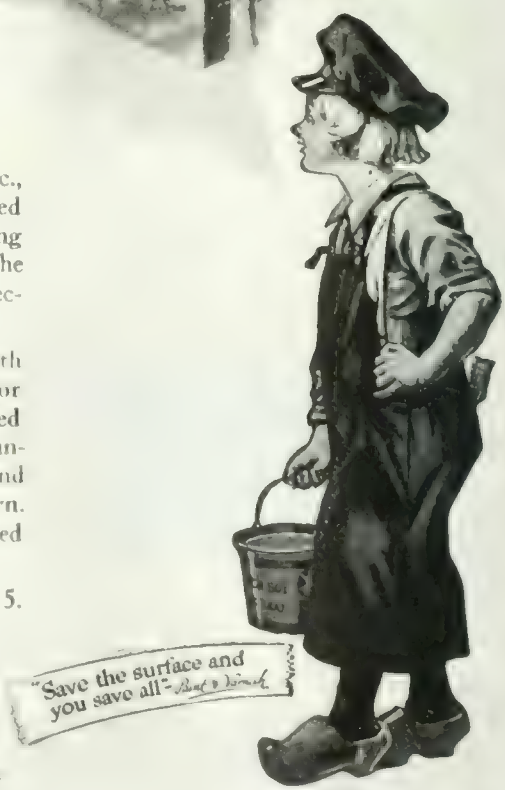
Strong and durable as iron and steel are, rust can eat into a big bridge or any such structure and eventually destroy it. But there is a way to prevent rust from eating your steelwork.

Dutch Boy Red-Lead paint prevents metal from rusting. It sticks tight to the surface and keeps out moisture and air. Weather cannot pry it loose. Hard enough to stand all kinds of weather, it also is elastic enough to expand and contract without cracking.

Contact surfaces, joints, rivets, etc., that are concealed after erection need particular attention. Here painting with Dutch Boy Red-Lead in the shop or before erection gives the necessary protection.

Dutch Boy Red-Lead comes both in paste and in liquid form. For priming coats it should be used straight. The liquid is supplied untinted and also tinted black, light and dark green, and light and dark brown. With the paste any dark color desired can be obtained.

Write for Painting Helps No. 5.



NATIONAL LEAD COMPANY

New York, Boston, Chicago, San Francisco
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JOHN T. LEWIS & BROS. CO., Philadelphia — NATIONAL LEAD & OIL CO., Pittsburgh

CHICAGO

JANUARY 15-19, 1923

ROAD SHOW

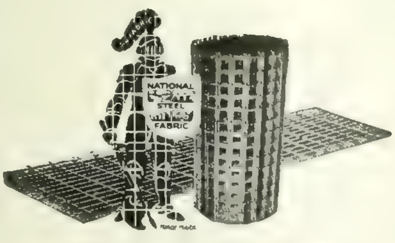
JANUARY 15-19, 1923

We extend you a cordial invitation to visit with our district managers at Booth 12-39, on the Second Floor Balcony of the Coliseum.

Messrs. Harry Beaton of Philadelphia, Charles Dugan of Chicago, Harry Gibboney of Atlanta, and one or two men from the home office will be present to welcome you.

All of them will do everything possible to make your trip pleasant and profitable. If there is anyway in which they can serve you, do not hesitate to call upon them.

Until the 15th, then.



Furnished in Rolls or Sheets

National Steel Fabric Company

(Subsidiary of Pittsburgh Steel Company)

700 Union Arcade, Pittsburgh, Pa.

ATLANTA, CHICAGO, CLEVELAND, DENVER, DETROIT, LOS ANGELES
MINNEAPOLIS, NEW YORK, PHILADELPHIA, ST. LOUIS
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World's Largest Manufacturers of Welded Steel Fabric

NATIONAL STEEL FABRIC CO

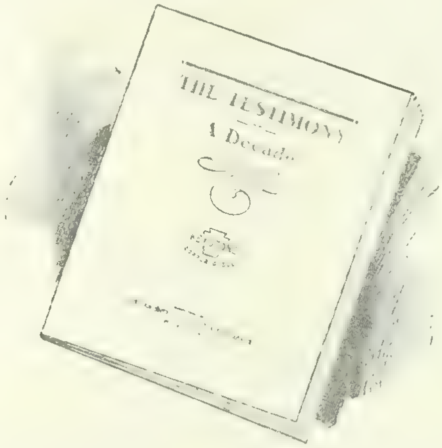
Subsidiary of PITTSBURGH STEEL CO

UNION ARCADE BUILDING PITTSBURGH, U.S.A.

KEYSTONE COPPER STEEL

THE ACHIEVEMENT of alloying steel with copper to increase its *resistance to rust*, is a most important one. Copper puts into Sheet Steel a new measure of permanence that cannot be obtained without its help. The proof is positive and impartial—the result of time and weather exposure.

Your District Sales Office will be pleased to supply this booklet.



Send for new set of Weight Cards and Apollo Calendar.

We have assembled in a brief booklet a few of the outstanding facts showing the superiority of Copper Steel, together with opinions of eminent authorities, official photograph of weather tests, and graphic chart showing corrosion losses of steel and iron sheets. This booklet is of particular interest to engineers, contractors, and users of sheet metal—and will be gladly sent upon request.

This Company is pleased to assist you in the solution of your sheet metal problems. Our large group of modern plants provide extensive facilities, and with these we combine an able and skilled personnel of long experience, whose earnest desire is to serve you well—and supply products that render the full measure of satisfaction.

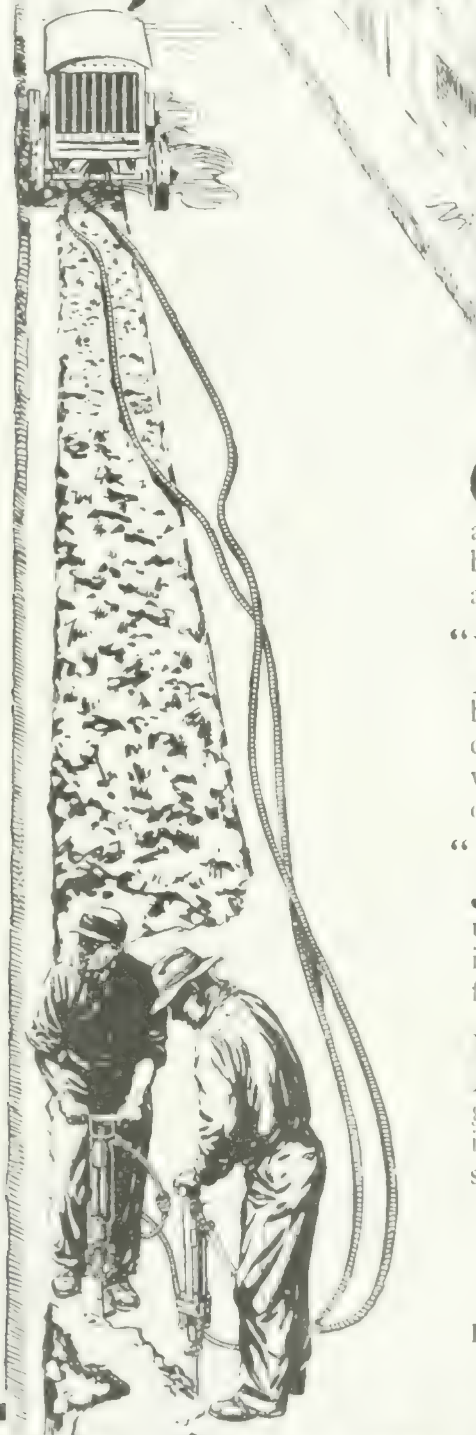
American Sheet and Tin Plate Company

General Offices: Frick Building, Pittsburgh, Pa.

MANUFACTURERS OF

Sheet and Tin Mill Products for all purposes—Black Sheets, Galvanized Sheets, Tin and Terne Plates, Special Sheets for Stamping, Corrugated and Formed Roofing and Siding Materials, Electrical Sheets, Wellsville Polished Steel Sheets, Automobile Sheets in all grades, Deep Drawing Sheets, Stove and Range Sheets, Black Plate, Etc.

Use IR Portable Compressors



"PAVING BREAKERS" and I-R PORTABLE COMPRESSORS enlarging manhole.

COMPRESSED-AIR operated machinery is being used to a greater extent every day for cutting asphalt, breaking out concrete, drilling rock, sandblasting, paint spraying, etc. It does the work rapidly and economically, is comfortable to operate and sturdy.

"PAVING BREAKER"—a light, compressed-air operated one-man machine for cutting asphalt, breaking up concrete roads and foundations and general demolition work. The compressed-air method does the work in one-fourth the time and at one-third the cost of hand methods.

"JACKHAMER"—an automatically rotated hammer type rock drill, hand held or mounted and used in all kinds of general rock drilling work. It is operated by one man and is now the standard drill for trench and contract work.

PORTABLE COMPRESSORS—complete air compressor plant consisting of: air compressor, gasoline engine or electric motor, radiator and cooling system, air receiver, etc., all mounted on a substantial all-steel truck with steel wheels and axles.

Bulletin No. 4051—"Paving Breaker"
Bulletin No. 4046—"Jackhamers"
Bulletin No. 3315—Portable Compressors

INGERSOLL-RAND COMPANY, 11 Broadway, New York

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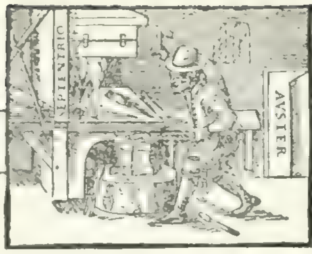
Ingersoll-Rand

FROM GILBERT'S  *DE MAGNETE —*

"WORD MONGERS" *and* "CHATTERING BARBERS"

"Word mongers" and "chattering barbers," Gilbert called those of his predecessors who asserted that a wound made by a magnetized needle was painless, that a magnet will attract silver, that the diamond will draw iron, that the magnet thirsts and dies in the absence of iron, that a magnet, pulverized and taken with sweetened water, will cure headaches and prevent fat.

Before Gilbert died in 1603, he had done much to explain magnetism and electricity through experiment. He found that by hammering iron held in a magnetic meridian it can be magnetized. He discovered that the compass needle is controlled by the earth's magnetism and that one magnet can remagnetize another that has lost its power. He noted the common electrical attraction of rubbed bodies, among them diamonds, as well as glass, crystals, and stones, and was the first to study electricity as a distinct force.

"Not in books, but in things themselves, look for knowledge," he shouted. This man helped to revolutionize methods of thinking—helped to make electricity what it has become. His fellow men were little concerned with him and his experiments. "Will Queen Elizabeth marry—and whom?" they were asking.

Elizabeth's flirtations mean little to us. Gilbert's method means much. It is the method that has made modern electricity what it has become, the method which enabled the Research Laboratories of the General Electric Company to discover new electrical principles now applied in transmitting power for hundreds of miles, in lighting homes electrically, in aiding physicians with the X-rays, in freeing civilization from drudgery.

General Electric Company

General Office *Schenectady, N.Y.*

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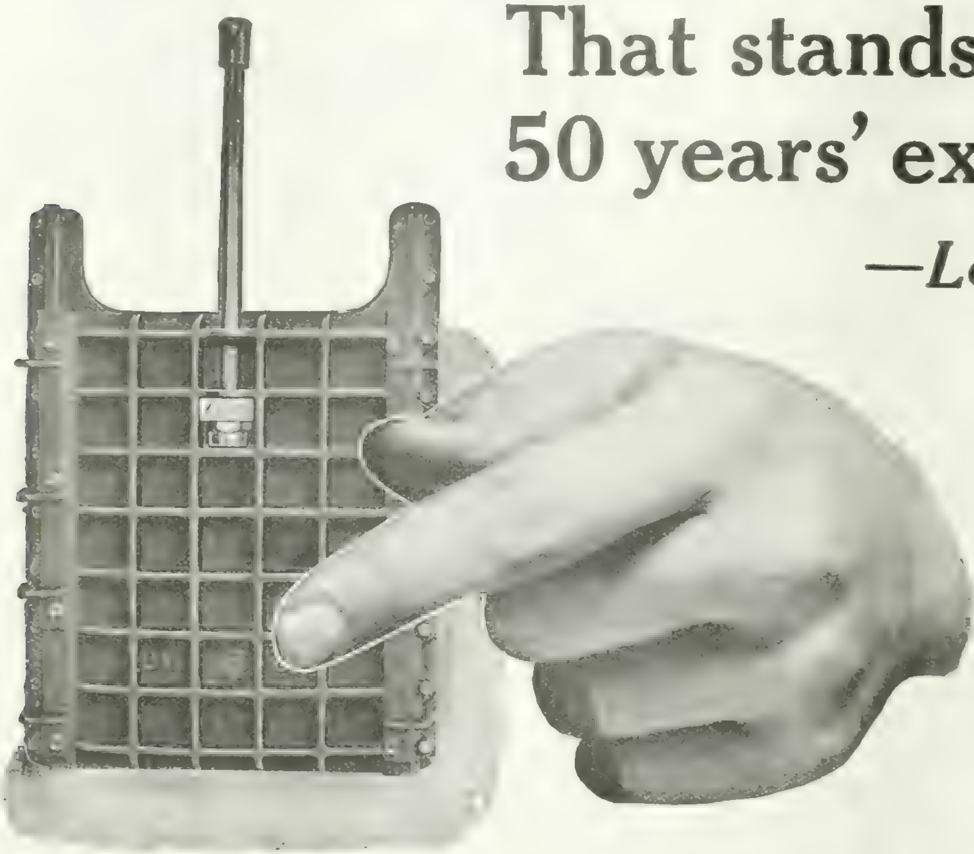
CHAPMAN

That stands for 50 years' experience

—Look for it!



Sluice Gates With a Pedigree

Any good foundry can produce a sluice gate. Perhaps it will be a *good* sluice gate. But is it worth while to take chances? You must ask yourself whether or not the sluice gates you purchase will simply save you money on *first* cost—or over a long period of years of operation. You must ask yourself whether they have been well designed, whether the workmanship and metals are up to a certain standard of excellence. And in Chapman Sluice Gates all these questions are answered affirmatively—because back of every Chapman Sluice Gate lie 50 years' of experience and reputation. Send for the Chapman Catalog 38—a fine "text book" of fine products.

The Chapman Valve Mfg. Co., Indian Orchard, Mass.

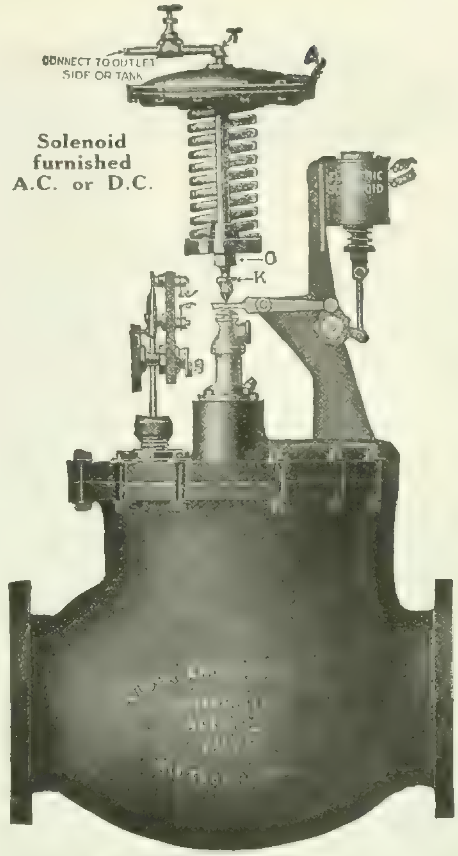
BRANCHES:

New York, Pittsburgh, Detroit, Chicago, San Francisco, Houston, Boston, Philadelphia, Cleveland, Los Angeles, Tulsa, Syracuse

VALVES

The test of actual years of Service has demonstrated Golden-Anderson

Patented Automatic Cushioned "Stop-Starter Electric" Controlling Altitude Valves

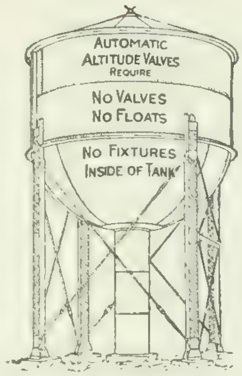


Solenoid furnished A.C. or D.C.

Sizes to 30 in.

You can't afford to experiment with systems of electrical control of water-level (pumps) in your standpipes, tanks, reservoirs. The failure of a "system" may mean heavy loss in water, revenue, troubles, complaints, etc. Select the *best you can* possibly afford, after thoro investigation —remembering always that the valves shown here have been proven efficient for this work by years of real service.

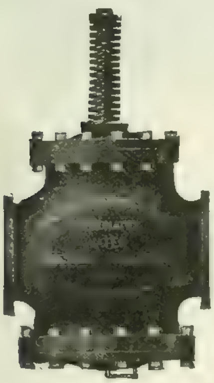
These valves will "cut in" or "cut out" one or more driven pumps. Actuated by the fall or rise of water level in standpipes, tanks or reservoirs. Control pumps automatically from distant points if desired. By maintaining a constant water level they stop water waste due to overflow, and also all unnecessary pumping. For high or low pressure. Air and water cushioned. No floats or fixtures. No water hammer or shock. No metal to metal seats. Solenoid furnished for alternating or direct current. Especially adapted for railroads, water works and industrial plants.



"No Floats or Fixtures"
"No Water Hammer or Shock"

Will Also Operate Warning Bells and Signal Lights

"Hosts of References"—Every Valve with an Absolute Guarantee



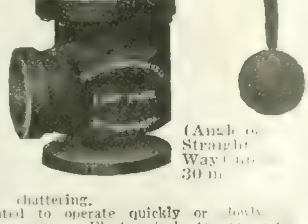
Golden-Anderson Patent

Automatic Cushioned Water-Regulating Valves

1. Maintain an absolutely constant reduced water pressure regardless of pressure fluctuation on the initial side.
2. Perfectly cushioned both in opening and closing. No metal to metal seating. No sticking or chattering.
3. Absolutely self contained. No auxiliary valve or by-pass is necessary.
4. Once adjusted, no further attention is required.
5. Sizes to 30 inches.

Golden-Anderson Pat.

Automatic Float Valves



(Angle or Straight Way) to 30 in.

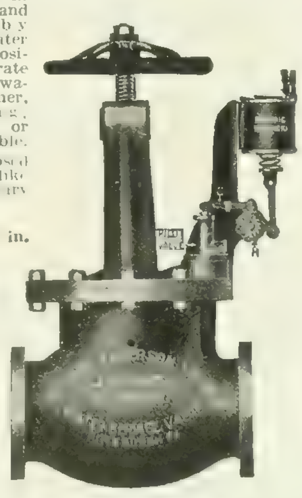
1. Accurately control the water in open tanks, hot wells, reservoirs, etc., between two fixed limits.
2. Cushioned by both water and air. No metal to metal seating, pounding, sticking or chattering.
3. Can be regulated to operate quickly or slowly. High or Low pressures. Float swivels to any angle desired.
4. Construction. Heavy Iron Body, Bronze ... Virtually indestructible, due to service.

GOLDEN-ANDERSON

Patent Automatic Cushioned Electric Water Service Valves

1. Give instant control of the water distribution from the pumping plant in case of fire or other emergency.
2. Can be opened or closed by electricity by closing a small switch for a few seconds only. Thus no current is wasted.
3. Can be provided with either d. c. or a. c. solenoid as circuits require.
4. Cushioned in opening and closing by both water and air. Positively operate without water hammer, surging, sticking or other trouble.
5. Can be closed by hand like any ordinary valve.

Sizes to 30 in.

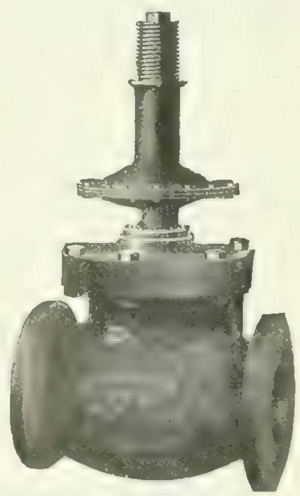


GOLDEN-ANDERSON

Cushioned Water Relief Valves

Automatically Relieve Excess Pressure—

Prevent Stress, Strain and Bursting Mains



Angle and Globe Patterns
Sizes 3 in. to 30 in.

Golden-Anderson Valve Specialty Co., 1202 Fulton Bldg., Pittsburgh, Pa.

COFFIN VALVE COMPANY,

Makers of the Largest Sluice and Gate Valves in America

Coffin Valves

Operate the great South Boston Drydock

Used to repair the giant "Majestic"

The largest Steamship afloat — the largest Drydock in the country — the largest Manufacturers of the largest Sluice Gates and Gate Valves in America — significant!

Check Valves
Flap Valves
Foot Valves
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Sluice Gates
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Butterfly Valves
Fire Hydrants

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Chicago, Ill.: Whitney & Ford, 1325 Cottage Grove Ave.
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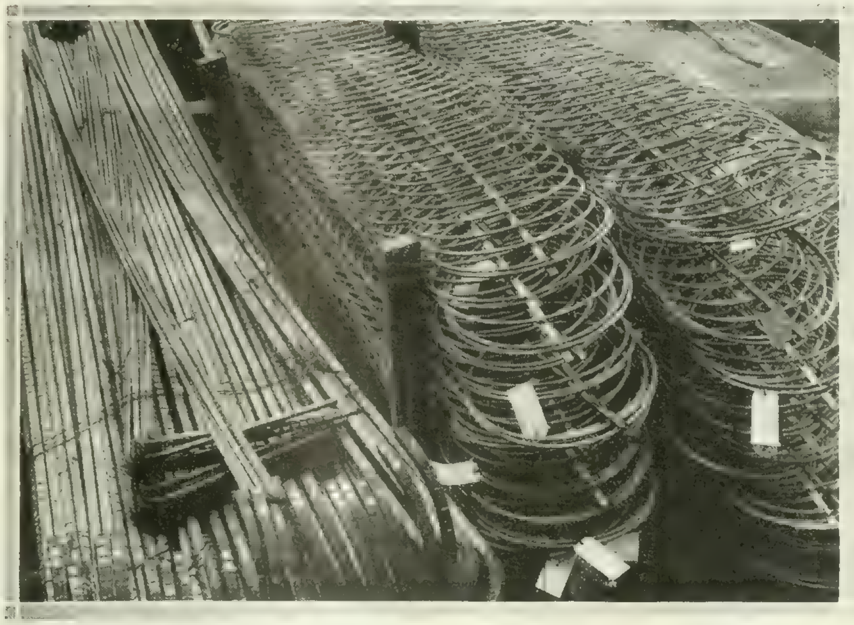

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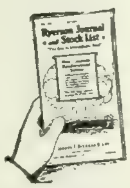

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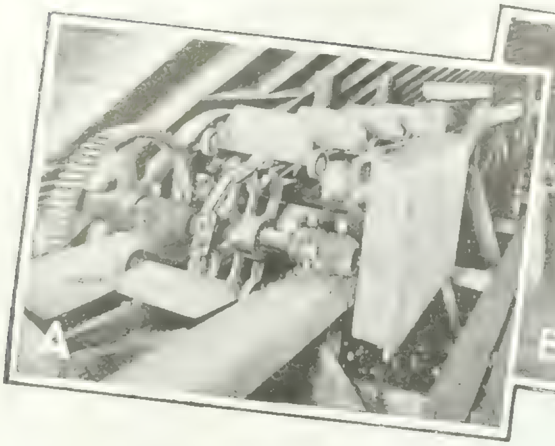

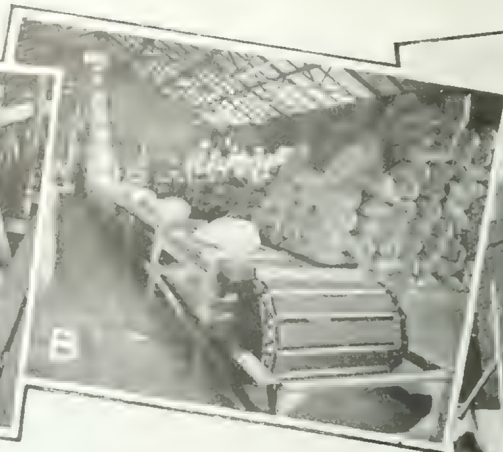

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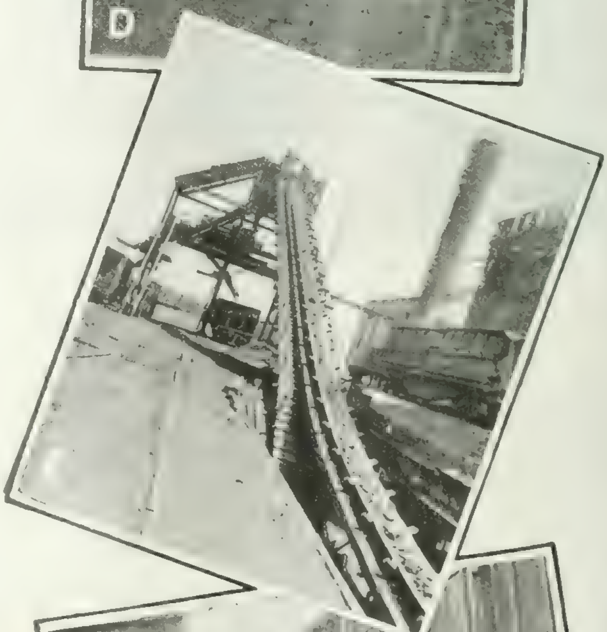

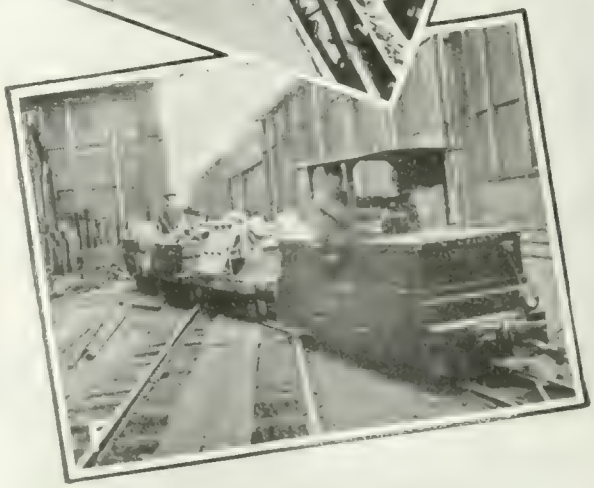

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

Volume 89 — NEW YORK, DECEMBER 28, 1922 — Number 26

Personal Liability

ADVANCE is being made, steady if slow, towards establishing the doctrine of personal liability for preventable accident. During the past year or two several cities have been added to the small list of those which place the cost of firefighting on the person whose negligence caused the fire, and about a dozen communities now follow this practice. The doctrine is quite general, however. It applies to other forms of accident than fire, to railroad operation and to building, for instance, and we trust that in no too far distant time it may be made practically effective here, by the joint force of statute, popular conviction and judicial interpretation. It tends to build up, in place of our well-recognized national tendency to neglect and carelessness, the habit of taking care. The forest fire, the broken arm and the train wrecked by a rotted tie will all be less common when that habit has become established.

Unique Sewage-Pump Bids

CAPITAL charges as well as operating expense are less frequently taken into account than they should be in comparing the cost of several ways of accomplishing the same end in municipal work. A notable instance of taking both into account is afforded by the recent electric-driven sewage-pump contract letting at Syracuse. The comparison was not between electric and other active power for the pumps but to determine which of two types of electric motor equipment—slip-ring and brush-shifting—would be most economical. Itemized bids were invited for the various units of each class of equipment. To reduce the bids to a comparative basis, amortization charges were figured on the equipment and to the total for each type was added the annual charge for current, based on the contractor's guarantee as to amount of current and the unit cost of the current to the city. More common use of such refinements in bidding may be expected with progress in engineering and in municipal government.

Better Equipment Maintenance

MAKERS and users of construction equipment and materials are both striving toward the common objective of securing for their machinery the maximum service on the job. Some contractors, after they have purchased their plant, make the mistake of paying little or no attention to it until a serious breakdown occurs. Then the job may have to be shut down until repairs can be made, resulting in idleness of at least a part of the working force and a setback to progress schedules. Oftentimes this result is due to the lack of an inexpensive repair part which, if it had been kept in stock or ordered in advance, could have saved its actual cost many fold. When repair parts are needed they are generally needed badly and the contractor sends in the usual "rush" order to manufacturers of equipment for replacements. Time and again shipments of this sort are delayed because the individual sending in the order fails to be specific as to what is wanted. The manufacturer puzzles over the meager information he receives and often has to wire back for more detailed instructions. There is an opportunity for a great deal more co-operation than now exists between makers and users of construction machinery. In the hope that a recital of actual experiences may eliminate some of the difficulties *Engineering News-Record* started in its department "From the Manufacturer's Point of View" in the Dec. 14 issue a discussion in which the equipment makers tell of some of the actual conditions governing the supply of repair parts. Both contractors and engineers should follow the discussion, which continues this week. It will point out some of the things that equipment users do that should not be done and may indicate some of the things they might do in the interests of better service. This general subject of equipment maintenance, long neglected, is coming to the front, as was indicated at the recent joint conference, in Detroit, between representatives of the manufacturers and the Associated General Contractors of America. The discussion above referred to tells the story from the manufacturer's point of view. At a later date it may be desirable to hear the contractor's side of the case. Any one with anything to say on this general subject, whether he be manufacturer, contractor or engineer, is invited to participate. A thorough airing of the views of all parties concerned cannot help but improve present conditions.

Broadcasting Practice

IN OUR issue of Dec. 14, we criticised the repeated announcement of the names of the Radio Corporation of America and the Westinghouse Electric and Manufacturing Co. during the broadcasting of a meeting of the American Society of Mechanical Engineers. We suggested that it might have been possible that the broadcasting companies required these repeated announcements of their names as one of the conditions of broadcasting the meeting. The Westinghouse company informs us that it lays down no such condition, but that it suggests, for the information of the hearers, that the code designation of the transmitting station be repeated at convenient intervals. Broadcasting experience has indicated the desirability of such practice.

Asphalt Inspection

ASPHALT plant inspection methods are outlined in rather remarkable detail in an article by Prof. W. J. Emmons in this issue. It is not often perhaps that so close control as is here demanded is found in practice. Indeed it is often contended that more than general watchfulness is not warranted when, as is commonly the case, a maintenance guarantee clause is written into the contract. With a clause of this kind in

force the contractor naturally resents exacting control of plant operation. Indeed, to regulate his mixtures and then demand that he guarantee their behavior and life over a term of years is unqualifiedly unfair. Retention of the maintenance guarantee clause in paving contracts precludes as a matter of mere justice plant inspection so detailed and exacting. In respect to the relative scientific merit of the two practices there would seem to be little doubt. Good plant inspection and control is a far more scientific and sure way of securing good asphalt mixtures than is any guarantee clause that can be enforced in practice. Another advantage is that it gives the engineer records with which he can do something to interpret service failures. On the whole, probably the cost of plant inspection is no greater than the charge which the contractor makes for risk in signing a maintenance guarantee. Whatever it may reasonably cost, it is worth the price as the only sure way of obtaining what the engineer specifies and the public pays for.

Optimism at Indianapolis

OPTIMISM prevails in the editorial sanctum of the Indianapolis *Commercial*. The burden of an editorial head "Public Service" printed Dec. 17 is that both the city officials of Indianapolis and the members of the State Legislature are being confronted by a demand from the public for better results than are now being given for their tax dollars. "Sooner or later," says the *Commercial*, "the inefficient public servant will be turned out. Officials with their ear to the ground—or in more euphemistic terms 'the wise public official' who wishes to continue in office—will not overlook the fact that more and more the tax-paying public is demanding for every dollar expended an honest dollar of return." Although this does not credit public servants with high ideals yet basically the *Commercial* is sound. If better public service comes it will be because of an insistent, persistent and intelligent demand from citizens and tax-payers. This alone is not enough. The public must show its willingness, once its needs have been formulated and agreed, to entrust the planning and execution of its work to technically trained men, reasonably paid, free from political interference and sure of their positions during good behavior and efficient service.

One Element of Progress

AS REFLECTIONS on engineering progress come upon the mind at the turn of the year, the large achievements engage attention, and the progress made in better utilization of materials and effort is overlooked. It is that element of progress which is found in routine activities and is therefore unobtrusive. Yet it is the principal, ever-present objective of the engineer and of those who work with him, though doubtless subconscious and unrecognized in most of us. In seeking continually for elimination of waste and truer adaptation of material to service, he carries his art forward to that perfection on which new creative achievement can be based. This tendency is found in all branches of the constructive arts; in production, by the seeking for greater uniformity or better controlled diversity of product; in marketing and standardization, where culling is transformed into grading and new uses are found for the remnants which existing markets do not absorb; and in engineering design.

What Is a "Sales Engineer"?

AMONG the letters published in this issue is a protest against the term "sales engineer". Our correspondent contends that it is an anomaly, that the ethics of selling and of engineering practice are incompatible, and that those engineers who perpetuate the term to describe the salesman who has engineering training or who sells an engineering product are performing a disservice to their profession.

We sympathize with Mr. Bedell. And if we limit the correct use of the word "engineer," as he has done, to describing those whose occupation is to supply disinterested technical knowledge and skill for the service of others, the soundness of his contention is obvious. He is correct again when he ascribes the growth of the practice largely to the manufacturers' efforts to capitalize the general respect for the term "engineer" and to invest with a certain prestige the men he sends out to sell his goods. And it is just this promiscuous appropriation of the name that is largely responsible for the difficulty in setting up and maintaining high professional standards in engineering practice.

In seconding Mr. Bedell's plea that use of the term "sales engineer" should be discouraged by engineers and their professional societies, we are not unmindful of certain related circumstances which have contributed to the growth of the practice and which must be remembered when we try to check it. One of these is the traditionally loose application of the word "engineer" which unfortunately has not enjoyed the limitation Mr. Bedell has placed upon it. Often it is used less to define a vocation than to describe a type of training. Then again, specialization both in training and in vocation has brought about the use of many qualifying adjectives; and this may have had something to do with the readiness of engineers themselves to accept "sales engineers" as just another variety. But neither of these circumstances can justify the use of the name "engineer" to describe any vocation in which an engineering graduate may happen to find himself.

Furthermore, it is true that not all manufacturers who employ "sales engineers" do it for the sake of window dressing. Some sales engineers are in fact not salesmen at all in the sense of booking orders. Some of them are employed to advise prospective or actual customers as to technical questions involved in a sale or to present technical considerations that may influence a sale. The value of such advice is not in question here—the prospect or the customer knows with whom he is dealing and can use it as he may see fit. This, to be sure, is not a professional relationship, but it is a technical relationship and can scarcely be included under the head of salesmanship. Perhaps a title other than "sales engineer" may fit more accurately; but when the individual is an engineer by training and engaged in a technical activity, it is easy to understand how this practice could have grown up without intention to mislead or to exploit the engineer's title. Frequently, indeed, it is the engineer employed on such work who is most insistent upon a title that will retain him in the ranks of the engineers despite the commercial flavor of his work.

Into Mr. Bedell's comment on sales and professional ethics no invidious comparison should be read. He assumes no "holier-than-thou" attitude. He simply states a fact. The salesman is frankly an advocate. The engineer—in the restricted sense—must be more

of a judge. The advocate, in whatever sphere, has a code of ethics by which the worthy are guided. The judicial officer likewise has his code. Each must be judged by his loyalty to his own code, and to judge either by the code of the other would be decidely unfair. There is no question as to one being better or higher; they are based upon radically different relationships.

In the interest of higher professional standards in engineering, the whole broad question opened up by Mr. Bedell deserves discussion. The principle involved is not confined to the "sales engineer." What of the "contracting engineer"? Is it not involved here also? Several material questions leap to mind; doubtless there are others. What do most of the so-called sales engineers actually do? Do they render technical advice; or do they sell or promote sales? Is the term frequently applied to salesmen of little or no engineering training? Will not discouragement of the practice help us toward a more clear-cut definition of what we mean by "engineer"? Most pertinent of all perhaps: How do the professional engineering societies now rate experience as a "sales engineer" when estimating a candidate's qualification for membership?

Building for Permanence

LOOKING back over the changes in our practical arts during the past three or four decades one may discern a slow but continuous movement toward assuring longer life of their products. The civil engineer's art is no exception; it is affected just as are the others. We build, or try to build, more lasting works than in the pioneer days. The spirit of the frontier railroad, of the mining camp, of the aspiring young metropolis, is fast disappearing—even today but little is left—and its disappearance denotes a change in the purposes that control constructional planning. Standards of merit have been modified; our valuation of what the builder produces has been rearranged to accord a recognized place to permanence.

The causes of the change are obvious. The important thing to note is that our altered attitude concerns almost everything that the civil engineer plans and constructs. Some generations ago, none but the water-supply engineer thought it worth while to plan far into the future; one may suspect that the general excellence of the country's water service traces back to this early perception of long-time values. On the other hand, the men who planned roads, railroads, bridges and buildings hardly looked beyond their present. They could not afford to plan more farseeingly, perhaps, or they were too busy with the task of building quickly.

Much waste followed in the train of these old-time practices. Loss by fire, by decay and by many kinds of obsolescence has borne heavily upon us and has taught us much. We have been learning step by step that it is not profitable to continue to do as we did in the years of mushroom growth. The present-day demand is unmistakably for permanence.

But the situation is in a way characterized by the term "demand." Permanence is a commercial demand, not an ideal that serves the planner's inspiration and therefore embodied in his work. The market asks for substantial, reasonably long-lived results, and the builder adjusts his planning to suit this demand. He endeavors to provide permanence by computing and designing—and in a measure, he succeeds—but he does not raise permanence to the rank of a controlling ideal, co-ordinate with suitability and service-excellence. Under these conditions can permanence have its full and proper influence upon our art?

To make the change in view more tangible, we may take bridge practice of thirty or forty years ago, which typified the mushroom-growth stage, and then take the present-day practice, when bridge money is spent almost lavishly. In the earlier period bridges were bought for the day's usefulness only, with price as the highest consideration and with vision bounded by the term of office of the town or county commissioners. There has been a revolution since then. The revolution in traffic conditions has brought it about. But whether there has been essential change in the bridge-builder's own spirit of working is open to grave doubt. To a great extent we still build bridges for the need of the day only—let tomorrow take care of itself!

Changes in building construction are of similar meaning. Mercantile building has advanced far toward being established on a standard of permanence, largely, however, through the dictates of fire protection rather than the thought of planning for permanence. We are not yet prepared to think of buildings remaining in service and being truly serviceable for many generations. And so, while we have built many structures of substantial materials, they were planned for short-time service and in time will clutter up our cities with antiquated buildings, monumental they may be, but hindrances to progress. There is steady advance however, in this field of commercial buildings and gradually there grows a conscious conception of the ideal of permanence.

Not so in the field of dwellings. We have grown out of the shack-town period of the Chicago conflagration, but we do not yet strive for permanence in the fullest sense. Nowhere are houses planned and built to be lived in as homes for long decades. The zoning movement may operate to improve the conditions responsible for this fact, but its influence can not yet be forecast. As matters stand today, our dwelling-house construction remains poor and ephemeral, as much so in the case of the planned house of the well-to-do as in that of the carpentered homes of the masses. Therefore we rebuild and will continue to rebuild every twenty-five years, until a more conscientious spirit comes into control and the planner strives to make each brick and each joist a thing that will serve its full purpose far on into the indefinite future.

In utilitarian engineering construction the conditions of past, present and future are quite parallel to those outlined. Examination of any individual field will illustrate the transition from building for a decade to building for a quarter century or so, and the steady movement toward building for the unlimited future. In each field, too, it may be seen that planning of enduring worth is more likely to result if the planner is inspired with a profound belief that his construction will and must endure. The great bridge cannot spring from a brain filled with the thought that thirty or forty or forty-five years will see the end of its life. It will be great only if there is wrought into every detail the belief that it will serve forever.

This is the coming spirit of all the engineering arts. The engineers of the pioneer era built well, no doubt, for their day of uncertain and speculative development but the conditions of those days have disappeared. Future needs will be met truly only if permanence becomes the ideal of all planning and building.

Foundation and Framing Design of Colfax Power Station

Structure Characterized by Simplicity—Concrete Mat Foundation on Gravel—Column Loads Distributed by Reinforced-Concrete Walls—Special Retaining Wall and Sea Wall Held by Ties—Stack Towers

By M. E. Thomas
Structural Engineer, Dwight P. Robinson & Co., Inc.

COLFAX STATION, recently completed, is a mine-mouth superpower plant situated on the Allegheny River about 15 miles from the center of Pittsburgh and only one mile from the Harwick coal mine, which supplies it. It is the most recent addition to the "Duquesne Ring," a 66,000-volt loop which encircles Pittsburgh. The ultimate capacity of the station is 300,000 kw., made up of five 60,000-kw. units. The size is limited only by the supply of condensing water available from the Allegheny River. While there are no radical departures from general practice, the methods of construction and general layout represent a combination of some of the best ideas in power-plant engineering.

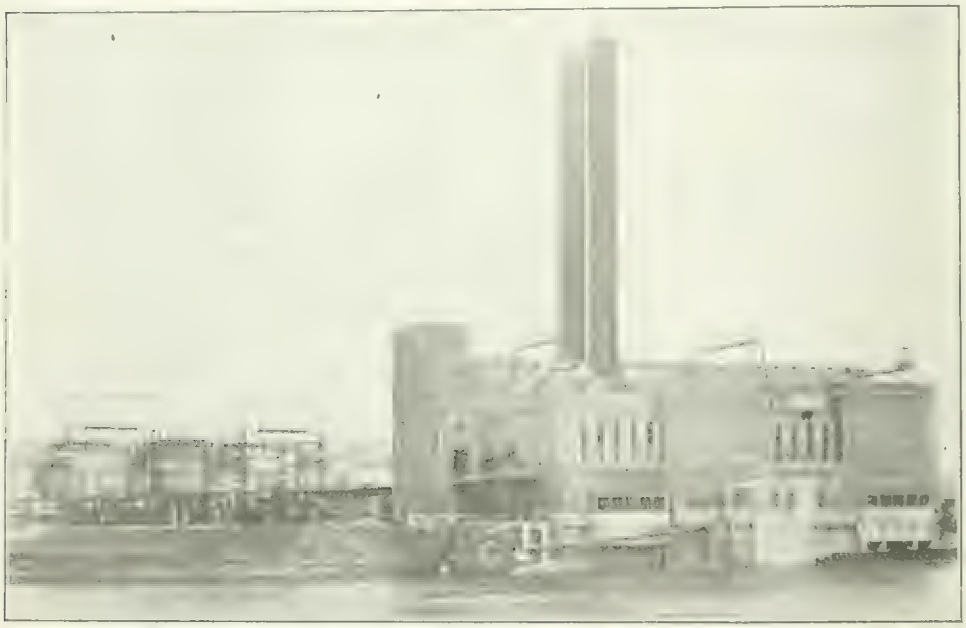


FIG. 1—LOOKING NORTH AT COMPLETED COLFAX STATION
[illegible] Ultimate [illegible] building. The right-hand end wall is removable, for future extension.

The structural features, in common with other details of the plant, are interesting because of the simplicity with which they have been worked out. The framework of the station is steel. The foundation is of box type, in which the basement walls serve as distributing girders to distribute the column loads to the footings, these latter being either continuous mats or spread wall footings, according to local requirements. The general profile of the foundation was controlled largely by the depth to firm bearing soil, a compact sand and gravel stratum.

Boiler Room Foundation—The load from the boiler room columns is distributed by continuous transverse reinforced-concrete walls reinforced as beams, extending from the north side of the building to the wall adjoining the turbine room. These walls are 3 ft. thick and vary in depth from 10 ft. 3 in. at the north side to 25 ft. at the south side. The variations in depth, made in horizontal steps, bring the foundations down to the underlying gravel and sand, which slopes from the north side of the property down to the river bed. The wall load is distributed to the soil by reinforced-concrete footings, which in common with other parts of the station foundation were proportioned for a soil loading of 3 to 4 tons per square foot. On the north side all of the transverse foundation walls are tied together by a deep reinforced-concrete beam which forms the foundation for the exterior wall. On the south side they are similarly connected by the longitudinal wall under the columns between the boiler and turbine rooms; this wall is 4 ft. thick and is about 30 ft. high above top of turbine-room basement mat.

A reinforced-concrete slab construction supported on top of the foundations forms the boiler-room basement floor at El. 754.

Turbine Room Foundation—The turbine room basement is 253 ft. 6 in. long, 80 ft. wide and 29 ft. 3 in. deep, and is designed to contain the foundations, condensers, etc., for the two turbine generator units. Its north and south walls, each 4 ft. thick and 30 ft. high, distribute the crane and roof column loads to the foundation mat, which forms the floor of the basement. The east and west ends are closed by retaining walls which also form the foundations for the walls of the building. The east wall, to provide for future extension, was constructed of vertical I-beams with brick arches between, tied back to deadmen to take the earth pressure.

The turbine room basement floor being below the pool level of the river is designed to resist the upward hydrostatic head of about 30 ft. (extreme low water is about El. 721, while maximum high water is 754) and is waterproofed over the entire area including part of the side walls. The basement floor therefore consists of a reinforced-concrete mat generally 6 ft. thick, except over the area adjacent to the turbine foundations, where it is increased to 8 ft. 9 in. to accommodate air ducts and tanks.

On the south side the main wall is carried in its full thickness of 4 ft. down to a depth of 14 ft. 7 in. below the bottom of the concrete mat. This wall forms the south side of the intake tunnel, 14 ft. 9 in. wide and 13 ft. 1 in. deep, which runs longitudinally under

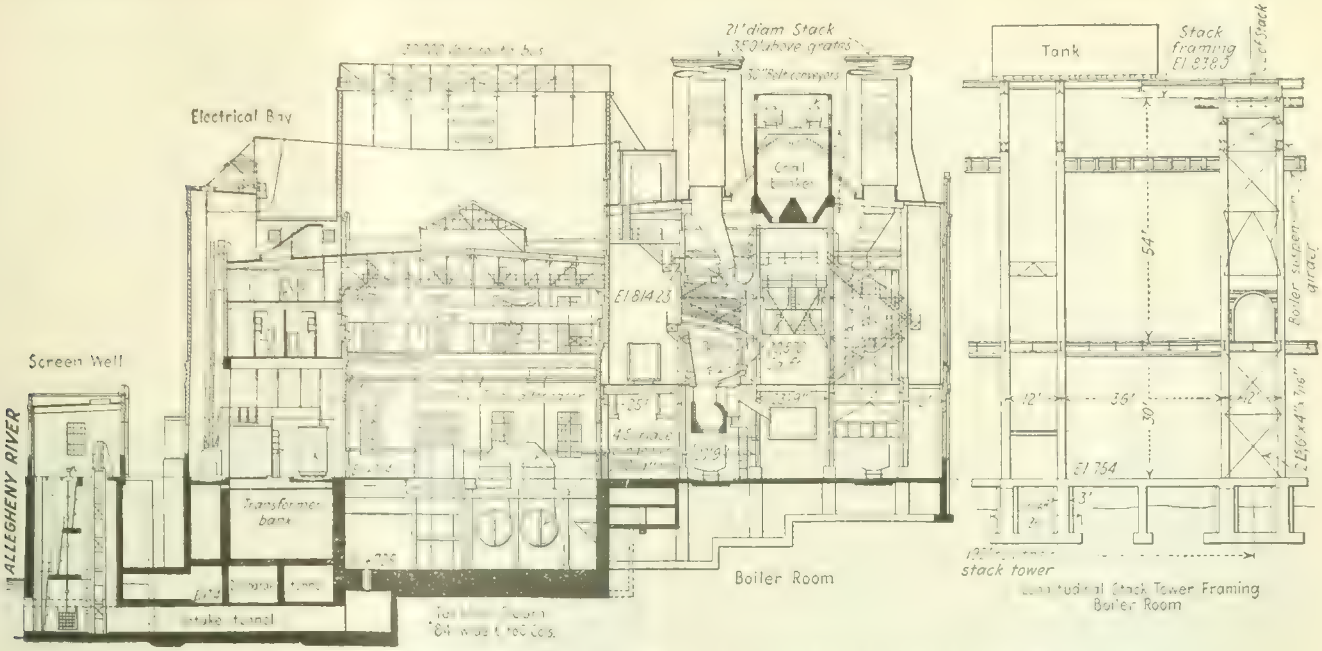


FIG. 2—TYPICAL CROSS-SECTION OF STATION, ALLEGHENY RIVER AT LEFT (SOUTH)

the turbine-room mat. The tunnel is 210 ft. long and is divided by a wall near the center, each part supplying the circulating water to the condensers of one unit by means of three suction pipes through the roof of the tunnel, and each part connected by a transverse tunnel under the discharge tunnel to the screen well.

Electrical Bay Foundations—Under the entire electrical bay is placed the discharge tunnel, designed for a capacity to provide for the future extensions, since it connects with the discharge to the river at its west end. This tunnel, 12 ft. deep by 45 ft. wide, is divided by two longitudinal concrete walls provided with openings at intervals to cross-connect. Its roof forms the floor of the electrical bay basement.

From the west end of the building the discharge tunnel is continued at an angle of about 45 deg. to the axis of the building to a point back of the harbor line, where it discharges into the river. Provision has been made for the future extension of the discharge tunnel, back of and parallel with a future sea wall at the harbor line, and to discharge into the river several hundred feet farther downstream.

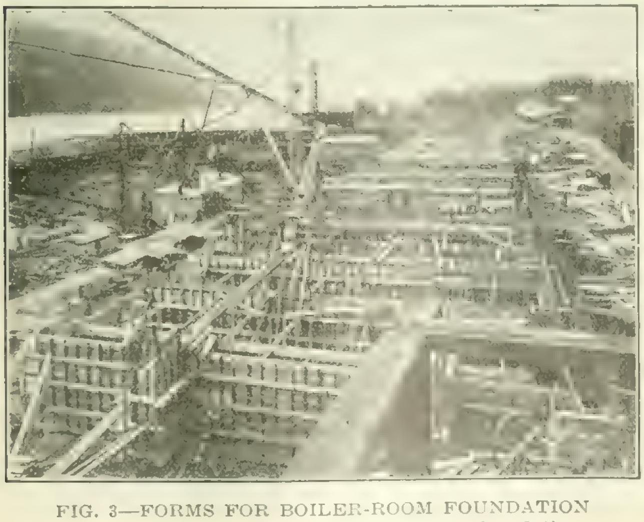


FIG. 3—FORMS FOR BOILER-ROOM FOUNDATION
Cross-walls distribute column loads to mat foundation.

The transformer-room floor consists of heavy reinforced-concrete beams, running transversely and spanning between the longitudinal foundation walls, with reinforced-concrete floor slabs.

Screen Well—The screen well is placed with the south

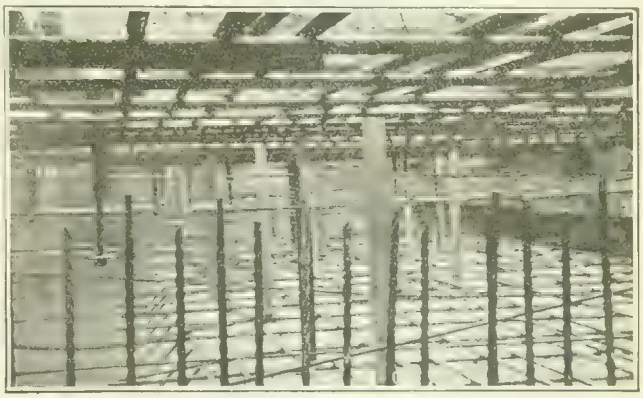


FIG. 4—REINFORCING OF MAT UNDER TURBINE ROOM

side on the harbor line at about the center of the present electrical bay. It is 44 ft. long and 32 ft. 8 in. wide, and is divided by a transverse vertical concrete wall into two independent units, each supplying the circulating water for one turbine unit. On the north side it connects with the intake tunnels by means of two transverse concrete tunnels, each 8 ft. x 12 ft. 6 in., passing under the discharge tunnels. On the south side the two wells are connected with the river by four openings each 7 ft. 3 in. wide and 10 ft. high, whose lower edge is flush with the bottom of the well.

Two 8 x 12½-ft. transverse tunnels connected with the discharge tunnels are placed directly over the two transverse intake tunnels, the four tunnels forming one construction. These two tunnels run under the electrical bay to the back of the screen well and are connected with the screen well back of the trash racks by openings 5 ft. square controlled by a valve to bypass the discharge water into the intake.

Sea Wall—A sea wall about 50 ft. high extends along

the harbor line, flush with the south side of the screen well. It is of reinforced concrete, 3 ft. 6 in. thick at ground surface and about 6 ft. thick at the bottom, where it rests on a concrete foundation 10 ft. wide and from 5 to 8 ft. deep. The lateral thrust from the earth pressure is taken by reinforced-concrete ties from the sea wall to the building, an upper row near the top and a lower row about one-third of the height from the bottom. The ties are spaced horizontally about 12 ft. apart. Considerable economy results from this type of construction as compared with a self-supporting wall of the same height.

Superstructure—The superstructure generally is a self-supporting structural steel frame with steel girders and beams supporting reinforced-concrete slabs for all floors and roof. The walls are generally of brick, except some special walls of reinforced concrete and the east (extension) end wall, which is of hollow tile construction.

The boiler room is about 350 ft. x 108 ft. between column centers and 87 ft. high from the basement floor level to the low point of the roof.

Between each group of four boilers on both the north and south sides the four columns are braced together from top to bottom with diagonal bracing, forming four braced towers, 12 ft. x 23 ft. 9 in., which support the stacks and carry the wind stresses to the foundation. The lower sections of most of these stack columns carry a load of over 1,500,000 lb. Steel I-beam grillages distribute the column loads to the concrete foundation walls. Anchorage is provided by four $2\frac{3}{4}$-in. anchor bolts $4\frac{1}{2}$ ft. long.

Eighty-four feet above the basement floor the base of the steel stacks are supported by the stack base framing. A system of girders forms approximately two squares, one within the other, between which 24-in. I-beams are framed at distances of 2 to 3 ft., the space between being filled with concrete. This forms a steel and concrete mat upon which the steel stack rests. The interior square is floored with a reinforced-concrete slab. The stack is anchored to the mat by means of twenty-eight $2\frac{3}{4}$-in. bolts passing through pipe sleeves in the concrete to pairs of 10-in. channels which distribute the upward load to the bottom flanges of the 24-in. beams.

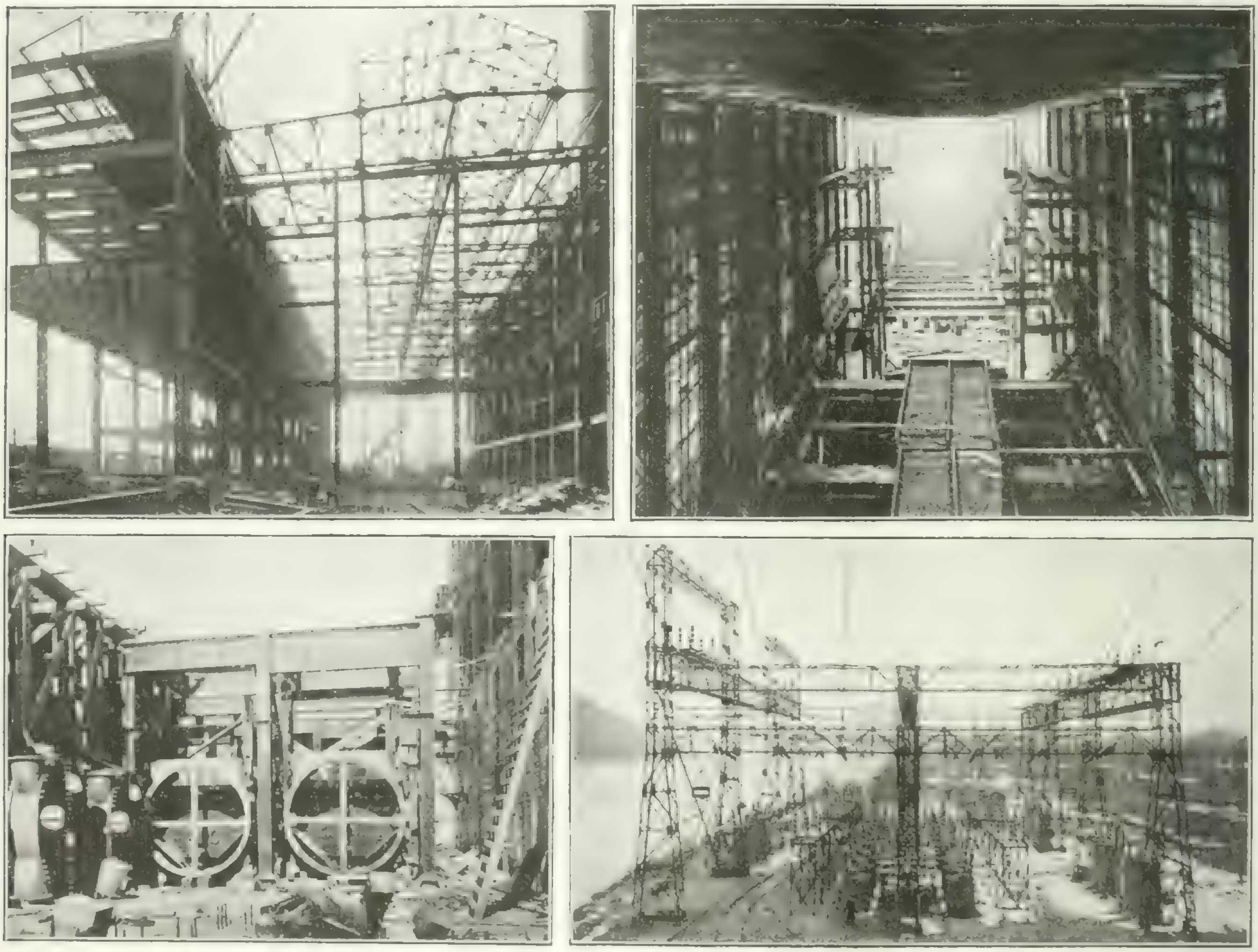


FIG. [illegible]—FRAMING FEATURES OF COLFAX STATION, A MINE-MOUTH POWER HOUSE

Upper left, turbine room frame, boiler room at right.
Lower left, steel foundation for 60,000-kw. turbine unit.
Upper right, reinforcement and forms of coal bunker.
Lower right, outdoor switching station.

Stacks—The stacks are self-supporting brick-lined steel stacks, 21 ft. 9 in. in diameter inside of the shell and 271 ft. high from the base, or 355 ft. high above the ground. From 30 ft. above the base the stack flares out to a diameter of 28 ft. at the base, where heavy angle seats and stiffeners provide connections for the anchor bolts. The breeching connections for the flues are on opposite sides of the stack. The lining consists of $4\frac{1}{2}$-in. hollow firebrick blocks supported by horizontal angles

riveted to the shell at intervals of about 10 ft.

Coal Bunkers—The main coal bunker, over the boiler room, is of reinforced concrete and is 22 ft. 9 in. wide and 28 ft. 9 in. deep inside from top of conveyor floor. Its capacity is 10 tons per lineal foot. The 12-in. side walls embed vertical 8-in. beams, and are designed to act as girders to carry the entire weight of the bunker and coal to the steel columns without the aid of the structural steel. The side walls also take the lateral thrust of the coal and are tied together by reinforced-concrete beams. The reinforced-concrete bottom is of suspended type. Cinder-concrete crickets form pockets to the coal spouts.

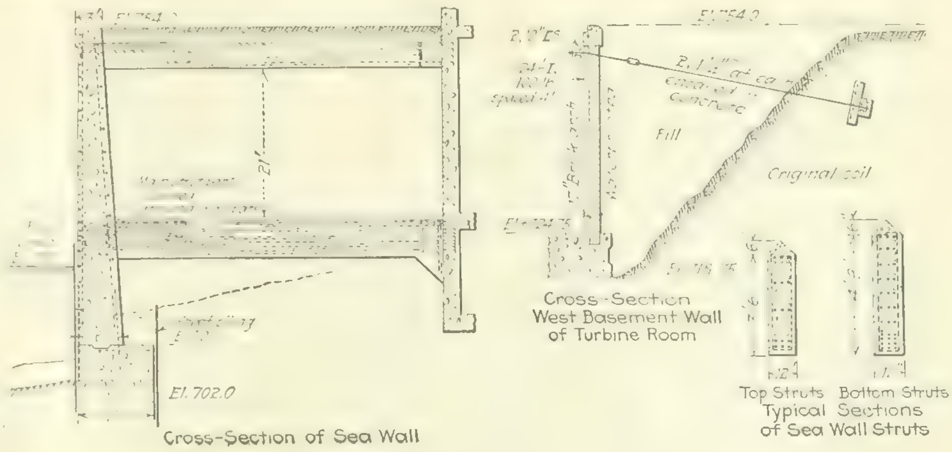


FIG. 7—SPECIAL SEA-WALL CONSTRUCTION

At the west end of the boiler room is a coal tower, whose main floor, on the level of the boiler room floor, is connected with the coal trestle and carries track stringers and rails continuous with those of the trestle. Directly under these tracks are two reinforced-concrete coal hoppers of 150 tons capacity each. The upper part of the tower contains employees' quarters and conveying machinery.

Turbine Room—The turbine room is about 254 x 84 ft. wide center to center of columns, and is roofed with steel trusses 60 ft. above the floor. A monitor and skylight 34 ft. wide run the length of the turbine room.

The turbines are supported on structural steel foundations extending to the turbine room floor level, El. 754. The turbine room floor consists of a concrete slab covered with 9 x 9-in. Welsh quarry tile, supported by a steel frame resting on steel columns and the concrete foundation walls. Except for the space between the high and low pressure turbines, where the floor is supported by the turbine foundation, the entire floor is kept free from the turbine so as to prevent transmission of the vibration of the turbines to the floor. Between the main units an open well about 25 x 50 ft. in the floor provides for lowering transformers and heavy machinery parts to the basement floor for repairs.

The interior side walls for a distance of 9 ft. above the floor are faced with white and gray speckled enameled brick with bull nose brick at corners, and a 10-in. black slate base above the tile cove. Above the enameled brick the walls are light buff Kittanning face brick.

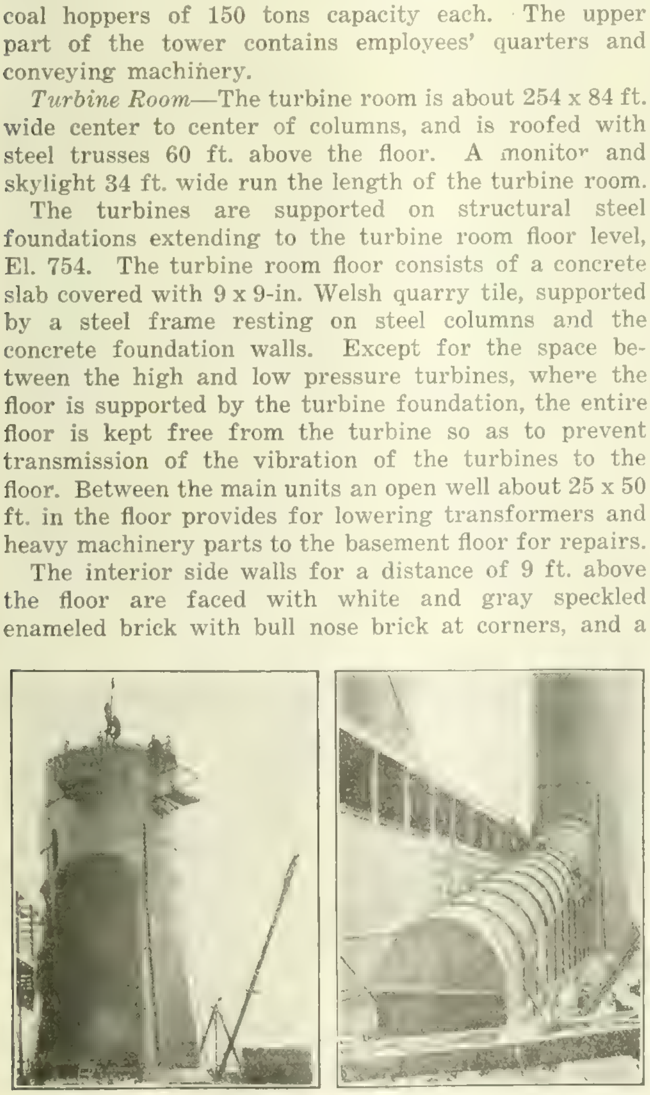


FIG. 6—22-FT. DIAMETER STACK, WITH SMOKE FLUE

The electrical bay is of steel-frame construction, with concrete floor slabs made thick enough to enclose the numerous electrical conduits embedded therein. The exterior walls and most of the interior walls are of brick, but concrete interior walls were used where it was necessary to carry conduits.

On the south side of each high tension bay, a group of six high tension brick shafts 12 ft. square extends from the turbine room floor level to a distance of 23 ft. above the electrical bay roof, where the conductors connect to the bus-bar structure on the roof.

The station was designed and built for the Duquesne Light Co. by Dwight P. Robinson & Co., Inc.

Belated Settlement of an Old Aqueduct

By Frederic I. Winslow
Division Engineer, Metropolitan District Commission, Framingham, Mass.

IN OCTOBER, 1920, a considerable settlement occurred in the principal thoroughfare leading from Natick to South Natick, Mass. At first it was supposed to be an ordinary settlement, caused by a leaky water main, which in this case happened to be a 10-in. cement-lined pipe and one likely to cause trouble, especially as there was a trolley car track in the street, with a fair amount of traffic.

After being filled in, and a further settlement occurring within a few days, it was ascertained that the settlement had occurred directly over the Badger Hill tunnel of the Sudbury Aqueduct, built in 1875. The extrados at this point were about 28 ft. from the surface of the street, and the point of settlement turned out to be 50 ft. from the beginning of the tunnel. As the water in the aqueduct appeared slightly discolored when sampled about 2,000 ft. away, the aqueduct was drawn down and entered. It was found that the settlement was directly over a number of "weepers" placed on the side of the aqueduct to prevent undue pressure from water from the hill. In all, about 50 cu.yd. of material, mainly gravel, were placed in the cavity. No further settlement has occurred.

Apparently the timbering used nearly fifty years ago had so decayed as to cause the dropping of the earth above, as there was probably a large amount of timber at this point.

Maintenance Engineering in Large Industrial Plants

Organization and Work of Department for Inspection and Upkeep of Buildings, Equipment, Yards, Tracks and Roadways

By Samuel E. Bird

Manager, Construction Department, Sears, Roebuck & Co., Chicago

MAINTENANCE AND REPAIR of buildings and other property at large industrial and manufacturing plants and public institutions is a continuous work which involves a great number of varied details and must be carried out systematically under expert management in order to keep the several structures in condition for economic service and for the safety and comfort of the employees or occupants. To detect and remedy troubles, solve problems, select materials and plan and supervise the work is truly within the field of the engineer. It is the purpose of this paper to show the scope and importance of the maintenance department rather than to give a technical discussion of the various classes and items of the work.

As examples of the problems which come to the engineer of plant maintenance the following may be mentioned: (1) The best materials for tuck-pointing settlement cracks in walls and at window joints, as well as the best time of the year and conditions for this work; (2) preventing dry rot; (3) preventing steel corrosion; (4) the installation of various kinds of expansion joints to take care of settlement, expansion and contraction, this applying especially in connection with concrete work and roads; (5) methods of waterproofing skylights, parapets and fire-walls; (6) the preparation of report forms covering building and machinery maintenance, the latter including elevators and motor trucks.

In large industrial plants and public institutions it is customary to have building superintendents or construction departments. Even in smaller plants, someone is detailed to look after the maintenance of buildings and to take care of repairs and replacements. Where a department has charge of building (architectural) as well as machinery (mechanical) maintenance, it should have as its head a man with training in architectural construction as well as with some knowledge of mechanical construction. A college education along mechanical or architectural engineering lines is a great help, as the theoretical knowledge enables the practical side of the work to be more easily grasped. On the other hand, some of the best construction maintenance men have been educated in the building field.

Much useful information may be gained from the study of catalogs, pamphlets and other literature sent out by manufacturers of equipment and building materials, but the maintenance engineer must be able to analyze and make proper selection. Any practical experience obtained from handling building operations in the field will prove valuable to a man taking charge of the maintenance of either large or small plants.

Building Inspection—Maintenance should include building inspections at regular intervals, with the findings tabulated and recorded on uniform blanks having divisions covering all parts of the structures; such as roofs, skylights, floors, columns, windows, stairs, foundations and outside walls. These blanks should have suitable file headings and should be kept in a filing cabinet, so that when repairs are made the items may be checked from the inspection records. The form of inspection blank will be determined largely by the type of building, whether of fireproof, semi-fireproof, steel, concrete, heavy mill construction or ordinary lumber construction.

In large cities such buildings are also subject to an annual inspection by the city, usually under the building department and subject to the building commissioner's approval. Among many other items this city inspection takes particular note of sanitation, light, fire and floor load conditions.

When new buildings or alterations or additions are under consideration the maintenance engineer has an opportunity to point out the type of construction most suitable for the purpose. He should have in mind the maintenance required for the various types, considering also the overhead, first cost and annual depreciation. If the operation to be carried on in the building is one demanding constant changes, especially in floor construction (as in the case of rearrangement of machinery of various types) this item should be given close attention. For both existing and new buildings the maintenance engineer must study their preservation, whether they are of concrete, wood or steel construction or a combination of the three.

Floors—The market is full of preparations for hardening cement floors and making them dustless. The maintenance engineer should analyze and study these; he must try them out and find the best adapted for his particular needs. Keeping concrete floors well surfaced is another problem. Where the traffic is light a good application of cement paint will overcome ordinary difficulties and prevent wear as well as dust. Where such floors are subject to heavy traffic, it may be necessary to give them a hardening or wax treatment, or if the traffic is too heavy for these treatments the difficulty of excessive wear may have to be overcome by the installation of an asphalt mastic aisle or other space where the wear is greatest.

In the cleaning of floors, care must be taken that no solutions containing a large amount of lye or other injurious materials are used. A good soap will usually serve for cement floors, but if this is not effective a proper solution must be devised for removing the dirt without injury to the floor. The patching of worn cement floors has been a difficult task and an interesting one, in which good results have been obtained by the use of special compositions made for the purpose.

Roofs and Skylights—There are many different kinds of roofing available. Asphalt, tar and gravel, built-up, slate, galvanized iron, tin, copper, zinc, etc. Each must be considered in régard to contraction and expansion, the conditions to which it is to be subjected and the probable charges for maintenance. Skylights are an important consideration. They are of various designs: flat, sawtooth, hipped, etc.; many with stationary as well as movable portions. Some skylights are of enormous size, running over 500 ft. in length and 100 ft. in width. These must be equipped with expansion joints, proper condensation gutters, conductors, etc., if a large amount of maintenance is to be overcome. The design must be selected also with due regard to the requirements for light, ventilation and heating.

One of the greatest problems is in keeping the skylights waterproof, since their leaking is one source of great damage to property in course of manufacture or in storage. Regular inspections of the expansion joint sections, calking the glass with elastic roofing cement under the cap sheets, and keeping the condensation gutters and drain gutters clean and well painted will overcome most of the trouble. Much of the difficulty with metal gutters at the base of skylights has been overcome by covering the metal with an elastic coating applied on a suitable membrane, such as burlap. This coating allows for the expansion of the gutters but also holds any seam tight which may be strained under expansion or contraction.

Paint and Preservatives—For preservation of building surfaces, paint when rightly applied is one of the best materials. When wrongly applied it may result in loss of time, money and energy. In this day of substitutions, some of which are very good and some not so good, it is advisable to study and analyze the various materials offered before applying them. For wood preservatives much information is obtainable from current literature and the catalogs of various marketed materials. The application of varnish and other wall decorative coatings is an item in maintenance of office sections, taking into consideration conditions of dust and smoke before adopting the various coatings. All such work should be done under careful specifications.

Timber Columns—In large buildings of mill construction, a problem of maintenance as well as a hazard exists in taking care of badly checked or warped wooden columns. In some older buildings such columns have had bolts put through them, but the bolt holes weaken the columns and in many instances under the writer's notice they have aided rather than prevented the checking. A much better method is to reinforce the columns by means of strong steel bands having a snug fit. Before the bands are applied, the cracked portion of the column should be pulled together with a clamping device. Wood screws with countersunk heads hold the bands in place in case of shrinkage of the timber. This construction avoids the objectionable feature of projecting bolts or screws.

Railway and Trucking Facilities—In enlargement or revision of plants the maintenance engineer must consider the convenient handling of materials and their delivery and shipment by rail or truck. This must provide for future expansion and will include the arrangement of tracks, driveways and platforms and the provision of cranes or other handling devices. At large plants he may have charge not only of buildings and machinery equipment, but of grounds and exterior parts of the property, such as roads, sidewalks, railroad tracks and switch tracks. He must be familiar with paving materials and be able to select good contractors and obtain proper bids for construction. In selecting the material, whether asphalt, brick, macadam or concrete, he must keep in mind the initial cost and the maintenance charge. Railroad maintenance in large yards is a task in itself.

Platforms and runways afford many problems. In small plants these structures are floored usually with plank. If exposed to the weather this planking should be laid with open spaces to afford ventilation. Where the traffic on the platforms is very heavy and where they are not exposed to the weather, wood blocks have been used to advantage. But with wood flooring exposed to the weather and having steel plates fastened to the blocks to facilitate trucking or reduce wear, there has been extended dry rot, resulting in heavy maintenance expense. A better flooring for such exposed platforms carrying heavy traffic would be asphaltic mastic of such composition as to meet the local conditions of weather and loads. Copper flashing will eliminate the chance of leakage due to shrinkage where this asphalt coating comes in contact with buildings.

Mechanical Handling of Materials—Machinery and appliances for the conveying, hoisting and handling of material may come under the supervision of the maintenance engineer. This equipment may include elevators, chain or belt conveyors, chain hoists, and inclined or spiral chutes. The maintenance item is greatly reduced if this equipment is made of standardized parts of simple design and if the manufacturer is easily accessible for repairs. In connection with material handling, the plant layout must be considered from the standpoint of continuous handling of raw materials to the finished stock, as well as the handling of materials received or shipped by railway, highway or waterway. Where large numbers of motor trucks are operated there must be a system of reports and records of service, mileage and maintenance and repair work.

Maintenance of elevators, machinery equipment and motor trucks should be handled as carefully and systematically as that of the buildings. The maintenance department usually has charge of the design of machinery guards, and in the last few years no movement has progressed faster than the safety idea. Closely allied to this is the work in regard to sanitation, comfort facilities, lighting and ventilation.

Plant Fixtures—Another branch of work taken care of by most maintenance and construction departments is the provision of merchandise fixtures, such as racks and bins. These may be of steel or wood, permanent or temporary, and stationary or collapsible. They must accommodate the merchandise conveniently without loss of space or undue overloading.

Insurance—Building insurance is sometimes carried and kept record of by the building department, which thus tries to keep the buildings and plant in such shape as to obtain the lowest possible insurance rates. Many concerns carry special kinds of insurance such as that on plate glass. In plants where fire prevention work is not handled by a special department it affords another activity for the maintenance engineer. Much information as to this line of work may be obtained from the local fire insurance companies, city fire departments or board of underwriters.

The elimination of waste must not be overlooked. By proper management much material from alterations and additions can be utilized, but to secure its best use there must be a systematic record covering such material, and sorting and storing facilities must be provided.

Care of Leased Buildings—Many plants find it necessary to rent additional buildings for storage space. The maintenance engineer should be consulted before the leases are closed, as the maintenance of rented buildings becomes a very expensive item where the tenant maintains the building during the life of the lease. An inspection of the premises should also be made at the time the lease is made, this inspection

being covered by written reports showing the exact conditions or being written into the lease so that no misunderstanding will arise at a later date relative to these maintenance items.

Contract and Force Account Work—In a department having charge of maintenance there should be a division to handle estimates, bids or proposals, as well as the letting of contracts. For keeping records this division should have filing equipment of the inclosed drawer type, with indexes and tickler system. Provision should be made for the filing of orders under construction, as well as for files for all completed orders carrying with them guarantees or important data.

Contracts carrying guarantees, as in the case of roofing, should be kept in the file until after the guarantee expires, the date of expiration being kept in a tickler. The contract should be filed also under the contractor's name, so that proper inspections and examinations can be made before the guarantee expires. Where it is hard to obtain outside labor for repairs and alterations a special department may be organized embracing the various trades, such as carpenters, painters, machinists, millwrights and sheet metal workers. It is customary for the construction department to hire these men, directly or through the employment department.

A drafting department is essential in connection with maintenance work. In most establishments this need not be large, but it should have the proper organization to produce results without loss of time or waste of energy. There should be equipment for filing drawings and making blueprints. In this department should be kept records of the various sewer, water, gas and other piping and conduit systems. A catalog file should be included in the office equipment, for which a sectional bookcase will be convenient. For this department the judgment of the engineer is needed in selecting the draftsmen and managing the work.

Column Strength of Single Angles

Tests of 170 Struts at Bureau of Standards—End Fixation Factors Ranged From 1.1 to 1.9 for Various Connections

COMPRESSION tests of single-angle steel struts made in 1917 by the Bureau of Standards but not reported until now (Technologic Paper 218) give new data on the strength of columns over an exceptionally wide range of slenderness—from length-ratio 50 to 350. The series included 170 separate angles, of sizes ranging from 1¼ x 1¼ x ⅛ in. to 6 x 6 x ¾ in., with over-all lengths ranging up to 23 ft. 3½ in. No effect of size of angle on column strength per square inch is noted in the report, but the tabulated results show a rather large range at all length-ratios, apparently due to variations in the grade of the steel. Thus, in one series of tests (Fig. 1) the range of maximum load for columns of length 100 was from 36,800 lb. per square inch for a 3 x 3 x 5/16-in. angle to 27,900 lb. per square inch for a 6 x 6 x ½-in. angle, although mill test reports gave practically identical properties for the two heats from which these angles were rolled.

Plots of the test results are shown in Figs. 1 and 2. Fig. 1 gives the individual test results for a series in which both legs of the angle were attached to end fittings by means of two or more bolts at each end. The heavy line is drawn through the average results at the several length ratios represented. The dot and

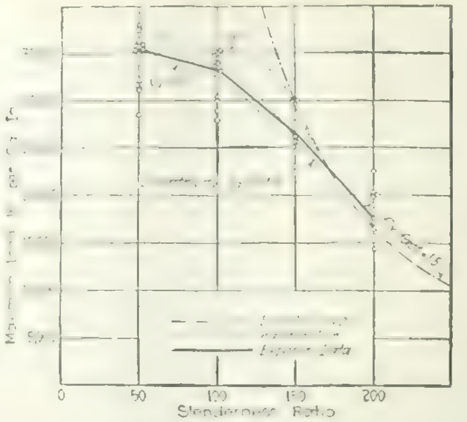


FIG. 1—RESULTS OF ONE SERIES OF SINGLE-ANGLE COLUMN TESTS

Angles 3 x 3 x ⅜ in. to 6 x 6 x ¾ in., 3 ft. 2 in. to 20 ft. 3 in. long over all; ends connected by two or more bolts in each leg.

dash curve at the right represents the Euler formula computed for a "fixation factor" of 1.5. This factor represents the ratio of actual length of strut to the length of the equivalent round-end column as estimated from the test results. This particular series extended only to length-ratio 200. Throughout the range it exhibits a variation in strength of 7,000 to 10,000 lb. per square inch, or 28 to 45 per cent of average strength.

All the 170 tests are brought together in Fig. 2, but here only averages are plotted. The upper heavy curve represents angles with flat (square) ends, not fastened.

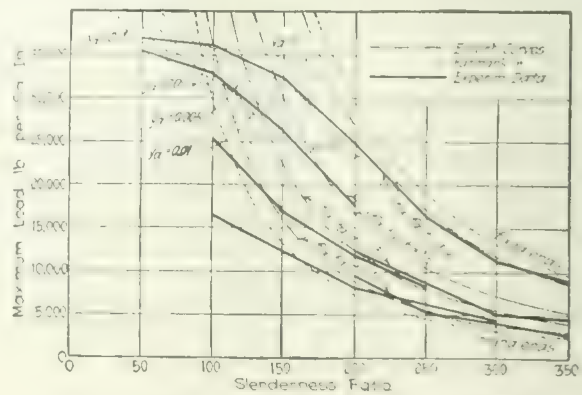


FIG. 2. AVERAGE RESULTS OF ALL TESTS

Total number of tests 170; angles 1¼ x 1¼ x ⅛ in. to 6 x 6 x ¾ in., tested in lengths up to 23 ft. 3½ in. over all. Strength of steel by mill test coupons 58,000 to 62,000 ultimate, 36,000 to 39,000 yield point (one result 47,000), 26 to 30 per cent elongation, 50 to 59% reduction of area. Upper heavy curve, tests with flat ends; next lower curve, connection by two or more bolts in each leg at each end; next pair of curves, connection by two bolts at each end; lowest curves, one-bolt connection at each end.

The next lower curve represents angles attached by both legs to end fittings, with two or more bolts in each leg at each end. The next pair is for angles connected to end fittings by one bolt in each leg or by two bolts in one leg, the results differing inappreciably. The two lower curves are for angles attached by only one bolt at each end; in the tests represented by the left-hand curve the ends were "folded," that is, one leg was flattened down upon the other and the bolt passed through the double thickness. The fixation factors, noted on the curves, 1.9 to 1.1, are deduced by the authors of the report, A. H. Stang and L. R. Strickenberg, as being the proper ones for the several conditions of ends tested, according to the agreement of the result with theoretical curves for these factors.

It is stated that formulas of the Rankine type do not fit the results, while the Karman formula (represented by the various dotted curves in Figs. 1 and 2 but not quoted) fits well.

Comparison of the relative strengths of the struts and their relative initial eccentricities, which latter were inferred from the midpoint deflections at 4/9 of the Euler load, are presented in tabular form as a study of the effect of initial eccentricity. The authors state that in nearly every case the struts with the larger eccentricity showed the lower strength.

Miami Conservancy Work Completed

Dams and River Improvement Work Are Completed and Enterprise Is Being Changed Over to a Maintenance Basis

THE $30,000,000 flood control project of the Miami Conservancy District is at the point of completion, according to a recent report from Charles H. Paul, chief engineer. All five of the dams are in the hands of caretakers and are being operated on a maintenance basis. River improvement and levee work at the nine cities and towns throughout the valley is either entirely completed or nearly so. In fact the only uncompleted construction jobs are the channel work at Hamilton, which will be entirely finished soon after the first of the year; the completion of a highway bridge at Troy, which will be open to traffic about Jan. 1; a small amount of levee construction at Piqua, which will be finished about the same time; and the construction of a water-works and electric light plant at Tippecanoe City, necessitated by the fact that the present plant comes within the limits of one of the retarding basins.

A large part of the extensive construction plant has been released, and is being overhauled and sold. As practically all of the work was done by the District's own forces, there is a large amount of plant and equipment to be disposed of, and this is one of the active features of the District's work at present.

As the whole job will soon be on a maintenance basis, the organization of the maintenance forces is now proceeding rapidly. Caretakers and patrolmen are being appointed, for duty at all points where the flood control works have been constructed, and a plan for systematic inspection and reports is being worked out, with the idea of keeping the works up to 100 per cent efficiency at all times, ready for a flood whenever one may occur.

An unusual problem is presented here, in that the floods against which these works will be of most benefit are not of annual occurrence but may occur only once or twice in a lifetime, and it is necessary to keep alive and up to the mark a project that may not be called upon for maximum service for many years to come. The matter of keeping tuned up, under such conditions, is much more difficult than where a real test occurs at least as often as once a year.

The accompanying photograph shows the result of some of the river improvement work. At Dayton more than 2,000,000 cu.yd. of material have been removed from the river channel. The safe capacity formerly was about 75,000 sec.-ft. and has been increased to 120,000 sec.-ft. At Hamilton the channel excavation, which amounted to about the same quantity, together with some raising and strengthening of levees and extensive paving of slopes gives a safe channel capacity of 200,000 sec.-ft. Formerly it was below 100,000 sec.ft.

MIAMI RIVER AT HAMILTON AS IMPROVED—ORIGINAL CHANNEL CAPACITY DOUBLED BY REGULATION

Amount of Lumber Used for Boxes

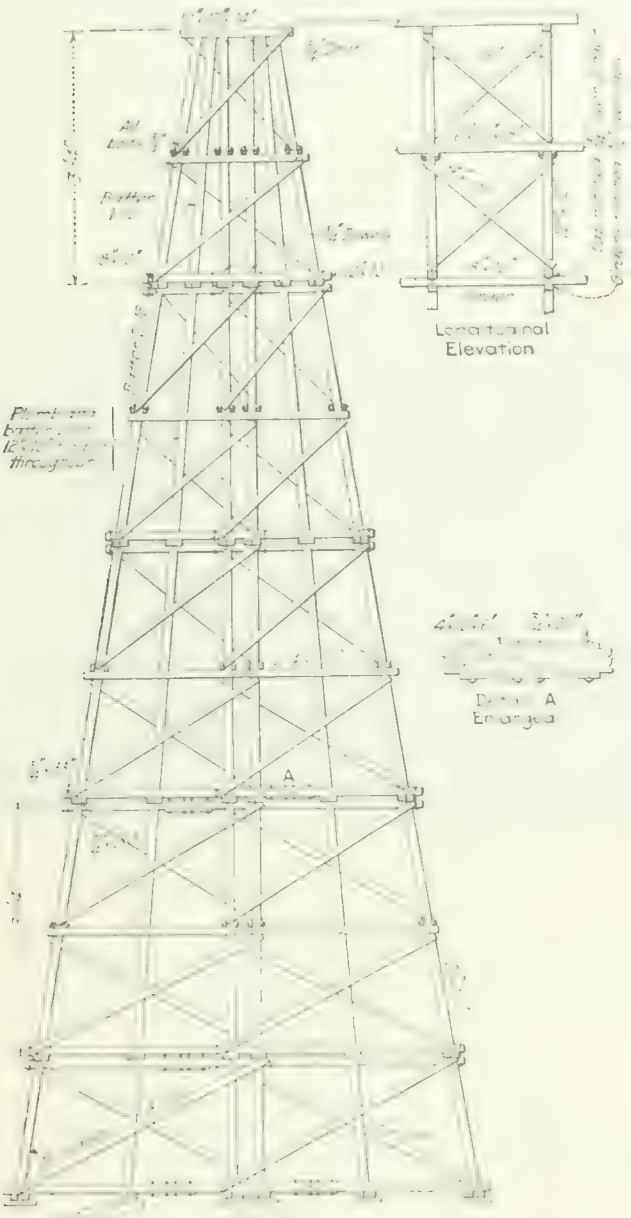
It is calculated that about 15 per cent of all the lumber produced in the United States is consumed in the manufacture of wooden boxes, according to the information bureau of the National Lumber Manufacturers' Association.

More than two-thirds of the low grade product of the North Carolina pine region is ordinarily used for box purposes. Nearly 50 per cent of loblolly or North Carolina pine goes into boxes; 35 per cent of shortleaf pine in the same territory; about 8 per cent of longleaf pine and a smaller percentage of the other softwoods in that region.

Heavy Trestlework Required on New Logging Railroad

Line 38½ Miles Long in Oregon Used 4,500,000 Ft. B.M. in Five Trestles—Cableway Erected High Bents in 30-Ft. Sections

A STANDARD-GAGE railroad 38½ miles long is now being constructed to the northwest of Portland, Ore., to tap heavy stands of fir timber that are to be cut in the near future. The line was originally begun as a private enterprise but construction has recently been taken over and is being completed by the Spokane, Portland Seattle R.R. Co. Rails have been laid over about 23 miles of the new line and construction is progressing rapidly. In addition to the railroad a mill



TYPICAL CONSTRUCTION OF FRAMED [illegible] TRESTLES

is under construction at Vernonia, which is at milepost 22 on the new line, designed to cut 250,000 ft. b.m. per 8-hr. shift. Logs brought out over the new railroad will be delivered via the United Railways to a booming ground on Willamette Slough near Portland whence delivery to mills of the vicinity can be made by water.

The new railroad begins at Wilkesboro, Ore., the terminus of the United Railways, a subsidiary of the Spokane, Portland and Seattle system, and extends thence 32.6 miles to the Columbia-Clatsop County line. This much of the new railroad is to be a common carrier operated by a company formed for this purpose and known as the Portland, Astoria & Pacific R.R. Co. Beyond the county line the Oregon-American Lumber Co., which is constructing the mill at Vernonia, will operate the remaining 6 miles of track as a private logging road.

The new railroad has a maximum gradient of 2.3 per cent, compensated, a maximum curvature of 12 deg. up to the county line and 14 deg. for the 6 miles beyond. Eighty-five-pound rails are used throughout. There is only one tunnel, which is 1,143 ft. long, but trestles and bridges abound. In all there are forty-two stream or canyon crossings including thirty-five trestles or bridge-approaches aggregating 10,140 ft. in length, five bridges of 60-ft. span, five of 72-ft. span and two of 84-ft. span. All the bridges are Howe framed timber trusses.

The most notable construction feature of the new line is the trestlework. Five of the trestles located within a track length of about two miles required a total of 4,500,000 ft. b.m. The Brook Canyon trestle, for example, has a maximum height of 165 ft. and is 696 ft. long; another structure nearby, built entirely on a 12 deg. curve, is 605 ft. long and has a maximum height of 133 ft. The Ganzer Canyon trestle, 925 ft. long and reaching a height of 155 ft., required 1,100,000 ft. b.m. in its construction.

Timber for these five trestles was delivered to storage yards at the site well in advance of track laying operations by the use of old logging railroad spur lines which were rehabilitated for the purpose. In the case of three of these the old spur tracks actually passed through sites suitable for timber storage yards. In the other two cases short extensions of the old spurs were required. From the storage yards, which were all in the bottoms of the gorges crossed by the new line, inclined cableways delivered timbers to framing platforms at one end of the trestle site and at deck level.

The framing platform consisted of a plank floor large enough to accommodate one 30-ft. section when laid out flat. The location was selected so that the platform would be under both the main cableway spanning the gorge and the upper end of the incline cable from the timber storage yard. Timbers were handled on the platform by a locomotive crane. All boring was done with compressed air boring machines served from compressors on the steam donkey engines used for operating the cableways. As each section was finished it was immediately removed from the platform to make room for the next. With a little care in operating the cableway each section could be delivered to its exact location in the trestle.

The framing platform crew normally consisted of twenty-one men. This included, in addition to the men actually framing and assembling the sections, all labor required to move the timbers from the storage yard in the valley below and complete the sections on the platform ready for removal by the main cableway. The work of this crew, it was found, would just balance the work of an erection crew on the trestle consisting of seven men. Included in the latter were two main cable-

way operators and one "hooker on," leaving only four men continuously employed on the trestle. These four, in addition to fastening the sections that were delivered at the rate of about one every hour, placed the girders and braces and drifted or bolted them into place as required.

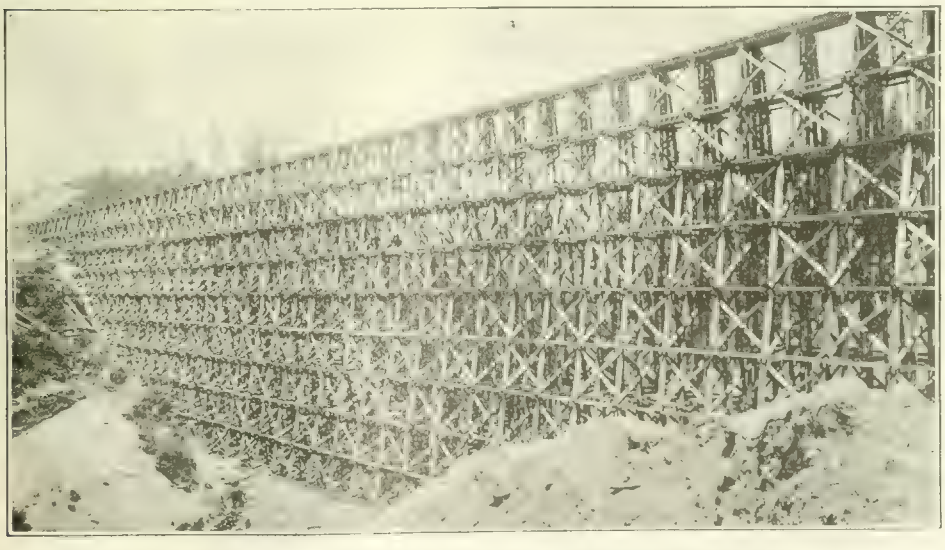
FRAMED SECTION EN ROUTE TO POSITION

The dark object near the top of the section is a 2 x 12-ft. log used as a counterweight.

For this average crew of twenty-eight men the daily payroll was $182. When placing seven sections per eight-hour day which was a common rate of progress, the labor cost on timber in place was about $8 per thousand feet board measure. On some days a much more rapid rate of progress was attained. In the case of the trestle located on a 12 deg. curve the main cable was provided with two anchorages a short distance apart on one side of the gorge so the arrangement of the cable end, in plan, would take the form of the letter "Y." With this plan and by paying out or taking up slack at these anchorages from time to time as required, the main cable was shifted so as to permit of delivering sections in place on all parts of the trestle. The main cable was $1\frac{7}{8}$ in. in diameter.

The location of the old logging road spurs was found convenient only in the case of the five large trestles. For bridge and trestlework farther along the line timbers went in from the nearest Southern Pacific R.R. siding on motor trucks which made the latter part of their haul over the graded roadbed. Thus the trestles were completed well ahead of the tracklaying crews and despite the numerous crossings and heavy trestlework there were no delays in track construction on this account.

The design of the trestles as well as the initial work of construction was under the direction of George Scoggin, chief engineer and F. I. Roth, assistant engineer, Portland, Astoria & Pacific R.R. On Nov. 1, 1921, the work was taken over by the Spokane, Portland & Seattle R.R. Co. and since then has been carried on under the direction of A. J. Witchel, chief engineer, and G. V. Lintner, assistant engineer, of that company. Construction of all trestles and bridges is being carried out by J. F. Clarkson & Co., Portland, subcontractors. The Utah Construction Co. holds the general contract.



GENERAL VIEW OF GANZER CANYON TRESTLE

This structure has a length of 925 ft., a maximum height of 155 ft. and contains 1,100,000 ft. b.m. of lumber.

Operation of a Drainage Pumping Plant

PERFORMANCE and operating cost of a drainage pumping plant on the Yuma project of the U. S. Reclamation Service as given by D. C. McConaughy, office engineer, in the February issue of the *Reclamation Record*, are summarized in the accompanying table. Two screw pumps, a 36-in. and a 30-in., driven by 100-and 75-hp. oil engines, have capacities of 60 and 30 sec.-ft. respectively. Provision is made for two more 36-in. units. The lift is variable, partly on account of changing water level and partly because the pumps are operated normally only a portion of each day, so that water accumulates in the forebay. In 1921, the plant averaged $8\frac{1}{2}$ hours operation daily, with an average lift of 9.25 ft. During a 6-weeks' flood stage in the Colorado River, the head reached a maximum of 14.2 ft. and the maximum daily operation was 22 hours. A chief operator and one assistant constitute the regular force, with a second assistant during the high water period. This force will be sufficient to operate the plant when additional units are installed.

PERFORMANCE OF DRAINAGE PUMPING PLANT

	Cost	Per Cent of Total
Operation: Labor	$4,176 74	37 5
Fuel	3,143 54	28 2
Lubricants	811 36	7 3
Repairs to machinery Labor	435 76	3 9
Materials and supplies	1,360 00	12.2
Minor equipment, repairs and supplies	864 56	7.8
Minor miscellaneous expense	16 65	0.1
Equipment	330 00	3.0
Total	11,139.61	100.0
Per acre-foot	0 437	...
Per foot acre-foot	0 044	...

	Pump Performance
Average run per day	100-hp., 9.1 hr.; 75-hp., 9.3 hr.
Average lift (both pumps)	9.9 ft
Water pumped: acre feet	25,520
Foot acre feet	253,170
Fuel oil, per acre foot	1.34 gal
Per foot acre foot	0.13 gal.

How To Inspect Asphalt Paving Mixtures at the Plant

Testing Outfit Required—Inspection, Testing and Storage of Materials—Proportioning the Materials—Methods of Sampling—Daily Report Blank

By W. J. Emmons

Professor of Highway Engineering, Agricultural and Mechanical College of Texas, College Station, Tex.

PLANT inspection is one of the essential details of asphalt pavement construction and, if intelligently carried on, is a measure of true economy. Given an inspector endowed with common sense, tact and a knowledge of the principles of asphaltic construction, the engineer may feel assured that the component materials and the resulting product will conform to his specifications and that in its uniformity of composition the mixture will almost certainly be far superior to one whose proportioning is left to the contractor's forces.

Field Laboratory and Equipment—A field laboratory should be established at the paving plant. It may be located in any convenient structure which is well lighted and in which a work bench is available. Preferably it should contain a window commanding a view of the mixer platform in order that the inspector may be in constant touch with operations there. The following apparatus should be supplied the inspector:

1—Penetrometer, field size, with standard needle.
1—[illegible] than 100 grams and sensitive to 0.1 gram, for sand tests.
1—[illegible] grams and [illegible] aggregates.
1—Set of sand sieves—10-, 40-, 80-, and 200-mesh sizes.
1—Set of [illegible] diameter holes or those necessitated by the maximum size of aggregate to be used.
2—Armored asphalt thermometers reading to 600° F.
1—[illegible]
24—[illegible] by 1½ in. in depth for penetration tests upon asphalt.
1—Ten-quart bucket for cooling penetration specimens.
1—Small dipper or ladle for sampling asphalt.
1—Wood paddle for the pat test upon sheet asphalt mixtures.
1—[illegible]
A supply of stout unglazed paper for the pat test.
A supply of report forms.

Duties of Inspector—The duties of the inspector should be as follows:

1. To test materials as received and during use and to see that they are not mishandled during storage.
2. To oversee the combination of materials, including the checking of proportions, accuracy of scales, and regulation of temperatures.
3. To secure samples of materials and the mixture as produced.
4. To submit daily reports to the engineer, giving full information regarding the operation of the plant.
5. To secure data regarding the origin and the costs of materials and the cost of plant operation.

> **RULES FOR INSPECTORS**
>
> *1. An inspector with a chip on his shoulder has a hard time getting what he wants.*
>
> *2. Except to the mixing crew, when quick action is demanded, give no direct instructions to the laborers—make known your desires to the foreman.*
>
> *3. Do not discuss plant problems and difficulties while off the job—a twisted version of your account may reach the engineer or contractor and cause embarrassment.*
>
> *4. Do not make unsolicited suggestions regarding the operation of the plant unless it is for the good of the pavement mixture.*
>
> *5. Make tests upon new materials promptly, decide carefully whether they should be accepted or rejected, and do not reverse your decision without very good reason.*
>
> *6. Be fair and consistent in your rulings. Remember that the contractor as well as the engineer has definite rights under the contract.*
>
> *7. Get your daily reports in daily.*

Asphalt—Ordinarily the inspector is required to test the asphalt for penetration only, and it is common practice to allow an approved brand to be used, provided the consistency is correct, without awaiting the results of complete tests from the laboratory.

A penetration test should be made upon shipments of asphalt as soon as the car is steamed and upon any which may have been left over from the previous day's operations. The asphaltic cement is kept hot by means of direct fire or steam and is agitated by steam or air. High temperatures (above 325 deg. F. for most asphalts) and violent agitation both tend to reduce the penetration and may even change the characteristics of the asphalt if carried to extremes.

When a refined asphalt and a flux are to be combined into an asphaltic cement, the inspector must determine the combination required to yield the desired consistency. This is most easily accomplished by preparing three or four mixtures of the refined asphalt and flux in widely different proportions and plotting a fluxing curve based upon the penetrations derived from them, using the number of parts of flux to 100 parts refined asphalt as ordinates and the penetrations at 77 deg. F., as abscissas. The ordinate of the point upon the curve corresponding to the desired penetration will give the parts flux to the 100 parts refined asphalt which it is necessary to use.

In order that accurate and consistent results may be obtained in the penetration test, the following rules should be strictly observed:

1. Fill the small can with hot asphalt and set aside for one-half hour in order that it may cool to air temperature. Be sure that the sample is free from air bubbles and that no dust from the plant can get into it.
2. Immerse the sample in water at exactly 77 deg. F. for one hour. (Sample shculd never be rapidly cooled in ice water.)
3. Perform the test with sample under water held accurately at 77 deg. F.

4. Specimens which have stood for more than three hours should be carefully reheated to about 325 deg. F., stirred and recooled under the conditions given above.
5. Take particular care that the needle is not allowed to rust or the point to become dulled. Stick it into a cork when it is not in use.
6. Wipe the needle with clean cloth between tests; never with oily or gasoline-soaked waste.

Sand—The sand supply should be watched by the inspector with extreme care, for upon its composition the success of the pavement largely depends. A general inspection should be made and samples for sieve analyses selected from all sand in storage piles as soon as the inspector reaches the plant. He should note the number of varieties, their individual uniformity and whether each is piled separately or is more or less mixed with other grades. This latter practice is very bad practice and should be guarded against. Subsequent shipments should be inspected and tested as soon as received to determine not only their suitability, but also whether they may be stored with the present stock or are of such different characteristics that they must be piled separately.

Samples must be taken so that they will be truly representative of the whole mass. This may best be accomplished while the sand is moist, as segregation of sizes is then avoided. The mixture of several handfuls, scraped from the vertical faces of holes dug into the pile at a number of points, constitutes a convenient method of sampling. The large sample should be taken to the laboratory, thoroughly mixed and reduced to the proper size for a sieve analysis by the quartering method. A 100-gram sample is sufficiently large for a sieve analysis, and if the material is dry the test may be run immediately. If the sand is moist the sample obtained by quartering should be a few grams heavy in order that it shall weigh not less than the 100 grams after drying. The 10-, 40-, 80- and 200-mesh sieves are generally used in making sieve analyses at the plant.

As the sand in most mixtures is a combination of two or more sands from the stockpiles, it is well to check the uniformity of feeding by frequent samples taken from the hot sand storage bin. A small frying pan or a wooden box with a short handle makes a convenient sampler. The sampler is taken at the time a batch is being drawn into the measuring box by passing the sampler back and forth through the stream. The first material flowing from the bin may not be representative and it is, therefore, better to delay taking the sample until a few seconds after the gate is opened. After cooling, the sample should be quartered to 100 grams and screened.

Stone screenings are sampled and tested by the same general methods outlined for sands. In the sieve analysis, however, sieves of larger sizes are used as required. To avoid excessive wear upon the fine mesh sieves, the sample is divided over the 10-mesh sieve, the proportions retained and passing noted, and separate analyses run upon each. The ordinary 100-gram sample is used for the finer portion, but 500 grams should be selected for the coarser. By multiplying the several component per cents constituting each sieve analysis by the respective per cents which the fine and coarse materials bear to the original sample of screenings, the sieve analyses of the parts finer and coarser than the 10-inch mesh sieve are proportionately reduced to per cent of the original sample.

Crushed Stone and Gravel—These materials, as they appear in the storage piles and shipments, should be inspected for freedom from weathered, or disintegrated particles and coatings of dirt.

It is difficult to sample large masses of coarse aggregate, especially if the sizes composing it are somewhat segregated. The best method is to go over the pile carefully, noting the presence or lack of uniformity, and take shovelsful from several locations in such a manner as to represent the composition of the whole as closely as possible. The sample so selected may weigh 40 or 50 lb. and should be collected in a large box or clean sack. After the sample is quartered down to 4,000 or 5,000 grams, a sieve analysis may be run by ordinary methods.

Grades of coarse aggregates, differentiated upon the basis of nature or test characteristics should be stored in separate stockpiles. The unloading of dirty or otherwise unsuitable aggregates should not be permitted.

Dust—The one test which the inspector is usually required to make upon material used as filler is that for fineness, or per cent passing the 200-mesh sieve.

The dust may be received at the plant either in bulk or in sacks. In the former case it is only necessary for the inspector to collect small quantities from a number of different places in the mass to secure his sample. In the latter case small quantities should be taken from a dozen or more sacks. Once the sample is obtained, it should be quartered down to 50 grams and shaken over the 200-mesh sieve until virtually no dust falls upon a clean sheet of paper placed under it. The residue retained by the sieve is then weighed and the per cent passing computed.

Dust which becomes damp or wet during storage forms into lumps which do not break down in the process of mixing and such material is unsuitable for use as filler.

Proportioning Cold Aggregates—The uniformity of all asphaltic paving mixtures depends to a greater or lesser extent upon the care and accuracy with which the cold aggregates are fed into the plant. Clearly defined piles of the several materials should be located at the foot of the cold aggregate elevator with one or two laborers assigned to feed them systematically in simple proportions.

Sometimes the contractor sinks a box around the foot of the cold aggregate elevator, dumps into it alternate wheelbarrowsful of the several materials and assigns a single man, armed with a hoe, to the task of maintaining the feed. Such a practice seldom results in uniform aggregate at the mixer, since the materials are very likely to become segregated. The only conditions under which such proportioning should be permitted are those in which each batch is fed into the plant and delivered to the mixer as a unit, and in such cases the barrows should always be accurately filled to a level of known volume.

Proportioning the Hot Aggregates—From the dryer the heated aggregates are elevated to screens which separate the materials and deflect them into the stone and sand bins over the mixing platform. Segregation of sizes in these bins is one of the difficulties in the path of uniform proportioning and constitutes the

strongest objection to the use of a single storage bin when such stone and sand mixtures are being prepared. Holes in the partition between two adjacent bins or in the screens will result in a mixture of two classes of aggregate and entirely upset the scheme of proportioning. The same thing may occur in some plants from the too rapid feeding of any one cold material, the result being that it finally fills its bin and overflows into the next. The composition of aggregate showing contamination with others should never be guessed at as a basis for the addition of bitumen, but the bins should be emptied and the trouble corrected before mixing is resumed.

The measurement of aggregates by volume is sometimes attempted, and, while not as easily controlled as measurements by weight, uniform results may be obtained provided the box-man can be impressed with the necessity for accuracy. The asphalt is always measured by weight and the volume of aggregates must be determined which will correspond to their proportions by weight in the mixture. The point to which this volume of sand fills the measuring box must be indicated by a permanent and clearly recognizable mark. A second mark must be made showing the height reached by the combined aggregates after the stone has been placed on the sand. The box-man must be required always to draw the sand first and to level each material even with its mark by means of a short hoe.

The greatest care should be taken to insure the accuracy of the scales. Before work starts the inspector should check them by means of test weights or with large rocks or sacks of cement previously weighed upon scales which may be found in express depots or elsewhere. After mixing begins whole loads should, if possible, be frequently weighed upon platform scales and checked back against the batch weights at the plant. Care should be taken that aggregate does not wedge under the free platform upon which the measuring box is mounted and all parts of the weighing apparatus should be cleaned daily. If the scales get out of order, mixing should be immediately suspended until repairs are made.

Unless the box-man is experienced and cool headed he will many times overrun his weights. This may

CITY OF BRYAN, TEXAS

[illegible] Report of Asphalt Plant Inspection

[illegible]
Location of Plant: *S. P. Siding*
Date: *9-[illegible]-22*
Weather: *Fair*
Temp. A.M.: *85*
Temp. P.M.: *90*
Type of Plant: [illegible]

MATERIALS AND PROPORTIONS IN PAVEMENT

Materials	[illegible] Brand	Proportions Of Feed	Batch Weights (Lb.)	Per Cent	Total Used (Tons)	In Stock (Tons)	Cost per Ton
[illegible]							
[illegible]							
[illegible]	[illegible]		*43*	*8.6*	*5.16*	*50*	
[illegible]	[illegible]	[illegible]	*208*	*41.6*	*12.[illegible]*	*100*	
[illegible]	[illegible]	[illegible]			*12.[illegible]*	[illegible]	
[illegible]	[illegible]		*41*	*8.[illegible]*	*4.9[illegible]*	*50*	
[illegible]	[illegible]	[illegible]	*208*	*41.6*	*24.96*	*175*	
[illegible]							
[illegible]							
Total			*500*	*100.0*	*60.00*		

DAY'S PRODUCTION

Construction	No. of Batches	No. of Loads	Hours in Oper'n	Sq.Yds. Laid
[illegible]	[illegible]	*30*	[illegible]	*580*

PLANT OPERATING COSTS

Material	Origin	Am't. Used	Cost
Coal (tons)			
Fuel oil (gal.)...			
[illegible] (gal)			

SAMPLES TO LABORATORY

Material	Origin	Am't. Rep'd	Serial No.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]

Labor	No.	Hours	Total Hours	Rate of Pay
Foremen.	[illegible]	*10*	*10*	
Engineers	*1*	*10*	*10*	
Skilled labor	[illegible]	*10*	*20*	
Unskilled labor	*6*	*10*	*60*	
Trucks	[illegible]	*1*	*50*	

MATERIALS TESTED AT PLANT

Material									Penetrations	
Sample from	*Sand Bin*	*Sand Bin*	*Sand Bin*	*Sand Bin*	*Sand Car*	*Sand Car*	*Scr'gs Car*		No.	Test
Per cent passing 200-mesh sieve	*3.0*	[illegible]	*2.0*	*3.0*	*6.8*	*0.3*	[illegible]		*1*	*50*
Per cent passing 80-mesh sieve	*24.0*	*25.6*	*12.0*	*26.0*	*50.0*	*6.7*	*1.2*		[illegible]	[illegible]
Per cent passing 40-mesh sieve	[illegible]	[illegible]	*46.8*	[illegible]	*39.2*	*49.0*	*2.8*		[illegible]	[illegible]
Per cent passing 10-mesh sieve	*29.7*	*30.6*	[illegible]	[illegible]	*4.0*	*40.0*	[illegible]		[illegible]	*51*
Per cent passing 4-mesh screen	[illegible]	*1.0*	*2.0*	*0.3*		[illegible]	[illegible]		[illegible]	*50*
Per cent passing 2-mesh screen							*36.0*			
Per cent passing [illegible] screen										
Per cent passing 1-inch screen										
Per cent passing 1¼-inch screen										
Per cent passing [illegible] screen										
Per cent retained 1½-inch screen										
Total	[illegible]	*100.0*	[illegible]	[illegible]	*100.0*	[illegible]	*100.0*		Ave.	[illegible]

[illegible] *-mesh at 1 P.M. due to poor feeding by new laboror.*

J. W. Brown, Inspector.

easily be a serious situation and he must be trained to work carefully. Sand requires approximately four times as much bitumen as does an equal weight of stone, and thus, if the routine amount of asphalt be added to an unbalanced aggregate, the mixture will be rich or lean, depending upon whether the stone or the sand is in excess.

Asphalt—The volume of a given weight of asphalt varies greatly with changes in its temperature and consequently this material is always proportioned by weight.

The asphalt bucket is suspended from a set of scales and these should be checked for accuracy as was suggested previously for those supporting the aggregate measuring box. The weights, both compensating for the tare weight of the bucket and representing the contents of the bucket, should be fitted with set-screws which will prevent them from being disturbed by the vibration of the plant or accidental blows.

The attention of the inspector should be given more or less constantly to the proportioning of the asphalt and particularly at certain critical periods. In the morning the bucket is clean and cold and retains a considerable proportion of the first batches as a coating on the bottom and sides. Succeeding batches continue to build up this layer until the bucket becomes thoroughly heated, when the adhering asphalt is gradually released. Finally an almost constant quantity is retained by the bucket for such period of time as the plant remains in continuous operation. It is clear, therefore, that in order to avoid a deficiency of bitumen in the first few batches and an excess in succeeding ones, the tare weight of the bucket must be almost constantly watched and the counter-balancing weight frequently adjusted.

Filler—Dust may be weighed with the other aggregate but is more likely to be blown away by the wind, especially if the mixing platform is not enclosed. Ordinarily, the weight of dust which one or more ordinary water buckets will hold is determined and the proper number of bucketsful added to each batch. As it is easy for the laborer only to partially fill the buckets or to forget exactly how many are required, the inspector should watch this detail carefully.

Regulation of Temperatures—Mixtures reaching the street should be hot enough to rake properly but not hot enough to permit the segregation of materials in this process or to injure the asphalt. Under ordinary summer temperatures outside limits for asphaltic concretes and sheet asphalt should be 225 deg. F. to 350 deg. F.

Of almost equal importance with the proper degree of temperature is the uniformity with which it is maintained. All asphalts suffer a decrease in penetration when heated, and the higher the temperature the greater will be the extent to which they will harden. Also hot mixtures compress to a greater degree than do cold ones. Thus extreme variations in temperature at the plant may seriously affect the serviceability of the pavement.

Constant attention must be given the rate of feeding cold aggregates and the fires under the dryer if uniform temperatures are to be maintained. When the plant starts in the morning, materials are fed in slowly, but nevertheless the first aggregate through the cold elevator, bins and measuring box may reach the mixer at too low a temperature to be properly mixed. By pushing the fires and feeding slowly, aggregate will soon come through at satisfactory temperatures and as soon as it does the rate of feeding should be increased. Otherwise the temperatures may swing to the other extreme and necessitate another delay until they can be lowered.

A method of reducing temperatures which are too high, is to increase the rate of feeding cold and damp aggregates and at the same time open the door of one or more of the fire boxes. Aggregate which is coming through at too high a temperature may, in some types of plants, be cooled by throwing cold sand into the heated aggregate as it falls out of the dryer.

Whenever it appears that aggregate is being received at improper temperatures, it should be held in the measuring box and tested despite the eagerness of the mixer crew to rush it through. Let the thermometer remain in the material until it ceases to rise. Remember that it is easier and less expensive to reject aggregates before rather than after the bitumen and dust have been added. In the former case they may be hauled back to the storage piles and used again later; in the latter case the batch is a total loss. It should seldom be necessary to reject a completed batch due to improper temperatures, although occasion to do so frequently arises due to blunders in proportioning on the part of the mixing crew.

Mixer and Conditions of Mixing—The mixer must be in good shape, all blades must be present, and, while long enough to prevent masses of partially mixed asphalt and aggregate from adhering to the sides of the mixer box, should not be long enough to wedge coarse particles. The blades should be so spaced and placed that the mixture is worked from both ends toward the center and the speed of rotation should be sufficient to churn the mass vigorously.

The aggregate, after being run into the mixer, should be turned for a few seconds in order to permit a uniform distribution of the filler before the asphalt is added. The asphaltic cement should be poured in slowly and uniformly over the full length of the mixer. The time of mixing should be extended somewhat beyond the instant at which the mixture appears uniformly black. At proper temperatures one minute for sheet asphalt and three-quarters of a minute for coarse graded mixtures is sufficient.

Asphaltic pavements should not be laid during a rain or on a wet base. As soon as rain starts to fall the inspector should direct that plant operations be stopped. If the precipitation is very light he may allow the last truck to proceed to the street and leave its disposition to the inspector there. Following light summer showers it is frequently possible to proceed with the work, but the inspector should await advices from the street before permitting the resumption of operations.

Samples of Materials and Mixtures—Samples of all new materials not conforming to those approved before the work is started should be sent to the engineer or laboratory, even though the inspector regards them as suitable and permits their use. Samples of aggregates should be taken by the methods outlined earlier in this article.

For proper control daily tests should be made upon the mixture for bitumen content and sieve analysis of the aggregate. The plant inspector should gradually

collect a sample for this purpose by taking a trowelful from each of a large number of batches during the day. It may be heated, mixed and quartered to the proper size at the end of the day's work. The proper sizes of samples for the several materials are as follows:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

All samples should be numbered serially and further identified by reference to them in the inspector's report.

Inspector's Reports—The engineer must be kept fully informed regarding the progress of the work and conditions at the plant. The inspector is furnished with report forms for this purpose and it is very necessary that they be submitted daily. The reports should be numbered in series beginning with the day the inspector reaches the plant and continued (Sundays excluded) until the work is completed. Every detail of the plant operation and inspector's activities should be included. A specimen report is shown here, illustrating a day's operation upon a modified Topeka mixture.

Keeping Costs—Cost data are necessary in order to formulate accurate estimates and the inspector should collect detailed information concerning them. If possible, the costs of materials, bills of lading showing weights of materials, and the wages paid to labor should be obtained from the contractor. The quantities of fuel and lubricants used may be obtained from approximate weekly consumption.

New Outfall Sewer and Sewage-Works Progress at Los Angeles

A PROGRESS report on the outfall sewer and sewage works project of Los Angeles, Calif., for which $12,000,000 of bonds were voted on Aug. 29, shows that on Dec. 4 there had been built or put under contract 3.68 of the 7.41 miles of emergency relief sewer, that plans had been made or were well under way for the remainder of this sewer; plans were being made for a 3-m.g.d. emergency sewage-works near Culver City, consisting of storage reservoirs, pumping plant, Imhoff tanks and sludge beds, sprinkling filters and secondary tanks, these works to be enlarged as the flow in the relief sewer increases; plans were being made for a new ocean outlet at Hyperion, at the end of the existing trunk sewer, the new outfall to be of 60-in. cast iron and to extend about a mile into the ocean, to a water depth of some 54 ft. below mean sea level.

The emergency relief sewer from the present ocean outlet to the emergency sewage-works on Ballona Creek is designed for a capacity of 40 sec.-ft., to accommodate the excess dry-weather sewage flow of the next three years. For the upper 2.15 miles of this relief sewer, now built or under construction, there is being used 44-in. riveted steel pipe formerly used on the construction of the Los Angeles Aqueduct. For the remaining 5.26 miles of this sewer a contract was awarded on Nov. 29, specifying Ferguson's segmental block for 1.58 miles, and for the remaining 3.68 miles there is under consideration the same material with wood-stave pipe as an alternative for the upper end and for the lower end reinforced-concrete pipe lined with vitrified clay blocks, with wood-stave pipe as an alternative.

The construction work at Hyperion will be divided into three contracts: (1) The ocean outlet already mentioned; (2) about 700,000 cu.yd. of grading for the sewage-works; (3) the sewage-works proper. The dates for letting these three contracts have not been fixed, but it is expected that the lettings will take place and the sewage-works and the ocean outfall be put in use before the new outfall to the ocean is put under construction.

John A. Griffin is city engineer and W. T. Knowlton engineer of sewers at Los Angeles.

Operator's Viewpoint of Canal and Structure Design

Irrigation System Efficiency and Maintenance Depends on Proper Layout—Experience on Valier Project Given

By George Ebner
Operation Engineer, The Valier-Montana Land and Water Co., Valier, Mont

WITH the increasing importance of problems relating to irrigation operation and maintenance and the greater study being given them a review of many practices which have been shown advantageous are of value when new construction is planned or replacement or remodeling is necessary. Observations are given on the location of structures, silt problem, design to prevent or minimize slides, methods of handling weeds, alkali and preferences as to chutes, pipes or drops.

The main canal should be free from check gates which create orifice conditions and under no circumstances should two sets of orifice gates, without overflow, be used in a diversion structure. If it is necessary, and it often is, to check water into a lateral some flashboard arrangement is preferable, since it is impossible to check with gates under the varying flow of a main canal. A combination of gate and flashboard control is oftentimes an advantage. Generally a weir action control will cause less surge and wash downstream and result in less maintenance expense.

Unless exceptional conditions exist no lateral or service turnout should ever be placed above the main canal grade. Excessive checking is necessary and good service is not possible. Whenever the turnout or intake can be placed below canal grade the check can be eliminated.

In diversion structures where silt laden streams are encountered the surface water is taken into the canal; in other cases silt traps and wasteways are used to wash out the sand during flood seasons. However with many mountain streams the entire flow even in flood season is taken. When the creek has a fall of 10 ft. per mile and the canal 3 ft. it can be seen that all the silt load will be thrown into the canal. By raising the diversion weir and canal intake a backwater pond upstream will be formed where the creek can unload. This plan was used on the Birch Creek headworks, designed by C. E. Atwood, chief engineer of the Valier Project, and after four years' use no appreciable silt has reached the headgates or has entered the canal.

On side hill location where the bank has a tendency to slide, it is believed that a wide, shallow canal section is better than one deeper and narrower. The bank pressure is less and there is less head to cause seepage. Often this situation can be benefited by a parallel drain at the toe of the bank with sufficient outlets. Bond ditching under the embankment and rolling the fill material are of direct benefit. A preliminary investi-

gation may disclose a tendency to slide and make a lined section or bench fluming advisable. Pumping plants could have been built in some cases where distribution begins at no greater construction cost than that of the gravity canal and the pumping cost would not exceed the gravity section maintenance charge.

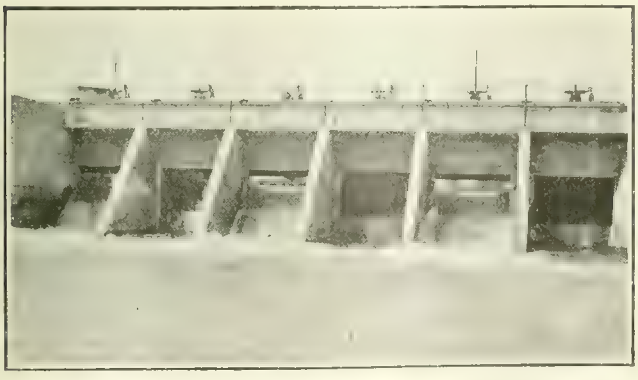
No canal should be permitted to cut and carry silt. With excessive silting portions of the canal may lose area so that to permit cleaning service must be interrupted every season. In maintenance work the construction of grade controls and drops will be found more economical than never ending silt cleaning. Too much importance cannot be attached to this point. The writer has in mind two canals of 400 and 500 sec.ft. capacity, slope of 0.004 and 18 and 20 miles length which after ten years are carrying their rated capacity without any silt cleaning at all.

Because of the growth of grass and weeds it is good practice to make small ditches of excess capacity. Cleaning is deferred and the yardage per station is light. Where moss grows an excess cross-section is needed in all canals to insure good delivery service.

Structures have been built which meet all hydraulic requirements but easily become clogged with weeds and thistles. This is true of baffles and of small openings below curtain walls. With a combined turnout and check the turnout is more likely to clog than it would were the check a short distance downstream. Of various measuring devices, weirs and Venturi flumes offer less obstruction than orifices.

Where alkali is present it is imperative that attention be given design, drainage and kind of material for initial or replacement structures. The cement gun is found profitable for repair work.

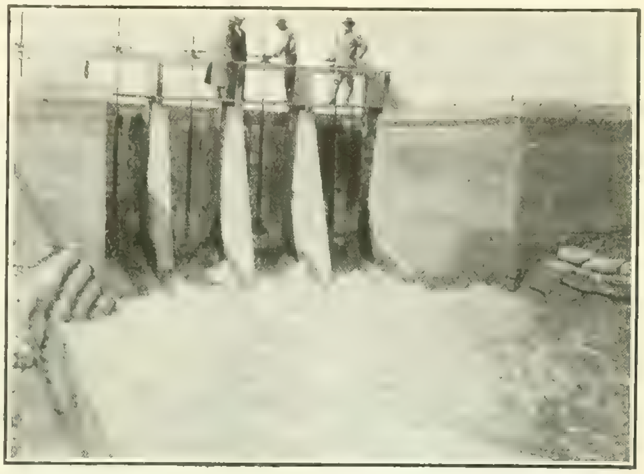
Wherever topography will permit their use open concrete chutes have been found more economical than pipe lines or a series of drops. It is axiomatic that all chutes should have transition intakes, computed cross-sections and be tile drained. Those built by the U. S. Reclamation Service are models in every respect. Metal chutes carrying silt-laden water are found to wear excessively under the high velocities created. The cost of a properly designed chute outlet is but slightly



WEIR TYPE OF INTAKE SHOWING LITTLE DISTURBANCE

greater than for the outlet of a single drop. Special attention is being given the hydraulic-jump type of outlet at the present time. In the design of all intakes to chutes, flumes and drops, care should be taken to maintain upstream in the canal the proper water depth and slope.

Remodeling a structure may increase its capacity or lower maintenance cost. On replacement structures



TURMOIL WITH ORIFICE GATES PASSING 250 SEC.-FT.
Disturbance so great sand bag revetment necessary to prevent erosion.

whenever the annual interest charge for new construction plus its annual maintenance is less than the present yearly maintenance, relocations or additional construction should be considered. For proper service and economy, the maintenance work should be kept up to requirements for no irrigation district can afford poor or frequently interrupted service.

The Proper Term for Water-Works Bonds

By Charles W. Sherman
Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

Conclusions of a paper read before the New England Water Works Association, Dec. 12.

1. The average life for a "typical" water-works plant in this country is about 50 years. It will rarely be less than this in individual cases, and may be as much as 60 years or more for some works.

2. Complete records of depreciation, including abandoned structures, of a number of water-works plants of considerable age show that the total accrued depreciation of the physical plant of such works is about 20 per cent of the cost. Departures from this mean are not great. Records of depreciation suffered by the plant still in service, modified by a suitable allowance for plant abandoned, confirm this as a reasonable figure.

3. The corresponding average age for works of 50 years' life is 20 years, leaving 30 years average remaining life. If the average useful life were 60 years instead of 50, the average age would be 27 years and the remaining life 33 years. Thirty years is a fair estimate of the remaining life of any water-works plant in normal condition, and therefore a proper term for which water-works bonds should run.

4. If the works have suffered a depreciation of 20 per cent, including abandoned property, there is a residual value of 80 per cent of cost of the physical plant. Water-works bonds may therefore be issued up to 80 per cent of the cost of the works.

5. Municipally-owned water-works should be self-supporting, and their financing should be on the same basis as that of private corporations.

6. The present Massachusetts law which limits bonds for the extension of municipally-owned water-works to 5-year terms is illogical and burdensome and should be repealed.

7. Special legislation for particular cases, made necessary by the existence of the five-year limit, is undesirable from every point of view.

8. Suitable control over municipal bonds for water-works purposes can be exercised by requiring the approval of the Public Utilities Commissioners in exactly the same way as for bonds of a private water company; and misuse of water revenues can be avoided by legislation limiting their uses to water-works purposes.

Hydrology of the 1922 Flood in the Illinois River

Maximum Stages Reached with Minimum Flow Due to Channel Restrictions by Levees—Long Period of Heavy Rainfall

By H. E. Grosbach
District Engineer, U. S. Geological Survey, Chicago

THE Illinois River flood of April, 1922, was notable in that the stages reached were the highest ever observed, although the flow was less than had been recorded within twenty years. This flood resulted from an unusually long continued period of rainfall. Precipitation occurred over the drainage basin on all except nine days of the period from March 10 to April 18. Fig. 1 shows basin and drainage area. For other notes on this flood see *Engineering News-Record,* May 11, p. 804.

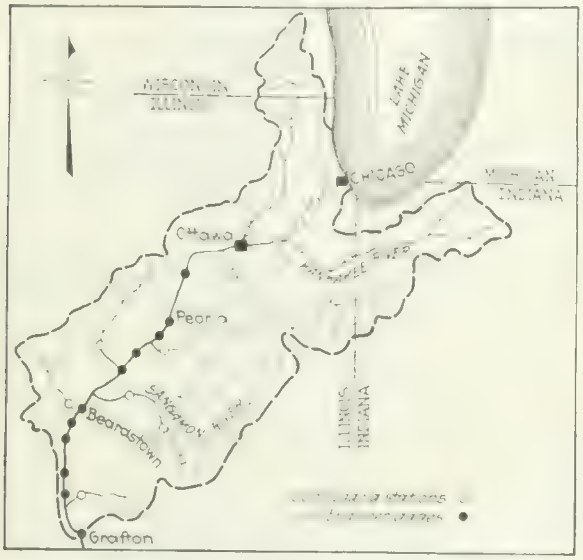


FIG. 1. MAP OF THE ILLINOIS RIVER BASIN

Daily average rainfall on different sections of the basin above Beardstown, computed from Weather Bureau records, is shown in Fig. 2. In this figure are shown also the daily discharges at Peoria and Beardstown for April, as determined from gage readings of the U. S. Engineers and discharge measurements by the U. S. Geological Survey, co-operating with the Illinois Division of Waterways and the U. S. Public Health Service. The discharge includes the flow of the Chicago drainage and sanitary canal, diverted from Lake Michigan.

Precipitation was heaviest in the drainage area of the Sangamon River, the largest tributary, where the average rainfall from March 10 to 14 was 3.0 in; March 19 to 20, 1.4 in.; March 24 to 31, 2.9 in.; and April 3 to 18, 5.4 in. The maximum 24-hour fall recorded was at Morrisonville in the Sangamon basin, and amounted to 4.4 in. The Sangamon was at high stages for several weeks reaching a maximum discharge of approximately 39,000 sec.-ft. at its mouth on April 14. Some tributaries from the north received much less rainfall and neither the Fox nor Spoon rivers reached flood stages. A maximum of 30,400 sec.-ft. was recorded on the Kankakee River at Custer Park, near its mouth.

Profiles of the maximum water stages in the lower section of the river for various floods are shown in Fig. 3. The flood of 1844 reached higher stages than any

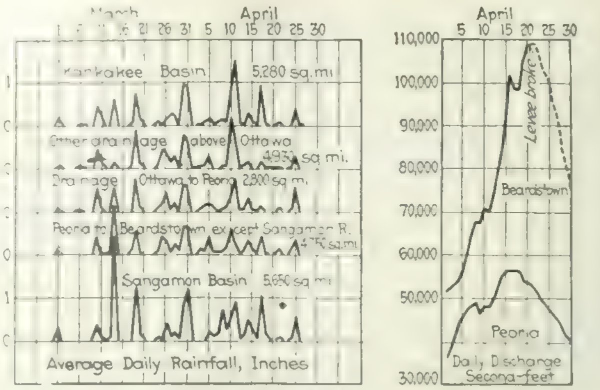


FIG. 2—DAILY AVERAGE RAINFALL AND DISCHARGE

previously observed since the Illinois Valley was settled. The elevations of that flood were determined by the U. S. Engineers from authentic high water marks.

The other profiles were drawn from gage readings by the U. S. Engineers. Maximum discharges are given below as indicated by the Geological Survey measurements except that the 1904 discharge at Beardstown was determined by the U. S. Engineers:

	1904	1913	1922
Peoria	70,000	55,000	56,600
Havana	80,000		68,000
Beardstown	115,000		109,000

It will be noted that the 1913 flood with practically the same stage and considerably less discharge at Peoria than recorded in 1904 rose to higher stages below Havana. No discharge measurements were made below Peoria in 1913. In 1922 the discharge at Peoria was considerably less than in 1904 and at Beardstown slightly less. The maximum stage in 1922, however, was 1.7 ft. above that in 1904 at Peoria, 2.5 ft. higher at

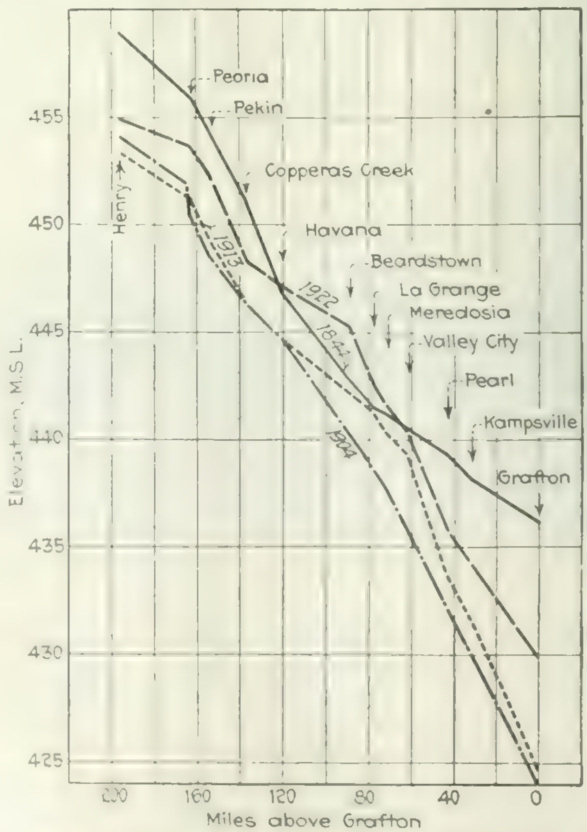


FIG. 3—PROFILES OF ILLINOIS RIVER FLOODS

Havana and 5.0 ft. higher at Beardstown, where the greatest damage resulted.

These increased stages were due largely to the construction of levees for land reclamation, which reduced the natural overflow channel of the river. The failure or overtopping of some levees near the crest of the flood, while allowing waters to overflow and damage surrounding country, did not provide sufficient outlet to cause a material lowering of the stage.

Small Tunnels Lined With Precast Concrete Ribs

Tongue and Groove Sections 9 In. x 6 In. and Weighing 330 Lb. Swung From Flat Cars Into Place by Two Men

AT THE Calaveras Dam of the Spring Valley Water Co. in California, short tunnels were required to admit water from intermediate levels of the reservoir to the intake shaft. As these tunnels traverse swelling ground, it was necessary to provide temporary support. A form of timbering was adopted which would also serve as permanent lining, in the shape of precast concrete ribs, as shown in the accompanying illustration.

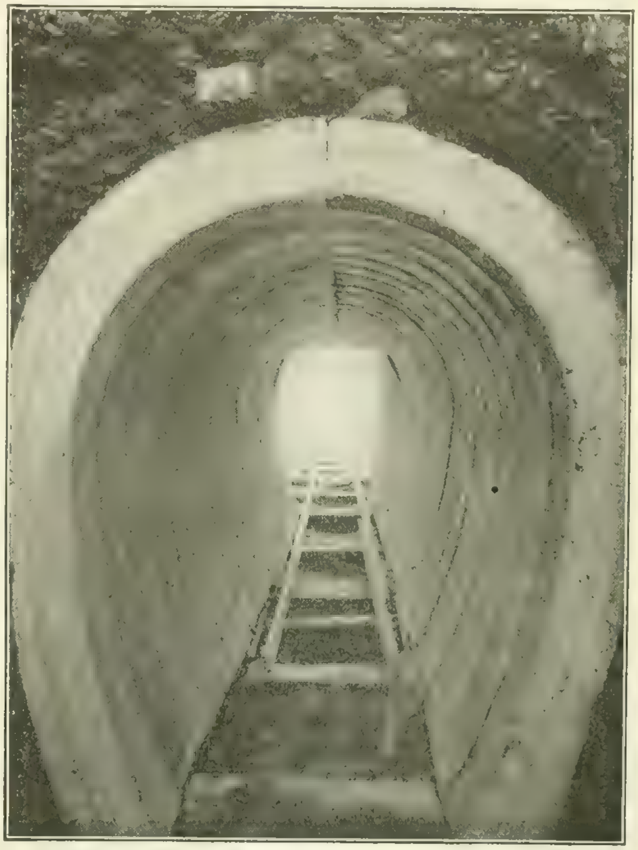
Inside the lining the tunnels are $4\frac{1}{2}$ ft. high and have a maximum width of $3\frac{1}{2}$ ft., with a 2-ft. width at the bottom. Three such tunnels are being built at different levels, the total length of the three being 600 feet.

As tried out at first, the ribs were made 6x6 in. in section and weighed about 220 lb. each. These were handled so much more rapidly and easily than anticipated that the size was changed to 9 x 6-in. section, the 6 in. being the thickness of the lining. These larger ribs weigh about 330 lb. apiece; they are taken into the tunnel on small flat cars and after a little practice a crew of two men is able to swing them up into place with ease. As a convenient means of securing good alignment each rib has a V-shaped tongue on one face and a groove of the same cross-section on the opposite face.

Ties under the track laid in the tunnel for construction purposes consist of heavy wood blocks with ends beveled to parallel an inclined surface at the lower ends of the ribs, as shown in the illustration. Two-inch planks are placed along the ends of these blocks and serve to align the bottoms of the ribs and maintain the desired bottom width of the tunnel during construction. As the first rib of each pair is placed, it is held by a wedge near the crown of the arch until the opposite rib is set. After two or three ribs are placed any space behind them is back-filled. As a final operation in lining the tunnel the cracks between adjacent ribs are to be grouted and a 6-in. concrete floor poured.

A 1:2:4 mix is used in the ribs, which are cast in a row at a conveniently located casting yard. Wood side forms were placed for the ribs of the first pour, these forms being so spaced that when the concrete had set and the forms were removed, the space between adjacent ribs was just the width of a rib. In this way the ribs poured first served as forms for a second pour. The only provision necessary to prevent bonding was a thin film of oil swabbed on just before pouring. By taking alternate ribs from the row in this way the wood forms used on the first pour were the only ones required during the entire work.

The work is being done under the direction of George



A TUNNEL LINING MADE OF PRECAST CONCRETE RIBS
Note arrangement of planks and spacers in background designed to hold ribs until invert is poured.

A. Elliott, chief engineer, and T. W. Espy, construction engineer of the Spring Valley Water Co., from whom the foregoing data were obtained.

Responsibility for Damage by Piledriving

In a case at law recently decided in London the owners of a building near the site of London Bridge sued the contractors for a new structure nearby, Robert McAlpine & Sons, for damaging their building by subsidence and vibration caused by the driving of piles. The building was over a hundred years old, but it was shown that in November, 1920, when the piledriving began, it had only recently been repaired and was declared to be in good condition. Six months later it had become dangerous and was shored up, and in January, 1922, the owners received notice from the city that the building would have to be torn down. The suit stated that the contractors had driven "671 piles more than 1 ft. square and from 24 to 38 ft. in length," through 16 ft. of made ground into clay, and that more were to be driven. The plaintiffs charged that at a certain depth the clay transmits vibrations like a fluid. The contractors denied the damage and denied that vibration from piledriving was capable of causing injury to property. The judge, however, found that the damage had been caused by the piledriving and that the contractor was responsible. The case is reported in *The Engineer*, Dec. 1.

Dust Removal by Vacuum Sweeping in Grain Elevator

Deposit in Vacuum Machines Fed Into Pipes of Low-Pressure System, Thence to Collector Stations—2 Tons Daily Average

FIG. 2—VACUUM UNIT AND DUST COLLECTOR

THE first application of the vacuum sweeping system for the removal of dust in grain elevators, in order to reduce or eliminate the explosion hazard, has been made recently in the great Chicago elevator of the Chicago & Northwestern Railway, following the reconstruction of the plant after the dust explosion in March, 1920. The dust removal installation was mentioned in connection with the reconstruction work in *Engineering News-Record*, Sept. 21, 1922, p. 483. This system has been used in other industries but this is the first application on such an extensive scale as is required for grain elevator service. In an average day about 250 bushels or about two tons of dust are delivered to the main collecting station at the Northwestern elevator. This is in addition to a low pressure collecting system.

Since the presence of dust in enormous quantities is unavoidable under present methods of operating grain elevators, the problem is to remove this dust before it accumulates to such an extent as to be dangerous. Removal of the deposits by brooms, scrapers and air jets causes clouds of dust which again settles so that only a part of the accumulation is actually removed from the building. By the new vacuum-sweeping system, which is a development of the familiar vacuum cleaner on a large scale, the dust is not dispersed but is drawn directly through suction nozzles into flexible tubes connected to piping which leads to large collectors or tanks. A vacuum of about 11 in. Hg. is maintained. The deposit in these collectors is fed automatically into the pipes of a low-pressure pneumatic system which delivers it to a main dust collector station at some distance from the elevator. The dust is separated from the air current before it reaches the exhauster, but the collection of the dust was a special problem owing to the great quantities to be handled, so that an ordinary collector would soon be filled. For this reason it was necessary to equip the collectors with discharge locks by which the dust is discharged continually and automatically into the low-pressure piping without the admission of air to lower the high degree of vacuum. The air passing from the collector tank is filled before reaching the exhauster so that it is discharged practically free from dust.

FIG. 1—VACUUM SWEEPING IN A GRAIN ELEVATOR

Both fine and coarse material are handled, the latter including husks, chaff and grain particles. Fig. 1 shows the cleaning of vertical surfaces, but nozzles of different forms are used in various parts of the plant. For handling piles of material, as where tanks are emptied or grain is spilled, larger hose is employed to ensure more rapid removal. One of the four multistage centrifugal vacuum-producing units is shown in Fig. 2, with its 20-hp. motor and a filter tank which discharges the dust into a pipe of the low-pressure air conveying system. This vacuum sweeping plant for the Northwestern elevator was designed and built by B. F. Sturtevant Co., Boston, Mass.

Smokeless Powder for Blasting

Comminuted smokeless powder, the invention of Maj. John Herbert Hunter, Ordnance Department, U. S. Army, can be used in blasting, being detonated by No. 6 or No. 8 detonators, the rate varying with its fineness. In use the powder should be packed in cartridges, as is the practice with dynamite. Because of the high percentages of poisonous gases produced, it should not be used in mines, tunnels, or other close places unless the ventilation is very good.

Unique Sewage-Works and Pump-Equipment Bid Plan

Sludge from Plain Settling Tanks at Syracuse Mixed With Solvay Lime Liquors — Pump-Equipment Contract Awarded on Basis of Annual Capital and Electric Current Charges

By Glen D. Holmes
Chief Engineer, Intercepting Sewer Board, Syracuse, N. Y.

THE Syracuse Intercepting Sewer Board has recently awarded a contract for the machinery and equipment for its sewage pumping station and grit chamber under specifications containing several features which are of more than usual interest. The specifications provided for alternative bids on variable-speed alternating-current motors of both the slip-ring and brush-shifting types. Each bidder was required to guarantee the calculated annual current consumption charges for the main centrifugal pumps driven by the variable-speed motors, based on the stated hourly fluctuations of flow and pumping heads, and the local power rate schedule.

In canvassing the bids for the equipment, particular weight was given to the efficiencies of the main pumps and the power factors and efficiencies of the motors. In order to determine to whom the contract should be awarded the bids were canvassed by comparing the sums of the annual amortization charges for the equipment and the guaranteed annual main pump current consumption charges submitted by each bidder in his proposal.

General Statistics—Before discussing the pumping station further, it may not be amiss to briefly summarize a few important statistical facts and other pertinent data. According to the 1920 census, Syracuse has a population of 171,717. The greater portion of the city is sewered on the combined system. The intercepting sewers have been designed and constructed for an estimated future population of 400,000 with a per capita contribution rate of 375 gal. per day. The variation in the sewage flow now reaching the treatment site ranges between a minimum dry-weather discharge of 10 m.g.d. to a maximum storm discharge of 150 m.g.d. The average flow for the year 1940 has been estimated at 27.5 m.g.d. and the present works are being constructed to treat twice this average, or 55 m.g.d. Pumping will be required for only such sewage as is to be treated and the excess over the 55-m.g.d. rate will flow around the plant by gravity directly into Onondaga Lake, which also receives the effluent from the treatment works.

Treatment—Sewage on reaching the works will first pass through a venturi flume for measurement and then enter an overflow chamber where excess storm flows will be diverted. From the overflow chamber the sewage to be treated will pass through an inclined rack or bar screen having clear openings of about 3 in., through a grit chamber, then through a mechanically-raked bar screen, with clear openings of ½ in., into the suction well, from which it will be pumped to plain sedimentation tanks equipped for the continuous or frequent removal of the deposited sludge.

The clarified tank effluent will flow by gravity into the outfall conduit and thence be discharged into Onondaga Lake through deep-water multiple outlets located about 1,600 ft. from shore. Sludge from the sedimentation tanks will be removed under water and pumped about 12,000 ft. to the lime waste beds of the Solvay Process Co. At these beds the sewage sludge will be thoroughly mixed with the lime liquors, which carry about forty times as much suspended solids as the sludge and contain about ten times the amount of active reagents required for complete sterilization of the sewage sludge.

COMPARATIVE BIDS FOR TWO TYPES OF MOTORS AND EQUIPMENT FOR SEWAGE PUMPING STATION AT SYRACUSE, N. Y.

Bids were received on Oct. 10, 1922, for slip-ring and brush-shifting motors and corresponding electrical equipment and were compared on the basis of annual amortization charges plus annual charges for electric current, as detailed below.

Item	Public Service Production Co.	John W. Danforth Co.	Roberts Filter Mfg. Co.	McCarthy Brothers & Ford
1a. Switchboard, control mechanism and wiring, brush-shifting type motors	$38,400	$23,247	$22,600	$26,500
1b. Switchboard, control mechanism and wiring slip-ring type motors	39,880	21,237	20,500	24,100
2a. Main centrifugal pumps and brush-shifting type motors	41,175	38,082	40,400	43,000
2b. Main centrifugal pumps and slip-ring type motors	32,025	23,248	24,600	24,600
3 Vacuum priming pumps	2,050	1,836	1,625	2,280
4 Sump pump and motor	2,185	1,794	1,740	3,000
5 7½-ton hand travelling crane	1,740	1,823	1,860	1,850
6 54-in. sluice gate	2,150	1,997	1,890	2,200
7 24-in. gate valves	2,150	1,525	1,750	2,110
8 Main suction and discharge piping	7,785	5,789	5,450	15,900
9 Vacuum piping system	2,425	1,621	1,560	2,350
10 Grit chamber sluice gates	8,200	6,727	8,050	9,300
11 Motor-generator set	1,135	1,012	950	910
12 Tram-rail system	2,100	1,882	2,465	2,240
13 Hoist, cab and bucket	3,685	3,796	3,660	4,360
14 Extra work, cost plus 15 per cent	......	......	......	......
15a. Guaranteed calculated annual current consumption charges for main pumps, with brush-shifting type motors, per specifications	10,350	9,697	9,760	9,800
Computed annual amortization charges being 7.4 per cent of the sum of Items 1a and 2a to 13, both inclusive	8,523	6,744	6,956	8,584
Sum of computed annual amortization charges for Items 1a and 2a to 13, both inclusive, and Item 15a, brush-shifting type	18,873	16,440	16,716	18,384
Guaranteed calculated annual current consumption charges for main pumps, with slip-ring type motors, per specifications	10,500	10,465	10,300	10,240
Computed annual amortization charges being 7.4 per cent of sum of Items 1b and 2b to 13, both inclusive	7,929	5,497	5,630	7,045
Sum of computed annual amortization charges for Items 1b and 2b to 13, both inclusive, and Item 15b—slip-ring type	18,429	15,962	15,931	17,285

Pumping Station Equipment—The pumping station is a one-story brick building about 46 x 60 ft. in plan. The equipment includes: Four main pumping units, consisting of a 24-in. bottom-suction centrifugal pump direct connected to a 75-hp. a.c. motor; a switchboard and control mechanism whereby the speed of the units will be automatically controlled to maintain the sewage level in the grit chamber at such elevation as is required to keep a constant velocity through the compartments in service; motor-operated vacuum priming units in duplicate, a small vertical centrifugal pumping unit for the drainage of the station and unwatering the several compartments of the grit chamber; a 7½-ton hand-traveling crane; several hydraulically- and electrically-operated valves and sluice gates; a 10-kw. motor-generator set for supplying direct current for the operation

of the grit-chamber cleaning equipment and various indicating and recording gages and mechanisms.

Each of the four pumping units is designed to handle one-third of the maximum quantity to be treated, one unit being a spare. The ordinary daily peak loads can be carried by two units.

Grit Chamber—The grit chamber has an over-all length of about 70 ft. with three flowing-through compartments each 40 ft. long, 4¾ ft. wide and 8½ ft. deep. The inlet to each compartment is controlled by an electrically-operated sluice gate. The cleaning equipment of the grit chamber includes a clam-shell bucket and cab traveling on an overhead tram-rail extending longitudinally over the center of each compartment.

In the operation of the grit chamber, the principal function of which is to prevent abrasive material from reaching the pumps and causing undue wear, shorter useful life and impaired efficiencies, it is desired to maintain a velocity of about 1 ft. per second. Velocities in excess of this rate do not permit the suspended inorganic matters to settle, while slower velocities are apt to result in accumulation of foul and objectionable organic deposits.

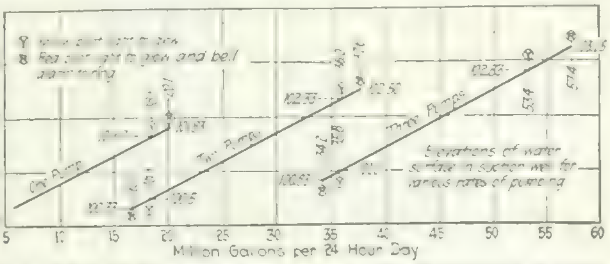


FIG. 1—SEWAGE LEVELS FOR VARIOUS PUMPING RATES
When the sewage level reaches the elevations indicated by "Y" a yellow pilot light glows, when levels indicated by "R" are reached a red light glows and an alarm bell rings.

The automatic control and maintenance of uniform constant velocity is without question preferable to manual control by attendants who for various reasons may not give the necessary attention required.

Operating Schedule—The operating schedule is such that for flows of less than 18.33 m.g.d. any one of the three grit chamber compartments may be in service with any one of the four pumping units; any two of the grit chamber compartments with any two pumping units for 18.33 to 36.67 m.g.d.; and all three grit chamber compartments with any three pumping units for flows varying between 36.67 and 55 m.g.d.

The grit-chamber compartments and pumping units are to be manually placed in and out of service, but while in service their operation will be automatically governed by a master controller.

Master Controller—The function of the master controller is to vary the speed of the motors driving the pumps in accordance with the elevation of the sewage level in the grit chamber. The operating conditions are shown in Fig. 1 and the specifications stipulate that the variation in sewage level shall not exceed 1 in. above or below that indicated on the graph when pumping the corresponding volume of sewage. The rate of pumping will be measured by a venturi meter equipped with indicating and recording mechanism.

Within the first stage, when one pump is operating, the master controller is to vary uniformly the rate of delivery of any pumping unit from 5.7 m.g.d. when the sewage level is at El. 100.33 to 20.1 m.g.d. when the sewage level is at El. 101.83.

With an increasing sewage flow, when the sewage level reaches El. 100.67, the controller will cause a yellow pilot light on the master controller panel of the switchboard to glow. This signal will serve to notify the attendant to place a second pumping unit in service, and he will manually start the operation of the second grit-chamber compartment sluice-gate motor, the corresponding screen-raking mechanism motor, the vacuum priming-pump motor and the main sewage-pump motor. Should the attendant fail to note the signal and the sewage level continue to rise and reach El. 101.83, the controller will cause a red pilot light to glow and will continuously ring a bell alarm until the sewage level recedes below El. 101.83.

Within the second and third stages, with two and three pumping units in service, the master controller will function similarly in accordance with the graph, Fig. 1. With an increasing flow, when the sewage level reaches Elev. 103.17, in the third stage, with three grit-chamber compartments and three pumping units in service operating at the maximum rate desired (55 m.g.d.) the three grit-chamber sluice gates will automatically start closing slowly and throttling the inflow until the level below the gate reaches El. 102.83. The gate will then continue to "hunt" so that any increase or decrease in the head above the gate will maintain the sewage level below the gate (in the grit chamber) between the limits of El. 102.83 and 103.17, thus preventing flows in excess of 55 m.g.d. entering the grit chamber. The throttling of the gates and the backing up in sewage level behind the gates will permit the excess flows to discharge over a weir in the overflow chamber and discharge directly to the lake.

Main Pumps—The pumps will be of the horizontal-shaft, single-stage, double-suction centrifugal type, with vertical bottom inlet and horizontal discharge. They are to be designed to give their maximum efficiency at the ordinary total head of 12.6 ft. when pumping at the rate of 13.75 m.g.d., and to give as high efficiency on as flat a curve as possible within the ranges of heads and capacities specified. The estimated annual average hourly quantities to be pumped and the corresponding ranges in head are shown in Fig. 2.

Electric Current—The treatment works are located in close proximity to the municipal garbage-reduction plant which is now operating on alternating current furnished by the Syracuse Lighting Co. Four sources of power (one of which is Niagara Falls) are available for instant interchange, insuring little if any interruption in service. The operating current is stepped down from 11,000 to 440 volts and is 3-phase, 25-cycle. The schedule of rates for power includes a demand charge, an energy charge and an adjustment for power factor, and is such that a substantial reduction in the annual current cost can be secured by the use of one meter for measuring the total current purchased by the city for the two plants. Auxiliary meters will be placed for properly distributing the costs.

Although direct current is perhaps better adapted for the variable-speed motors of the pumping station, estimates of cost indicated that their installation would not prove economical, on account of the necessity for providing large rotary converter units in duplicate and the cost of additional floor space for housing this machinery.

Motors for Main Pumps—The choice of motor drive for the main centrifugal pumps narrowed itself down

to two types; either the brush-shifting or the slip-ring. Although the brush-shifting motors are more economical in regard to current consumption, they require a considerably larger capital investment. From such information as was obtainable from the manufacturers and various users, it appeared that the brush-shifting type of motor might show a lower capitalized cost for installation and operation, but the difference in the estimated capitalized costs was so slight that it was felt that greater competition would be afforded by including both types of motors in the specifications.

In general, each of the motors is to be of not less than 75 hp. rated capacity and capable of developing the specified loads at the necessary speed reductions. The synchronous speeds are not to exceed 500 r.p.m. when operating under no load; the motors are to be designed for continuous service and for direct connection to the centrifugal pumps. Slip-ring motors were to have open-phase wound rotors and a power factor at full load not less than 91 per cent. A power factor of not less than 96 per cent was required for brush-shifting motors at full load.

Canvass of Bids—The legislative act under which the Board operates requires that all contracts be awarded to the lowest responsible bidder. This restriction, if bids were canvassed on the prices submitted for furnishing and installing the equipment, would not permit giving proper consideration to the efficiency of the various units.

All of the funds of the board are obtainable from the sale of 20-year serial bonds, bearing interest of about 4½ per cent, according to market indications at the time of issue. It is, therefore, necessary during the following 20 years for the city to raise by taxation each year for retirement and interest charges an average amount equal to 7.4 per cent of the bonded cost of the work. This 7.4 per cent is designated in the specifications as the amortization charge. It will also be necessary for the city to provide funds in its annual budget for the operation of the pumping station, including electric current, labor, supplies, etc. The cost of electric current is dependent upon the type of motors and pumps and their efficiencies while other annual operating charges will be but little affected.

In order that the slip-ring and brush-shifting motors might both be admitted to the specifications, and be considered fairly and truly upon their performance, and that each bidder might know definitely what consideration would be given for efficiency of performance, the specifications provided:

The bids will be canvassed to determine the bidder to whom the contracts will be awarded by comparing the sums of the annual amortization charges and annual main-pump consumption charges submitted by each bidder in his proposal, and that responsible bidder whose sum is the lowest will be awarded the contract.

The annual amortization charges shall be computed by multiplying the total amount of the bid for the machinery and equipment by 0.074. This 7.4 per cent average annual charge is computed as the interest upon the serial bonds issued by the city to pay for the work and for the retirement of one-twentieth of the total sum each year until the entire issue is amortized at the end of twenty years.

Tests and Trials—Pressure, endurance, capacity and efficiency tests are to be made prior to acceptance of the equipment. The efficiency tests to determine whether the guaranteed main pump current consumption charges have been met or exceeded are to be made not less than 30 or more than 60 days after the units have been placed in regular service. The tests are to be made under the joint direction of the engineer and contractor. In case of disagreement, an expert of acknowledged reputation, acceptable to both the engineer and contractor, will be chosen and his decision will be final.

The tests and the manner of conducting them are specified in detail. The performance tests of the main pumps are to be made at each hourly rate of pumping and corresponding head shown in Fig. 2. The rate schedules for electric current and method of application, with examples, were presented in full in the specifications in order that there might be no misunderstand regarding the computations and guarantees of the electric current consumption charge.

Bonus and Penalty—A bonus will be paid the contractor if the performance tests show that the guarantee has been exceeded and that the annual current consumption charges will be smaller than the amount stated in his proposal. The amount of this bonus will

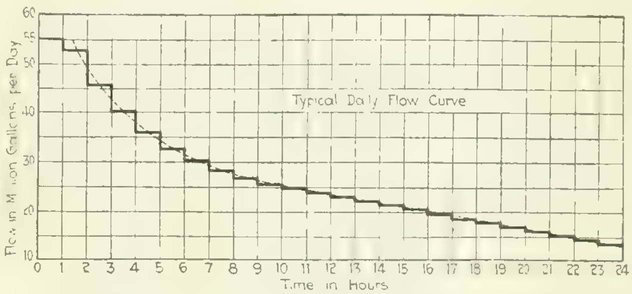


FIG. 2—TYPICAL DAILY SEWAGE FLOW CURVE

be one-half the present worth of an annuity, equal to the decrease in current consumption charge, based upon a period of twenty years at 4 per cent compound interest, or \$6.795 for each dollar that the test shows the annual current charges to be less than that guaranteed. In case of failure to meet the guarantee a deduction will be made equal in amount to the present worth (as above described) of the excess current charge, or \$13.59 for each dollar of excess current cost.

Indicating and Recording Gages—The station will be equipped with somewhat more than the usual number of recording gages to keep the superintendent informed regarding routine operation of the works and the attention given by the attendants of each shift. This equipment includes apparatus for the following records:

Total flow reaching the works—venturi flume.
Total volume pumped and treated—venturi meter.
Discharge head—for each of the four main pumps.
Vacuum in priming system.
Sewage level in pump well.
Sewage level above screens—grit chamber.
One electric time recorder with 12 pens showing time of:
  Starting and stopping each of the four main pumps.
  Opening and closing each of the three grit chamber gates.
  Starting and stopping of each of the three screen cleaning mechanisms.
  Starting and stopping the sump pump motor.
  Starting and stopping the d.c. generator set.

Previous to advertising for bids the unual sections relating to the method of canvassing, tests, trials, guarantees, as well as the bonus and penalty clauses, were thoroughly discussed with manufacturers of pumps, motors and general equipment contractors The general consensus of opinion indicated that the specifications were altogether fair and would result in keen competition. This proved to be the case, as an unusually large number of contractors figured on the work.

During the advertising period some adverse criticism was received from a few pump manufacturers, who objected to the tests for efficiency being made over the entire range of speed variation. They desired the specifications so modified that it would be necessary to make a guarantee of efficiency only against a single stated average quantity to be pumped. One or two manufacturers objected to the tests being made when pumping sewage. As a result of this attitude, which was not announced until shortly before the date set for receiving bids, several prospective bidders did not submit proposals.

The itemized proposals received for the machinery and equipment are given in the table on page 1121. The contract was awarded to the Roberts Filter Manufacturing Co., of Darby, Pa., in accordance with the lowest proposal, which included slip-ring motor equipment.

The equipment to be installed includes: Westinghouse motors, switchboard and control apparatus, Morris Machine Works pumps; Coffin Valve Co., electrically-operated sluice gates; Eddy Valve Co., hydraulic-operating gate valves; Cleveland Crane & Engineering Co., tram-rail system for grit chamber cleaning.

All of the work of the Syracuse Intercepting Sewer Board is being carried out under the direction of the writer as chief engineer, who desires to give special recognition to the valued services of J. X. Cohen, designing engineer.

Use of Copper Sulphate at Hartford and Effect on Filter Runs

Utilized to Lessen Amount of Filtrate—Costs Also Reduced—Runs Long When Micro-Organisms Are Few

By J. E. Garratt

Office Engineer, Water Board, Hartford, Conn.

Abstract of a paper read before the New England Water Works Association.

For several years copper sulphate has been applied to the reservoirs of the Hartford water system at times when the number of micro-organisms has been large. Previous to the filtration of the supply, which began late in the fall of 1921, copper sulphate was used principally to improve the taste and odor of the water. Since the introduction of filtration, the use of copper sulphate has been continued to lessen the amount of material which the filters have to remove from the water and thereby lengthen filter runs and reduce costs of operation.

The new filters were started in a small way in November, 1921. Early in February, 1922, the whole supply to the city was being filtered. Nepaug water was used until the middle of March. During all of this time the micro-organisms were low in number, ranging from 80 to 25. The average amount of water passed between scraping or rakings was about 250 m.g. per acre of filter bed.

From March 17 to April 3, while high-colored bottom water was wasted from the Nepaug Reservoir previous to the spring turn-over, water to the filters was taken from the West Hartford reservoirs. This raw water had a color of about 25. The numbers of micro-organisms was not as low as in the Nepaug water but they were relatively low: 80 on March 17, increasing to 185 by April 3. A filtered water with a color of about 15 was obtained. The rate of clogging during this short period indicated that the quantity of water filtered between cleanings or rakings would have averaged about 250 m.g. per acre had water of this character continued through the filters.

Copper Sulphate Used—Nepaug water was again put onto the filter beginning April 3. By the end of the month micro-organisms had increased to 150 or so, more than one-half being Asterionella. In anticipation of the probable need of treating the Nepaug reservoir with copper sulphate as was done the previous year, the principal West Hartford reservoirs, in which the total micro-organisms had gradually increased to from 240 to 300 (in two Asterionella was the principal micro-organism and in another Nitzschia), were treated with copper sulphate at the rate of 2.3 lb. per m.g., early in the month of May, in order to have them available with water low in micro-organisms for use while the big reservoir was being treated.

Early in May, with Nepaug water, the filters clogged very rapidly. Runs of as little as 40 to 50 m.g. per acre were the rule. It began to look as if night shifts would be needed on the washing outfit. On May 22 Nepaug water was shut off so that the reservoir could be treated with copper sulphate. While the total number of micro-organisms did not seem large yet there were several times as many as in the water which had been used previously. At the surface they totaled 300 and at the depth of 30 ft., 200. It was decided to treat the portion of the Nepaug Reservoir near the intake at the rate of about 1.3 lb. per m.g. The predominating micro-organisms were Uroglena, 50 per cent, and Asterionella, 30 per cent. The treatment, however, was without material results. The total organisms at the surface were not reduced in number while at a depth of 30 ft. they increased very materially to about 600 total.

In the meantime the treated West Hartford reservoir water, with total micro-organisms of 50 to 100, was put onto the filters, filter runs lengthened appreciably to 130 to 150 m.g. per acre between washings, and the washing emergency was passed.

But it was desired to use Nepaug water as soon as possible so it was decided to treat the same portion of this reservoir again. On June 3, 1922, sulphate was applied at the rate of 2.3 lb. per m.g. Total micro-organisms were 250 at the surface and 600 at a depth of 30 ft., half Asterionella and half Uroglena. Quite a few small fish were killed. Samples taken three days after treatment showed a slight reduction in Asterionella and practically no reduction in the number of Uroglena. Samples taken the following day, June 8, showed still further reduction in the micro-organisms at the surface (average total 140) but large increase in number at a depth of 30 ft. (average total 1,030).

On June 9 the change back to the Nepaug water was made, taking water from the intake nearest the surface where the micro-organisms were the lowest in number. On June 14 conditions were the same as on June 8, but by June 21 surface counts had decreased to an average of 65 and at the 30-ft. depth to an average of 100.

Filter Runs Shorten—As a result of more or less off-hand consideration of all this, it appeared that all that was necessary to do in order to keep filter runs long was to keep micro-organisms low in number. Careful watch, therefore, was kept of micro-organisms. No

considerable increase was noticed in the Nepaug water but all of a sudden early in July filter runs of 36 to 50 m.g. per acre were gotten. Experience had shown that filters could be lightly raked over once or even twice without materially increasing the amount of sand to be scraped off and washed ultimately so that no washing crisis seemed at hand, but on several beds there were periods of only ten days between rakings or scrapings and in one case only seven days.

While water in the Nepaug reservoir was low in micro-organisms it was found that water in the West Hartford reservoir into which the pipe line from Nepaug emptied, had developed a considerable growth of micro-organisms (Nitzschia) so on June 8 this reservoir was shut off and the Nepaug water allowed to pass directly to the filters. About July 11 the West Hartford reservoir was treated with 2.3 lb. per m.g. of copper sulphate, the micro-organisms reduced from 270 to about 100 by July 18 and on that day the gate on the line to and from the treated reservoir was opened again. At the time this treated water was again free to pass onto the filters one bed had passed only 60 m.g. per acre and had lost 3 of its 5 ft. of head. Other beds had either just started on new runs or were practically at the end of runs of 40 to 50 m.g. per acre as stated above. A few days later it was noticed that loss of head on the bed which was in the midst of a run began to decrease. It continued to decrease. At the same time a slimy deposit on the walls and bottom of the aerator disappeared. This bed gained a new lease of life and continued in service until Aug. 24 passing 180 m.g. per acre. Runs on other filters since the last of July have varied from 90 to 160 m.g. per acre. Micro-organisms in Nepaug reservoir per acre have continued low, 30 to 50. But at the present time (Aug. 25), micro-organisms in the West Hartford reservoir have again increased to over 300 without as yet causing any noticeable increase in the rate of clogging of the filters.

Presumably we have not as yet got the whole story in regard to the amount of copper sulphate needed for effective treatment or in regard to the relation between number of micro-organisms and lengths of filter runs but it is thought from the information so far collected that the application of copper sulphate has possibilities as an aid to economical filter operation of Hartford water.

Personal Liability Laws for Losses From Fire

A summary prepared by the National Fire Protection Association shows that a number of American communities now have laws which require the owner of premises in which a fire occurs to reimburse the city for the services of the Fire Department, as well as to pay damages to persons or property resulting from the fire, provided the fire is due to non-observance of a fire order or non-compliance with law. Provisions to this effect are found in the charter of New York City, the Pennsylvania State code, and in the city ordinances of Cleveland and Cincinnati, Ohio, Portland, Ore., Billings, Mont., and Austin, Rangers, San Angelo, Cleburne, Wichita Falls, and Greenville, Tex. The summary as published also includes several court decisions bearing on owners' liability in connection with fires, decisions which indicate a drift toward the view incorporated in some European law codes, by which the parties responsible for the origin of a fire are liable for all losses caused by the fire.

Fire-Fighting Ability of Chicago Summarized with Recommendations

A GRADUAL, continuous extension of metered services, an increase in the water pressure to at least 50 lb., and a new high-pressure fire system are the starred [urgent] recommendations of the National Board of Fire Underwriters as to the water supply in a recent report on Chicago. Other recommendations include the following: Combustible material should be removed from pumping stations to render them fireproof; an emergency crew with an automobile carrying gate-operating tools and records should be available; no mains should be tapped before the property needs the service; the distribution system should be strengthened so that it can furnish 1,500 gal. per minute in outlying residential districts, 3,000 to 6,000 gal. in closely-built residential districts of two- and three-story buildings, and 5,000 to 15,000 gal. in inner mercantile manufacturing and lumber districts.

The high-pressure fire system recommended would have a pumping capacity aggregating 30,000 gal. per min., made up of small units in the Chicago Ave., Harrison St. and Fourteenth St. stations. The distribution system should deliver two-thirds of the full capacity about any block with a maximum pressure of 200 lb., and arteries should be so arranged that the failure of any one would not prevent the specified delivery. No dead ends or pipes less than 12 in. are allowable. Gate valves are to be spaced not to cut out more than three hydrants by a single break. Hydrants are to have four gated outlets, to be set on 8-in. gated branches and to be so distributed as to serve an average area not exceeding 40,000 sq.ft. Connections are to be provided for fire boats.

The following paragraphs epitomize the board's findings as to the present water supply fire-fighting facilities and a summary of the whole situation.

Water Supply — Municipal works; organization good; records complete. Supply from Lake Michigan, inexhaustible; cribs and tunnels of sufficient capacity and in good condition. Pumping stations not fireproof, but with low internal hazards and mostly unexposed; mutually reinforce each other; capacity of pumps ample. Distribution in one service, except three small outlying sections. Consumption excessive and its reduction of utmost importance. Pressures too low for adequate fire engine supply in some parts of the city. Arterial system fairly adequate; minor distributors well gridironed. Gate valves generally well spaced and in fair condition. Old hydrants of unsatisfactory patterns, but new hydrants satisfactory; all poorly maintained; distribution mainly good.

Probably the following paragraphs were written with the recent Burlington Building "group" fire in mind:

Building Department—Laws mainly good; several fire prevention features omitted or not sufficiently restrictive. Enforcement somewhat lax. Fire units of large area, but still inadequate. Structural conditions strong to weak in congested value district; new construction in principal portion of district practically all fireproof.

Conflagration Hazard — In the congested value district the increased amount of firepoof construction, especially in the portion south of the river, the increased number of automatic sprinkler equipments (many in buildings which might be classed as conflagration breeders) and the large amount of window protection have reduced the general conflagration hazard. However, group fires are probable in many sections because of poor structural conditions, the frequent high winds and the inability of the fire department to cope with serious fires.

From Job and Office

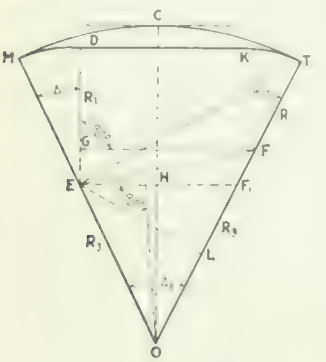
Hints That Cut Costs and Time — *For the Contractor and the Engineer*

Third Curve Replaces Two Curves Joined by Tangent—Four Solutions

In Engineering News-Record, Oct. 26, p. 713, there appeared a solution to a curve problem wherein a third curve replaced two short curves joined by a tangent. The solution offered by Mr. Syme therein has interested engineers widely, and numerous letters have been received in which different solutions to the problem have been set forth. Four of these solutions follow.—EDITOR.

By Burnett Hamilton
Street and Engineering Department, Alameda, Calif.

USING T as the origin of co-ordinates determine the co-ordinates of the points E and F. The direction of the line TFO is known as the point T is fixed. Draw EF_1 locating F_1 so that $FF_1 = ME - TF$. Determine the co-ordinates of the point F_1 and close between F_1 and E, securing the bearing and the length of the line EF_1.



The triangle EF_1O is isosceles and as the directions of the lines F_1O and F_1E are known, the angle OF_1E (which is equal to the angle OEF_1) is known. The angle $EOF_1 = 180$ deg. — $(\angle OF_1E + OEF_1)$, which gives the direction of the line OM.

Solve the triangle EOF for EO,

Then $EO + EM = OM$, the required radius.

* * *

By J. C. Crawford
Assistant Engineer, Pennsylvania R.R.

GIVEN radius R_2, angle Δ_2, tangent KD, and radius R_1: to find radius R_3 and Δ_1.

$GE = R_1 - R_2$; $EF = \sqrt{(GE)^2 + (KD)^2}$;

$$\sin EFG = \frac{GE}{EF};$$

$EFO = 90° - (\Delta_2 + EFG)$; $FO - EO = GE$.

Having the base EF, the angle EFO and the difference between the sides EO and OF, the triangle EOF can readily be solved under the rule that "In any plane triangle, as the base is to the sum of the other two sides, so is the difference of those sides to the difference of the segments of the base made by a perpendicular let fall from the vertical angle."

Then $OF = R_3 = R_1$, and $\Delta_1 = \Delta_3 - \Delta_2$.

* * *

By C. K. Conard
[illegible]

THE curve TCM is to replace the tangent KD that joins two curves on the ground, and must start at a known point T. From T as an origin of co-ordinates work latitudes and departures through TF, FK, KD and DE, to obtain the co-ordinates of center E. By differences of co-ordinates determine the length and the bearing of ET.

From E draw EL perpendicular to TF produced.

In the right triangle ETL the angle ETL and the side ET are known.

Solve for TL and EL.

Now ME plus EO equals TL plus LO or, EO minus LO equals TL minus R_1 equals a known quantity, say m.

In the triangle EOL, $EO^2 = EL^2 + LO^2$ and $EO - LO =$ the known quantity m, or $EO = m + LO$.

Substituting, $m^2 + 2mLO + LO^2 = EL^2 + LO^2$.

From this, $LO = \dfrac{EL^2 - m^2}{2m}$; $LO + TL = R_3$ and the angle at O may now be found.

Angle MED equals angle O minus angle KFT.

* * *

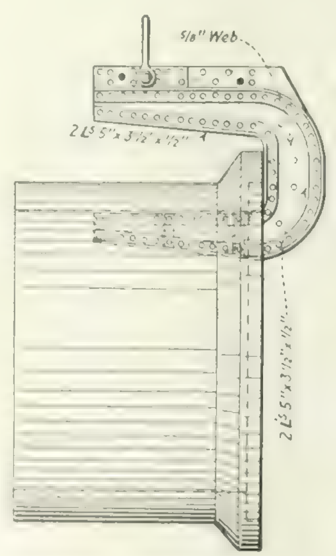
By E. A. White
County Engineer, Pierce County, Tacoma, Wash.

DRAW the curve MCT and join the centers E and F; draw GF perpendicular to DE, produce TF to a point F_1 making TF_1 equal ME; EF_1 will then connect points on the radial lines of curve MCT and will be parallel to its long chord MT. Bisect EF_1 at H and erect a perpendicular which will intersect TF extended at O, the center of the curve MCT. Solve triangle GFE as before, which gives sufficient data to solve triangle EFF_1.

Then, in right triangle OHF_1 side HF_1 and angle $HF\,O$ can be computed and the triangle solved, giving the data for computing Δ_3 and R_3.

Steel Hook Handles Concrete Pipe

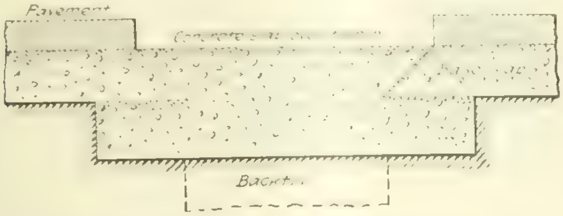
AT THE recent annual convention of the American Railway Bridge & Building Association held in Cincinnati, Ohio, the committee on labor saving devices described in its report a structural steel hook for use in holding the larger sizes of concrete pipe when placed by a derrick. The hook, illustrated herein, is made of heavy structural steel. By adjusting the lifting line to one of the other two holes in the upper part of the hook the pipe can be picked up from one end. The usual manner of setting a pipe is to place a cable or chain sling around the exterior and set the pipe in the desired position. When the sling is removed there is a tendency to uncouple the bell and spigot end. The use of a hook obviates this difficulty and under some conditions expedites the work.



PICKING UP CONCRETE PIPE WITH STEEL HOOK

Trench Backfill Covered with Concrete Slabs

IMPROPER backfilling of trenches has been so great a source of trouble, states H. H. Edwards, City Engineer, Danville, Ill., that municipal control of the



CONCRETE SLAB COVER FOR BACKFILLED TRENCH

replacement of paving over such openings has become necessary. It is now required that for any street opening a permit must be obtained and a bond filed sufficient to protect the city against damage. Backfilling and repaving are done by city forces, the owner being charged the exact cost plus 10 per cent. Over the trench is laid a 12-in. concrete slab extending 12 in. on solid ground on each side, and where a concrete base is cut the edges are sloped to support the trench slab, as shown in the acompanying drawing. For wide or deep trenches, ½-in. transverse bars 6 in. c. to c. are placed 2 in. from the bottom of the slab. With this construction there has been no trouble from sunken pavements.

Precast concrete slabs 5 x 2 ft. and 8-in. thick, reinforced as described above and having the joints grouted, are contemplated as an improvement upon the slab poured in place. It is hoped that this form of concrete base will save time and will permit the replacement of paving in cold weather when it would be difficult to lay new concrete.

Inexpensive Method of Mounting Maps

By Emile Low

U. S. Assistant Engineer, Buffalo, N. Y.

ENGINEERS often find it desirable to mount maps, drawings, documents or photographs. Mounting by use of paste is tedious and having binding done at a bindery is expensive. A better process is to use rubber mounting tissue, which is convenient and cleanly. The other requisites are either a flat, electric or gas iron and a felt pad or ordinary blanket. The procedure is as follows:

Place the pad on a table. The map is then laid face down, after first placing a strip of tissue paper about 5 in. wide around the edge of the map, between the pad and the map and projecting one-half its width outside of the map (this is to prevent the edge of the map from sticking to the pad).

The mounting tissue, of a size to overlap the drawing about ½ in. all around, is placed on the reverse side of the drawing. The cloth on which the drawing is to be mounted is cut about 1 in. larger than the mounting tissue. It is placed over the rubber mounting tissue and fastened to the board or table at two corners with glass push pins.

Then run an iron over the cloth, beginning at one end and moving along one edge. Then move the iron at right angles to the edge thus fixed.

After the drawing is mounted the edges are trimmed off. In trimming it is advisable to cut about ⅛ in. outside the edge of the drawing as a neater edge can be secured.

Fast Time Recorded in Casting Concrete Segmental Sewer Blocks

WHEN a crew of 12 men first started pouring segmental concrete block sections which form the circular sewer being constructed in Queens, N. Y., and known as the Woodside tunnel sewer, 3 hr. and 40 min. were required to pour the first 72 three-block sections. Each block weighs approximately a ton and 8 blocks

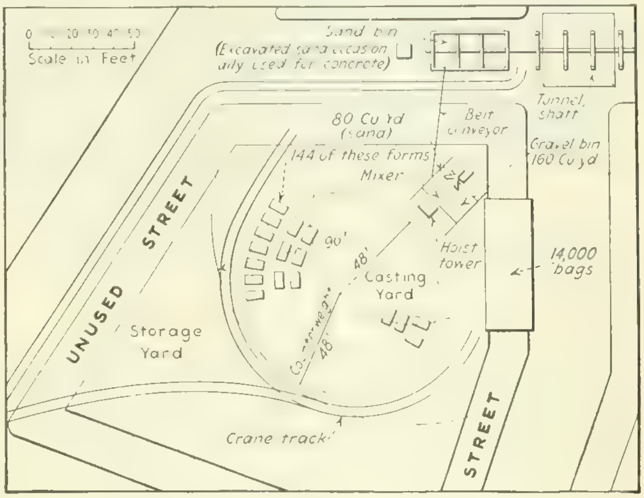


FIG. 1. LAYOUT OF RADIAL CASTING YARD
The radial layout allows all forms to be reached by an easy swing of the boom supporting the chuting. Forms are poured alternately allowing each section 24 hr. in which to set before forms are stripped.

are required to the full circle. When the first day's run had been made the resident engineer told the crew he would not be satisfied until an average pouring time of 1 hr. 30 min. was maintained. Since then the 72 forms have been filled in a record time of 55 min. and in many cases slightly over 1 hr. and the 1½-hr. schedule is never exceeded.

The Woodside tunnel sewer is a segmental block ring with an inside diameter of 11 ft. 9 in. and a uniform

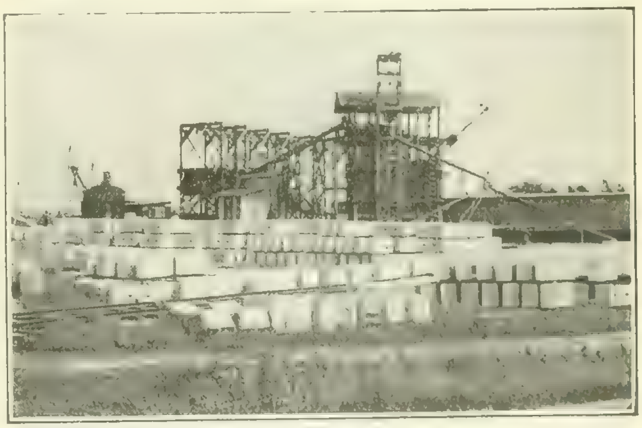


FIG. 2. STORAGE YARD AND CONCRETE PLANT
Dates of casting blocks are easily discernible. Each of these blocks weighs a ton.

wall thickness of 16 in. The contract, which is held by Booth & Flinn, New York City, calls for the construction of 4,025 lin.ft., most of it on Fiske Ave. from Queens Boulevard to Polk Ave.

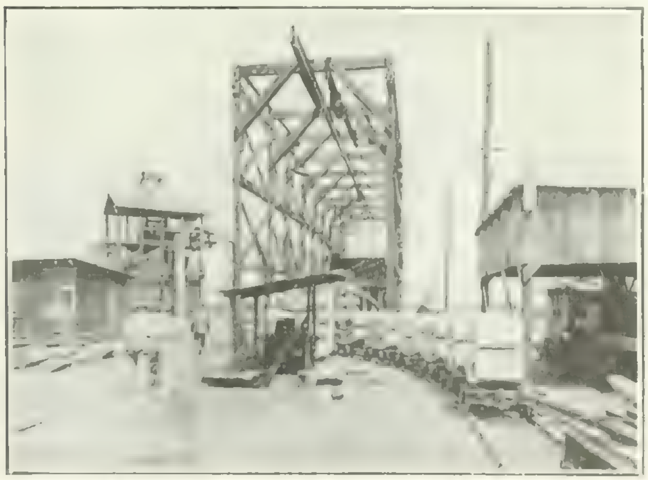
The yard in which concrete sections are cast has been carefully arranged and located near the shaft so that blocks can be handled practically from the casting

FIG. 3—SEGMENTAL BLOCKS CAST ALTERNATELY
Each form accommodates three 1-ton blocks. By pouring sections alternately 72 sections are poured and 72 sections [illegible]

yard to the shaft. The layout of the casting yard is indicated in the accompanying sketch. As is indicated, forms were laid out radially so that an easy swing of the boom (operated by one man) which supports the chuting through which concrete is handled reaches all forms easily.

Specially-constructed steel forms are used and three one-ton blocks are cast within one form. There are 144 forms and pouring is done into alternate forms so that every 72 sections poured are given 24 hr. in which to set before stripping.

A locomotive crane circles the casting yard and a switch is provided at about the center so that blocks can be handled direct from forms into the storage yard from either end of the track. A concrete bed of even grade and smooth surface has been laid as a foundation for section forms, so that little difficulty is experienced in adjusting forms for receiving concrete. After the sections are all poured the recessed forms are bolted on top to give the blocks their lock joints.



[illegible]
From the storage yard the blocks are hauled by electric [illegible]

As it is cast each block is marked with the date. When ready to store each block is picked up by the crane fitted with a semi-friction grab onto one side of which is welded a knob that slips into the grout

FROM JOB AND OFFICE

Hints That Cut Costs and Time

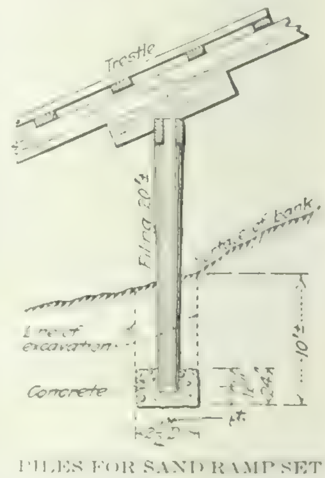
hole of the block. From the storage yard the blocks are loaded onto heavy-truck narrow-gage cars and hauled direct to the mouth of the shaft by an electric locomotive.

The sewer is being built for the Bureau of Sewers, Borough of Queens. **A. H. Jorgensen** is the contractor's resident engineer.

Piles Are Set in Concrete to Avoid Inconvenient Driving

By George W. McAlpin
Glenwood, W. Va.

DUE TO the necessity of completing work by a certain date and the inability to secure piledriving equipment the writer was led to use the following method of setting instead of driving piling for a sand and gravel incline. The distance from the top of the bank to the edge of the river, over which the incline was to pass, was about 300 ft. To rig up a piledriver to cover this distance would have been expensive. Also such equipment was not available at the time. It was necessary to sink the pile bents, rather than use the ordinary mud sill, due to the tendency of the river to scour at high stages. Consequently, holes for each piling were excavated, the first 4 ft. with long-handled shovels and the rest of the distance, usually 5 to 6 ft., with an extended handle post-hole digger. About 12 in. of concrete was then placed in the bottom of each circular hole, the piling set in and plumbed to correct position and an additional 12 in. of concrete poured around it. The holes were then backfilled and tamped. The method has proved cheap and effective, the concrete forming a perfect base for each piling.



PILES FOR SAND RAMP SET IN BURIED CONCRETE

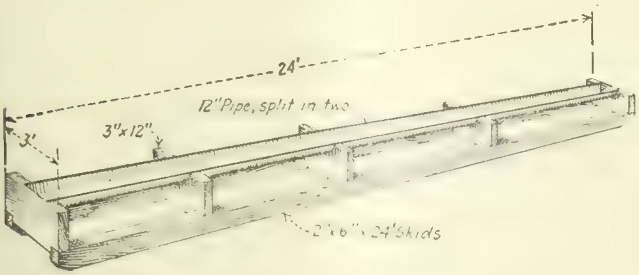
Dipping Trough for Iron Pipe Made From 12-in. Casing

IN THE coastal oil fields rust causes the loss of thousands of dollars annually in new and second-hand materials. The oxidation of iron occurs everywhere to a greater or less degree, but it is especially rapid in this part of the United States, where the climate is subtropical and the humidity extreme. Probably the greatest loss is in the deterioration of drill stem, casing, line pipe, and the like which is not in use.

Painting is the only safeguard, but painting with a brush is a slow and costly process, and, furthermore, the inside of the pipe is not touched. The cheapest and most effective way of applying paint to all surfaces of a length of pipe is by dipping. To facilitate this work,

FROM JOB AND OFFICE

For Contractor and Engineer



CASING MAKES TROUGH FOR DIPPING IRON PIPE

the dipping trough shown in the accompanying illustration was devised. It consists of a semicircular receptacle, about 24 ft. long, made of a short length of 12-in. casing that has been split in two and the two pieces butt-welded by means of the oxy-acetylene blowpipe, and with semicircular plates welded over the ends. The trough is set in a suitable wooden frame on skids.

In using the trough, it is partly filled with the preservative paint. Smaller sizes of pipe are simply immersed; pipes of larger diameter must be revolved once to coat all surfaces. After being dipped the pipe is elevated, two blocks of different heights are slipped under it, and the excess paint is allowed to drain back. —*Engineering and Mining Journal-Press.*

Acetylene Torch Melts Pipe Joint Filler

By George C. Love

Chief Engineer, Newport News Light and Water Co., Newport News, Va.

The accompanying photograph shows a piece of work recently completed by this company wherein it was necessary to remove a 14-in. cast-iron water main from a pile trestle. The joints were of the usual bell and spigot type with calked lead filler. Water was first drawn from the main and then an ordinary acetylene burning outfit was used to melt the filler. The pipe was left in condition to be used again, part of the lead was recovered and the work was done more rapidly than by any other means available.

BURNING LEAD FILLER FROM PIPE JOINTS

Graphs Allow Rapid Yardage Calculation

By R. C. Hardman

Division Engineer, Central Highway Board, Republic of Panama, Aguadulce, Panamá

For use in preparing a preliminary estimate of quantities on a projected location of some 125 km. of highways in the Republic of Panamá, a large part of which was through broken country necessitating much side-hill work, the accompanying graphs were prepared. As will be seen these show the amount of cut or fill per 20-m. station for varying center-line values and varying transverse ground slopes.

The graphs were made by substituting the proper values for the particular cross-section of roadway to be used in general equations derived in terms of center-line values, width of base, side slopes and transverse ground slopes. As will be seen, two general equations are necessary—one when the section is trapeziform and the other when the section is triangular.

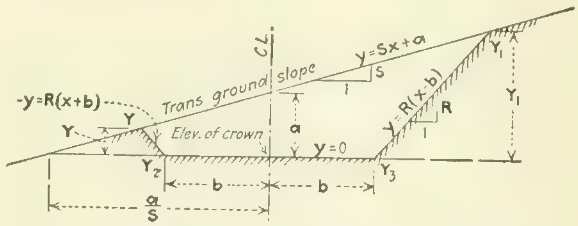


FIG. 1—SECTION USED IN FORMULA DERIVATION

Referring to Fig. 1:

Let a = depth of cut or height of fill on center line
b = one half width of base
R = ratio of side slopes
S = ratio of transverse ground slope
A = area of trapeziform section
A_1 = area of triangular section.

The equations of the four lines forming the trapezium are:

$$y = Sx + a$$
$$y = R(x - b)$$
$$-y = R(x + b)$$
$$y = 0$$

Solving for the co-ordinates at the common points Y, Y_1, Y_2 and Y_3 we have:

$$Y = \frac{R(a - Sb)}{R + S}$$

$$Y_1 = \frac{R(a + Sb)}{R - S}$$

$$Y_2 = Y_3 = 0$$

Then $$A = \frac{\left(\frac{a}{S} + b\right)Y_1 - \left(\frac{a}{S} - b\right)Y}{2} \qquad (1)$$

Substituting the above values for Y and Y_1 Equation (1) becomes

$$A = \frac{a^2 + 2Rab + (Sb)^2}{R - \frac{S^2}{R}} \qquad (2)$$

Which is the general equation for the trapeziform section.

When the line $y = Sx + a$ passes through the point Y_2, $\frac{a}{S} = b$ and Equation (1) becomes the equation for the triangular section by the dropping of the last term of the numerator, which is equal to zero.

Therefore
$$A = \frac{\left(\frac{a}{S} + b\right) Y_1}{2} \qquad (3)$$

which becomes
$$A_1 = \frac{a^2 + 2Sab + S^2 b^2}{2\left(S - \frac{S}{R}\right)} \qquad (4)$$

when the values for Y_1 are substituted.

For use for any particular cross-section, the values of b and R are substituted for the general case and value of S for the special cases and the equation becomes of the form $A = Aa^2 + Ba + C$ from which curves can be rapidly made.

If ditches, surfacing trenches, etc., are to be used their area must be added or subtracted as a constant for all values of a when $a > Sb$ and the proper proportion of such area when $a < Sb$.

For purposes of actual use the center-line values are taken from the profile and tabulated, the rate of ground slope is taken from the topography and tabulated beside the former so that both variables will be together for picking quantities off the chart, the plotted curves being, of course, ($A \pm$ Ditch constant) times length of station.

In taking off the rate of ground slope, the easiest method is by counting the number of contours crossed by a known unit of measure, such as one centimeter, depending upon the scale of the map.

It will be noted that the curves take care of the combined cut and fill section which occurs when $a < Sb$, by showing two readings for any given transverse slope.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Contractor and Footing Course

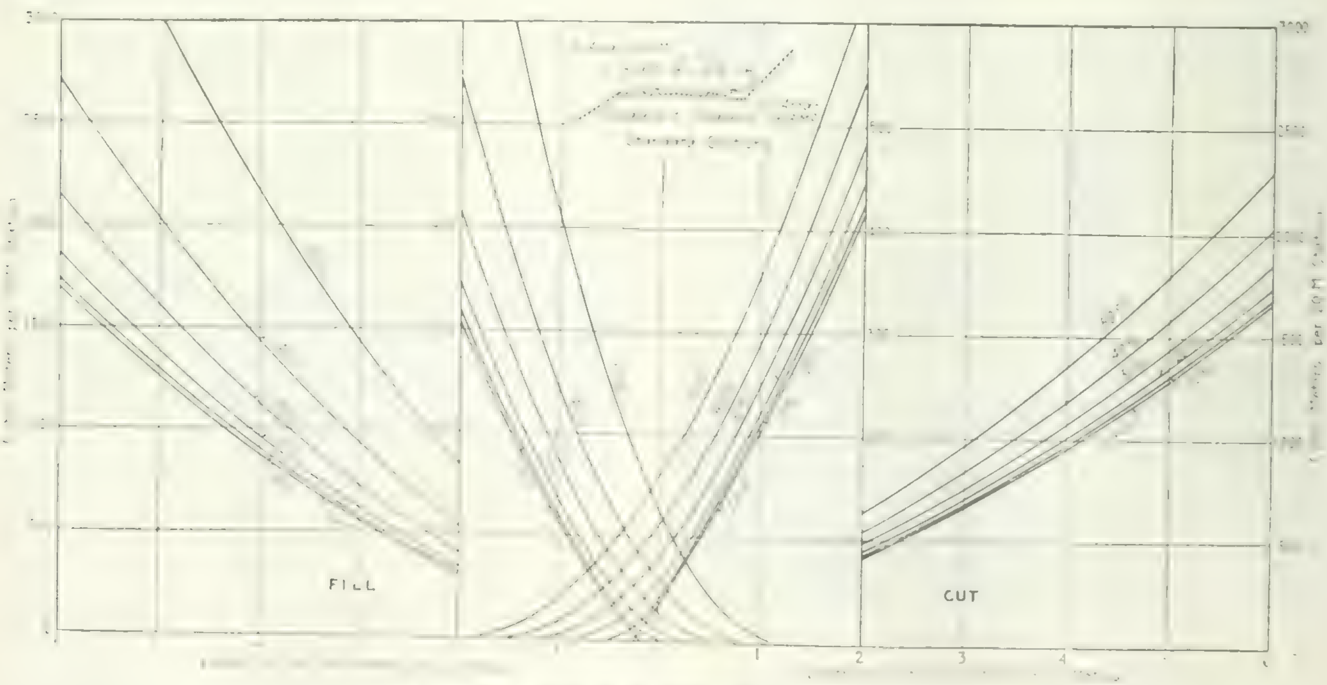
By Frank E. Sanborn
Oxford, Ohio

Does every construction superintendent and foreman realize the harm he may do by lack of care in building the footing courses? The designer has planned his footings for equal settlement of the whole foundation, adjusting the loadings to the different kinds of soil encountered, and he wants the pressure to be uniform across the footing course. All this planning is made useless by wrong location or size of the footing course.

Errors in footing location may come about through wrong measurement on the ground, carelessness in staking out the trench, or digging away from the line. Any of these causes will produce a loading on the ground which is not uniform as intended but is greater at one edge than at the other, a condition which invites unequal settlement. The man laying out the trench or hole may regard it as rough work, sufficiently close if there is a footing course under the wall no matter if it is wider than called for, especially as the work is soon covered and out of sight; yet due care is as important here as at any other place in the structure.

Uniform distribution of load is secured only when the load comes in the center of the footing course. Any foreman or laborer can verify this fact by placing a block of wood on the surface of soft ground and stepping on it: if his foot rests on the center, the block squeezes down evenly, while off-center loading makes the nearer edge sink down deepest and causes the block to tip.

What is the amount of these inequalities of pressure resulting from off-center loading? For the simplest case we may compare a correctly located footing, Fig. 1,



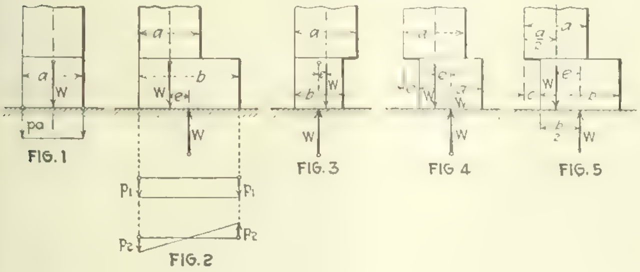
FROM JOB AND OFFICE

For Contractor and Engineer

with a footing widened out on one side, Fig. 2. In Fig. 1 the load W comes in the center of the width of the footing course and the pressure per square inch of area is the same everywhere,

$$p = \frac{\text{Weight on the footing per inch of length}}{\text{Inches of width}} = \frac{W}{a}$$

In Fig. 2 we have the same load W, at the same dis-



FIGS. 1-5—BADLY BUILT FOOTINGS

tance from the unaltered side of the footing, but the soil loading is non-uniform. The greatest load per square inch, p_{max}, will be $p_1 - p_2$ or,

$$p_{max} = \frac{W}{b}\left(4 - 3\frac{a}{b}\right)$$

which means that the intended loading p has been multiplied by the factor

$$\frac{p_{max}}{p} = \frac{a}{b}\left(4 - 3\frac{a}{b}\right).$$

At the opposite edge of the footing the intended loading has been reduced in the ratio

$$\frac{p_{max}}{p} = \frac{a}{b}\left(3\frac{a}{b} - 2\right).$$

$\frac{a}{b}$	$\frac{p_{max}}{p}$	$\frac{p_{min}}{p}$	$\frac{a}{b}$	$\frac{p_{max}}{p}$	$\frac{p_{min}}{p}$
1.0	1.0	1.0	0.5	1.25	—0.25
0.9	1.17	0.63	0.4	1.12	—0.32
0.8	1.28	0.32	0.3	0.93	0.33
0.7	1.33	0.07	0.2	0.68	—0.28
0.6	1.32	0.12			

These values are plotted in Fig. 6. The negative values mean that the top part of the projection of the footing course would press upward against the soil upon it.

Thus it appears that if a foundation course is widened on one side, the maximum pressure per square unit of area upon the soil is increased, unless the footing is made more than three times its proper width. If a 16-in. course is made wider on one side by 4 in., making its total width 20 in., then $\frac{a}{b} = 0.8$ and $p_{max} = 1.28\ p$; that is, the greatest pressure is 1.28 times the designed pressure. If the designed pressure is 4,000 lb. per sq.ft., then the greatest pressure becomes 5,120 lb. per sq.ft., while the pressure at the opposite edge is only 1,280 lb. per sq.ft., so that the greatest pressure is four times the smallest pressure. With this unequal loading of the soil, tipping of the footing course due to uneven settlement is to be expected.

The footing course may be reduced in width on one side, Fig. 3. Then the same formulas apply, merely interchanged; the pressure ratios are plotted in the right-hand part of Fig. 6. A 16-in. course reduced by 1½ in. on one side would have a 14½-in. width and a value of $\frac{a}{b} = 1.1$; the greatest pressure would become 1.43 times the designed pressure. For an intended soil loading of 4,000 lb. per sq.ft., the actual loading at one edge is 5,720 lb. per sq.ft. and that at the opposite edge 3,080 lb. per sq.ft.

If the course is widened or narrowed equally on both sides, then the load would be uniformly distributed upon the soil, but of less or greater amount respectively than planned and so not in keeping with other footings.

If the footing is of proper width but wrongly located, an eccentric load results as shown in Fig. 4 and plotted in Fig. 7, the factor of pressure increase being

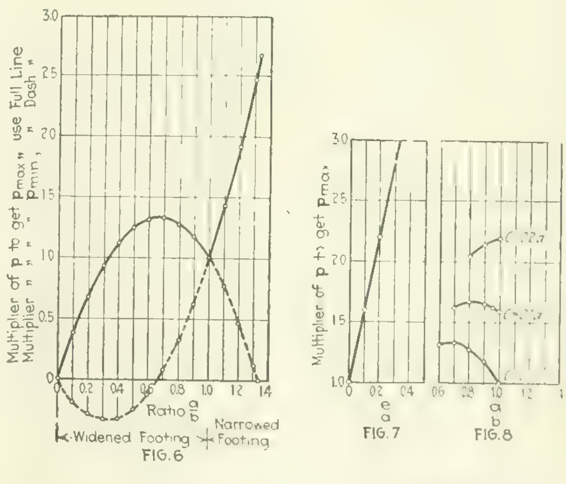
$$\frac{p_{max}}{p} = 1 + 6\frac{e}{a}$$

It is possible also that a footing may be both widened and misplaced, or widened on one side and narrowed a less amount on the other side, as in Fig. 8. For this condition the factor is

$$\frac{p_{max}}{p} = \frac{a}{b}\left(4 + 6\frac{c}{b} - 3\frac{a}{b}\right)$$

and may be represented by a series of curves depending upon the relative values of the widening and the narrowing. Three of these curves are given in Fig. 8.

Thus, good building practice requires that the contractor follow the plans closely in laying out and constructing a foundation. Lines should be stretched and stakes driven in the proper places; digging should follow



FIGS. 6-8—PRESSURE RATIO IN UNSYMMETRICAL FOOTINGS

Fig. 6—One side of footing misplaced. Fig. 7 Footing shifted sideways. Fig. 8 Width and location wrong.

the line, the sides of the trench be pared plumb, and the bottom be made level. Plumb-bobs hung from lines stretched between batter-boards will be helpful. A carpenter's or mason's level will be found of service. Any widening in an earth form for concrete should be corrected with form boards and not filled out with the concrete in the thought that the extra concrete is cheaper than the form boards. Some foremen think that a widened base always reduces the loading on the soil, but they are wrong.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Studies of Flow of the Tennessee River

Sir—Permit me to call attention to a statement in the article by Benjamin E. Jones on "Flow in Tennessee Checked Against Hydraulic Formulas," appearing in *Engineering News-Record*, Oct. 12, p. 610, as follows: "The extent to which the values of n and C obtained in these experiments could be applied to other similar channels depends, of course, on the relation that the cross-section at the bridge on the Tennessee River bears to the average cross-section of the whole stretch of channel involved in the measurements —on the whole the area at the bridge doubtless represents fairly well the cross-section of the seven miles of channel."

Experiments upon channels show that even where the locations are selected for investigation because of their regularity, considerable variations in cross-section and hydraulic radius are present. The case of a measurement on the Ohio River at Cincinnati might be cited where the maximum variation of the area was "from about 15 per cent below the average to about 14 per cent above," and the maximum variation in the hydraulic radius was "from about 23 per cent below the average to about 33 per cent above." (Quotation from "Calculation of Flow in Ohio Channels," by Ivan E. Houk; Miami Conservancy District Technical Reports, Part IV., p. 119).

A section selected at random in a crooked river is therefore not likely to represent "fairly well" the average cross section. In fact, while such a section may be nearly the average, it is more likely to be considerably different, especially at low stages. Any conclusions based upon such an assumed condition are liable to be entirely untrustworthy. It is greatly to be regretted that a number of other cross-sections were not available for use in determining the real average cross-sectional area of the river, as the data would then be very valuable and interesting, but without them any conclusions drawn from the data must be regarded as "not proved." E. W. LANE.

Representative of the Morgan Engineering Companies.
Yangchow, Ku., China, Nov. 7.

[Mr. Jones submits the following reply.—EDITOR.]

Sir—The results of slope and discharge measurements on the Tennessee River were published to show the relation, if any, between variations in values of C and variations in values of hydraulic radius and slope. The measurements answer this purpose whether or not the cross-section is uniform throughout the channel involved. For example, measurement 33, with hydraulic radius of 10.9 ft. and slope of 0.0000506, shows a value of 40 for C, whereas measurement 34, with hydraulic radius of 10.5 and slope of 0.0000839, shows a value of 52 for C. A change in the average cross-section would have little effect on the relative values for C.

Mr. Lane's criticism would apply only if it is desired to use the values of C and n found for the Tennessee River in computing the discharge of other channels. In that case they would necessarily be used in connection with other similar measurements and the engineer would give them such weight as the facts in his opinion warranted.

A survey of Tennessee River made in 1910 shows an average width at low water in the stretch of channel covered by the slope measurements about 15 per cent greater than at the bridge at Chattanooga. The average depth of water at different cross-sections was nearly uniform. The survey was made before the Hale's Bar dam was constructed and there may have been changes since in the average depth but probably not in the average width. BENJAMIN E. JONES,

Hydraulic Engineer, U. S. Geological Survey.
Washington, D. C., Dec. 19.

A Protest Against "Sales Engineer"

Sir—Is it not time to do away with the term "sales engineer" before it gets any further? The writer's objection is that there is no such thing. Selling is not in any sense engineering; and while an engineer may leave his occupation and take up selling, yet such an act does not make him a sales engineer. It is true that a technical training often qualifies a salesman to do better work in the promotion and selling of engineering supplies; but he is then an engineering salesman, not a sales engineer.

The ethics of the two occupations are incompatible. If a salesman applied a professional man's ethics to his own work, he would soon be out of a job. Should an engineer use a salesman's methods he would be accused of sharp practise. A salesman has little identity of interest with his customer; he "sells" his customer in the interest of the manufacturer by whom he is paid. An engineer would act unprofessionally if he recommended the purchase of any material or process the use of which would result in his gain. He gives service to, and is paid by, the customer whose interests and his are one.

It is to be regretted that a name, as soon as it gets a reputation that is at all advantageous, is borrowed or stolen by others for its reflected credit. It is to be expected that many manufacturers will want to call their salesmen engineers; but the last thing to happen should be for engineers to use the name themselves that way. The writer invites the attention of both the American Association of Engineers and also the American Society of Civil Engineers to this matter, for the words "sales engineer" are used freely in the employment bulletins of both societies. Among the mechanic arts we are all familiar with the hoisting engineer, the stationary engineer, etc.; with the encouragement now given by engineers to the general use of their name, we may soon look for its adoption in a variety of indoor lines, such as sales engineer for drummers and floor-walkers, accounting engineer for clerks and bookkeepers, and tonsorial engineer for barbers.

Faribault, Minn., Dec. 16. A. W. BEDELL.

Liquid Pressure and Coal Bin Design

Sir—The letter of Edward Godfrey in *Engineering News-Record* of Nov. 9, p. 808, seems to require elaboration of some statements in my letter in the issue of Oct. 19, p. 669.

My objections to a method of approximating the lateral pressure of granular materials, such as sand, grain, coal earth, etc., are based upon theoretical, experimental and economic grounds. That granular materials, for example coal in a bin, do not act like liquids is evident and will probably be accepted by all. That no liquid-pressure formula can take into consideration the effect of surcharge or of the width of the bin is also true. Of course, tables of coefficients may be computed to take care of each individual case, but, if they are reliable, such coefficients have been computed by taking into consideration the physical properties (those possible values which will give the maximum pressure) of the material in question. The Pascal law for liquid pressure requires that the lateral pressure be independent of the width of the containing vessel. But the pressure of a granular material on the side wall of a narrow bin is not as great as that on a wider bin, all other conditions being the same.

Some of the supporters of the "equivalent liquid pressure" method recommend the formula P, a horizontal pressure, equals $\frac{1}{2}Cwh^2$; the value of C is then given as $tan^2\ \frac{1}{2}(90°-\phi)$, where ϕ is the natural slope. Substituting, we see that the formula is really Coulomb's formula for the pressure of a horizontal fill against a perfectly smooth wall with a vertical back face, after Woltmann's assumption that the tangent of the angle of natural slope was equal to the coefficient of internal friction had been added. Incidentally, I might mention that Coulomb did not include the natural slope in his theory, based on the wedge of maximum pressure. I realize that most texts do not emphasize Coulomb's own restrictions to his formula, but they can be found in the original papers, "Memoires de l'Academie Royale des Sciences"

T. 7, 1773, or in "Theorie des Machines Simples" by Coulomb. A second edition (1821) of the latter is in the Congressional Library. Later developments of this theory assume the existence of a vertical component in all cases (since the wall cannot be perfectly smooth) and also take care of all cases of surcharge or sloped wall.

Unfortunately, experimental data on a scale large enough to be applicable are rather meager. However, the tests mentioned below, where work with sand, grain and earth is reported, all seem to show the reliability of the wedge theory, at least as a close approximation. Tests with similar materials in different parts of the world with unlike types of apparatus check each other so closely that there can no longer be any argument about the existence of a component along the wall. Lack of space prevents more than the references:

A. A. Steel: *Engineering News*, 1899, p. 261;

H. Mueller-Breslau: "Erddruck auf Stuetzmauern," 1906;

R. B. Fehr and C. R. Thomas: Penn. State College Bulletins 8 and 11, 1912-13;

P. M. Crosthwaite: Proc. Inst. C.E., 1916, 1920;

A. R. Fulton: Proc. Inst. C.E., 1916;

M. Enger: *Proceedings*, A.S.C.E., 1920, p. 251;

F. H. Hummel and E. J. Finnan: Proc. Inst. C.E., 1921, p. 369;

Preliminary Cincinnati Tests: *Engineering News-Record*, Aug. 25, 1921, p. 314; Jan. 19, 1922, p. 106.

It is hoped that the complete set of tests on sand performed by the writer at the University of Cincinnati, 1921-2, may soon appear in print.

Practically, the use of an approximate method based on assumed coefficients is neither economical nor safe. It is true that no exact design of a retaining wall or bin is at present possible. That is so because of lack of information, but is no reason for not using what information is available. Incidentally, where in engineering design can we point to an exact method? But, in order that the approximation be closer and therefore more economical, and based upon experimental data and therefore safer, it is advisable to beware of easy, short-cut formulas, especially since those who do not realize that there are limitations to such formulas are the ones likely to place greatest faith in them. R. W. Dull in *Engineering News*, Aug. 21, 1904, gives a complete set of formulas and coefficients for the design of steel bins, based upon both the Poncelet wedge and the Rankine theories. They are no harder to use than the "equivalent fluid method" and have the advantage of experimental verification, to some extent anyway. Until we know more about granular materials and their action, it seems to me that extra care should be taken in designing structures where the action of such materials must be taken into consideration. JACOB FELD,

Formerly, Baldwin Fellow in Civil Engineering,
Brooklyn, Dec. 4. University of Cincinnati.

Sir—If Mr. Feld would boil down his objection to the equivalent-fluid-pressure method of designing retaining walls and bins, there would be only two points left. One of these is that the equivalent fluid pressure method does not include nor imply the existence and effect of vertical friction on the side of the wall or bin. The other has to do with the effect of surcharge.

Taking up first the case where there is no surcharge: The horizontal pressure on the side of a wall or bin, as found by the equivalent-fluid-pressure method, is absolutely identical with the tabular results found by R. W. Dull in *Engineering News*, July 21, 1904. This is true both of the case where vertical friction is neglected and the case where a certain angle of friction is assumed, though, of course, the coefficient or unit weight of "liquid" is different in the two cases. Furthermore, by using a proper unit weight of fluid the lateral pressure for the case of indefinite surcharge is identical with that worked out by Mr. Dull, to which Mr. Feld refers as a correct method.

The effect of vertical friction on a coal bin is not used at all in the design. In a retaining wall it is an aid to stability which is too uncertain to enter as an element in design and had best be neglected.

As to the work saved: It is certainly easier, say in the case of horizontal beams in the side of a bin, simply to take the depth from the top of bin as a basis for fluid pressure and to design each beam for its spacing and span, rather than to find the total wedge pressure for the whole side of the bin down to that beam and half way to the next and deduct the wedge pressure to the mid-space to the beam above, as Mr. Feld's theory and method requires. Besides this, a designer feels far more secure with a simple method of unit loads, easily checked, than with a long formula.

The surcharge in a coal bin, which may be a wagonload of coal, or even a carload, piled in a pyramid on top, does not justify entering into extremely complex theory in design. Probably not one engineer in five hundred could apply the theory to this problem without giving it study for a day or two. I am among the 499, for I give very little time to theories that have so little of the practical to commend them. I venture to say that, given identical bins to proportion, on identical unit stresses, Mr. Feld's theoretical method and my rough one, given in *Engineering News-Record*, Nov. 9, 1922, would produce identical beam sizes. This, it seems to me, is the proof of the pudding.

Pittsburgh, Dec. 8. EDWARD GODFREY.

The Ventilation Problem in the Light of Recent Research

Sir—I have read with much interest the letters in *Engineering News-Record* of Dec. 7, 1922, on "Sanitation, Ventilation and Vaccination" by F. W. Harris and Rudolph Hering's comments on p. 1040 of the following issue, entitled "Ventilation, Body Temperature and Health." It would be most short-sighted to minimize our debt to vaccine and serum therapy. Vaccination has played a large part, along with sanitation, in the conquest of typhoid fever; and vaccine and serum therapy promises far more than any other measure in the control of pneumonia which we hope for but have not yet attained. Yet it is well that the importance of air conditioning as a factor in building up vital resistance should be emphasized. As you pointed out in your one line of editorial comment on Mr. Harris' letter, these procedures are fortunately not mutually exclusive. Let us by all means "vaccinate, ventilate and sanitate."

Mr. Hering's emphasis on the importance of air conditioning is more than justified for there is no more neglected field of applied physiology than the hygiene of the skin. The work of the New York State Commission on Ventilation (to be presented in book form by E. P. Dutton & Co., during the coming winter) makes it clear that overheating of occupied rooms is a factor of the first importance in reducing efficiency and increasing respiratory disease.

It is important, however, to note that modern ideas of ventilation with their emphasis on temperature control, rather than the removal of hypothetical and non-existent atmospheric poisons, demand a somewhat radical change in ventilation practice. The studies of the New York State Commission on Ventilation indicate that the ample air flushing (30 min.-ft. per person) required by the laws of many states is not only unnecessary but positively harmful since such an excessive air flow inevitably tends to overheating, discomfort, and increased respiratory disease.

Mr. Harris' statement that "windows are for light and should only be used for this purpose during the winter months" will not be accepted by those who have followed recent advances in this field, for the best general system of schoolroom ventilation which we observed in the studies of the New York State Commission is that which admits air over slanting window boards, with ample radiation below to moderate its temperature, and with gravity exhaust ducts for the removal of vitiated air from near the ceiling. The substitution of this system for fan ventilation will not only save money in construction but will also effect material saving in operation (since a much less volume of air must be warmed per hour) and will promote both the comfort and the health of the occupants.

New Haven, Conn., Dec. 16. C.-E. A. WINSLOW,
Professor of Public Health,
Yale School of Medicine.

News of the Week

New York, December 28, 1922

Reclassification of Federal Employees Doubtful

Heavy Work Devolving Upon the Senate Appropriations Committee May Keep Measure Out

Washington Correspondence

Although several hearings have been held by a sub-committee of the Senate appropriations committee, the final report on the bill to reclassify the employees of the federal government and readjust salaries has not been formed and in view of the heavy work devolving upon the appropriations committee because of the annual supply bills fears are expressed that the reclassification measure will not be brought to action on the floor in time to assure passage at the present session of congress. Senator Smoot, chairman of the sub-committee in charge of the bill, has stated, however, that a report may be expected shortly.

Friends of the reclassification bill are dubious of its passage in the present Congress even with a report coming in January because of the doubt over the shape in which the bill will appear when it does come from committee.

Further Changes Proposed

The civil service committee of the Senate considered this measure some weeks and reported it with a recommendation that it be passed on Feb. 8, last. Because of the financial features of the bill, it was referred to the appropriations committee for further study. The civil service committee made a number of changes in the bill from the form in which it was passed by the House. While the sessions of the sub-committee on appropriations have been executive, with a number of government officials testifying as to their ideas, it is generally understood that further changes have been seriously considered by this committee. Senator Smoot himself is the author of another reclassification bill which originally projected reforms based upon a somewhat different theory than those contained in the Lehlbach-Sterling bill, which was the basis of the one now under consideration.

It is said that the appropriations committee has been considering further reductions in the number of classes outlined in the bill, and that there has been serious thought of eliminating workers in the field and confining the measure to government employees within the District of Columbia. Changes in title and in relative pay for professional and sub-professional workers also have been suggested, it is said, because these men are leaving the service in increasing numbers.

Franklin Furnace Typhoid Outbreak Reaches 16 Deaths

Up to Dec. 15 the typhoid outbreak at Franklin Furnace, N. J., noted in *Engineering News-Record*, Dec. 14, p. 1045, had resulted in about one hundred reported cases and sixteen deaths.

New Jersey Road Bonds in Demand at Good Premium

Bids for $2,000,000 of 4½ per cent highway bonds of the State of New Jersey brought offers totaling about $50,000,000 on Dec. 19. The highest of nine bids for the entire issue was at the rate of 102.097 and secured the award. Bids for portions of the issue ranged from par to 103+ but the syndicate bid gave a higher yield than the best of the fractional bids.

Special Train for A.G.C. Convention

A special train will take the members of the Associated General Contractors to the annual convention at Los Angeles, Calif. Assembling at Chicago at the close of the Good Roads Show the members will leave by the Atchison, Topeka & Santa Fe Ry., at 6 p.m. Jan. 21 and arrive in Los Angeles at 12 m. Jan. 29. The trip will include a stop at Grand Canyon. For the return trip a choice of three routes, via the Union Pacific, the Southern Pacific or the Chicago, Milwaukee & St. Paul railways will be afforded. Complete schedules of the several trips, including excursions and stops at points of scenic interest, and giving railway fares, may be secured from the Associated General Contractors, Munsey Building, Washington, D. C.

Shreveport Division of Katy Sold at Public Auction

The Shreveport division of the Missouri, Kansas and Texas R.R., from Greenville, Texas, to the Louisiana state line; and the McKinney branch, between Greenville and McKinney, Texas, were sold at public auction in Greenville Dec. 16 for $700,000, the minimum price asked by the court. The lines involved in the sale total approximately 180 miles.

The sale of the branch lines at Greenville ends the receivership of the "Katy" R.R. that has been in effect since September, 1915, and also brings to a close the successful reorganization of the Katy lines, which has been worked out by a group of New York bankers headed by firm of J. W. Seligmann & Co.

It is planned to extend the line west for a connection with the Ft. Worth & Denver City, but just what point at which the connection is contemplated is not generally known. The road will have direct connections with Dallas and Ft. Worth and other important shipping centers.

The deal above mentioned will eventually give the Edenborn lines 523 miles of railroad through a rich lumber and farming belt, also two deep waterways.

Concrete Institute Program Is Announced

An exceptionally live and interesting program has been provided for the nineteenth annual convention of the American Concrete Institute to be held at the Hotel Sinton, Cincinnati, Ohio, Jan. 22-25, 1923. The meeting starts at 2 o'clock Monday afternoon with a special session on concrete products manufacture and has a meeting that night; Tuesday, Wednesday, and Thursday there will be three meetings each day, the Wednesday evening session, however, being devoted to a get-together social meeting.

Papers include methods of making concrete pressure pipe, by W. G. Chace of the Lock-Joint Pipe Co.; design and construction features of the ideal section of the Lincoln Highway, by W. G. Thompson; trend of design and construction of concrete roads, by H. Eltinge Breed; correction data for comparative test results from field specimens, by G. W. Hutchinson; effect of impure water on the strength of concrete, by Prof. Duff A. Abrams; design of elastic structures from paper models, by Prof. George E. Beggs; an interesting case of dangerous aggregate, by J. C. Pearson; thoughts on concrete houses, by J. C. Pearson; developments in surface treated concrete, by R. F. Havlik; some defects in concrete buildings, by H. C. Loring; inundation methods for measurement of sand in making concrete, by W. A. Slater and G. A. Smith, of the U. S. Bureau of Standards; analysis of the variables in concrete from the construction standpoint with some results of job tests, by W. P. Bloecher, Stone & Webster; and causes of steel corrosion and concrete disintegration, and methods of their prevention, by M. M. Upson.

In addition to this there are the usual presentation of specifications, a number of which this year are of great importance and a whole session devoted to a question box to which already some very important questions have been submitted. The secretary of the Institute is Harvey Whipple, 1807 East Grand Boulevard, Detroit, Mich.

Reclamation Levee Under Way on North Sulphur River

The Howard-Kenyon Dredging Co., of Houston, Texas, has unloaded a dredging machine at Cooper, Texas, to be used in the construction of the levee being constructed by the Delta Lamar Improvement District No. 1. The district now has a channel machine in operation and a channel in North Sulphur River about nine miles long is being cut. With the additional machinery, a levee about 12 miles long will be built. The levees and channel, when completed, will reclaim about 7,000 acres of rich bottom lands at a cost of approximately $350,000, and will make one of the best agricultural tracts in the State.

Winners of Michigan U. Highway Fellowships Announced

The board of regents of the University of Michigan at its November meeting appointed the following to receive 1922-1923 fellowships in highway engineering and highway transport:

Roy D. Chapin fellow in highway transport, Major Mark L. Ireland, Quartermaster Corps, U. S. A.; 1901, B. S. and 1913, M. E., Michigan Agricultural College; 1921, M. S., Massachusetts Institute of Technology. Since 1904 Major Ireland has been an army officer.

Roy D. Chapin fellow in highway engineering, William J. Groves; 1920, B. S., University of Missouri. (Entered School of Arts and Sciences, University of Missouri, 1914-15, School of Engineering 1915-1918, U. S. Army, June 1918 to June, 1919, School of Engineering, University of Missouri, 1919-1920.) Mr. Groves is at present assistant county engineer, Fayette County, Texas.

Detroit Edison fellow in highway engineering, A. T. Bragonier; 1909 graduate of Normal Department, Shepherd College; 1916 B. S. C. E., West Virginia University. At present Mr. Bragonier is instructor in highway engineering, West Virginia University and an engineer with the West Virginia State Highway Department.

Detroit Edison fellow in highway engineering, John D. Slye: 1914, B. S. C. E., University of Colorado. Mr. Slye, since 1919, has been chief of road surveys, U. S. Bureau of Public Roads, Denver, Colo.

Port Authority Reaffirms Opposition to Newark Bridge

The Port of New York Authority has reaffirmed to the Secretary of War its position of opposition to the construction of a bridge by the Central Railroad of New Jersey at the mouth of Newark Bay from Elizabethport to Bayonne and urges the postponement of action by the War Department on the matter for at least two years. The Port Authority, in a letter to the United States engineer officer in New York, states that it will be not possible until two or three years have passed to foreshadow the development of Newark Bay as to marine traffic and that it would be unfair to possible Newark Bay traffic to set up across the lower bay a bridge which would impede such traffic.

Hearings are still under way at Washington in the matter of the bridge, which was authorized by federal law some years ago and which is now being opposed by the city of Newark. The railroad's authorization expires next Friday and it is now endeavoring to have the last date for commencing work put forward some years.

Army Engineers Visit Rio Grande

Army engineers have been sent to El Paso, Texas. to inspect the Rio Grande River between El Paso and Fort Quitman, Texas, with the view of passing on the proposed deepening and straightening of the river channel as a means of removing the flood and mosquito menace at El Paso. The project will involve the expenditure of millions of dollars, according to Major Adams, who is in charge of the inspection party.

Electric Generating Stations To Absorb Indiana Fuel Wastage

The proposal of the construction of electric generating stations at the coal fields, to absorb fuel wastage has taken definite form in the North Middle West.

In discussing the situation recently Walter P. Bloecher, of Stone & Webster, has the following to say:

"The electric power and lighting utilities of some seventy cities and towns in Central Indiana, with Indianapolis as a center, have been consolidated by the Central Indiana Power Co. All will be interconnected and operated more or less as a unit. A new power station, with initial capacity of 40,000 kw., will be constructed on the bank of the Wabash River and in the center of some 3,400 acres of proven coal lands which the company has acquired. The electrical requirements of something in excess of 500,000 people will be met by the system. Savings in fuel, in administration and general overall expense are set up as results which may be expected to flow from interconnection operation.

"The new power station will be designed and built by Stone & Webster construction forces under the supervision of Kelsey Brewer & Co., of Grand Rapids, managers of the new system, while the financing of the consolidation, with the station and necessary physical links, to the extent of approximately $12,000,000, will be handled by Halsey, Stuart & Co., Stone & Webster, Inc., Spencer, Trask & Co., A. B. Leach & Co., and Paine, Webber & Co.

Municipal Garbage Collection to Be Continued at Seattle

By a vote of 5 to 4 the city council of Seattle, Wash., recently decided against changing from municipal to contract collection of garbage. Motor-truck collection is to be tried. A proposal to shift the collection work from the health to the public works department has been made.

Bridge Over Tanana River Nears Completion

When the Tanana River freezes over solidly, the finishing touches will be put on the 705-ft. span being used on the Alaskan R.R. to bridge that stream. The approaches have been completed and the falsework is all in awaiting the freezing of the river to complete the erection of the structure. It is believed trains will be using the bridge before the end of the year.

ALASKAN RAILWAY BRIDGE ACROSS TANANA RIVER

High Dam Conflict Awaits Legislative Action

Federal Power Commission Expected to Act Quickly Should the Minnesota Legislature Fail

Washington Correspondence

If the Minnesota legislature does not take action in the matter involving the use of the High Dam in the Mississippi River between St. Paul and Minneapolis, the Federal Power Commission is expected to act and quickly. The delay which has been occasioned by the conflict over who shall utilize the power which can be developed at that government dam, already has cost the Federal Government nearly $700,000. The matter has been further complicated by the filing of an application by Henry Ford.

The trouble was precipitated when the St. Paul Association, composed of leading citizens, induced their city to file an application with the Federal Power Commission for the right to develop the power which could be produced at the High Dam. This association is endeavoring to establish a new industrial area, and as a part of that campaign had secured the promise of Henry Ford to build a factory to employ 5,000 men on the understanding that the association would obtain power rights which it would transfer to him.

Conflicting Applications Filed

This action caused the Northern States Power Co. to file a conflicting application. Still another conflicting application was filed by the City of Minneapolis. The Federal Power Commission held a hearing, but at the request of Senator Nelson, a decision was delayed so as to give the Municipal Electric Corp., composed of the cities of St. Paul and Minneapolis and the University of Minnesota, an opportunity to obtain the necessary state legislation to construct and operate the power plant.

It is apparent to those who have observed the situation closely that there is no chance for the two cities to get together on any proposition. In the meantime it has become apparent that the Federal Power Commission hardly would grant a license in such an indirect arrangement as is involved in the city of St. Paul—St. Paul Association—Henry Ford proposal.

As a result of the government's large investment in the dam, it is known that federal officials are disposed to make a final settlement of this project just as soon as the Minnesota Legislature will have indicated its intention in the matter.

Colorado Engineers to Make Survey of State's Technical Schools

The Colorado Engineering Council will make a survey of the state's technical schools, according to Arthur Ridgway, president of the council. The council will endeavor to ascertain the adequacy of technical education to meet the demand of engineering practice.

Mr. Ridgway asserts that "the council desires above all things else to see educational standards so maintained and specialization so distinctly marked that our young men will begin their professional careers thoroughly equipped to cope with the intricate and constantly increasing problems of our advanced civilization."

Great Northern Power Has Extensive 1923 Program

Will Spend Between $5,000,000 and $6,000,000 on Extensions—Pharris New Chief Engineer

Extensions of the Great Northern Power Company's Duluth electrical development to be started during 1923 at an estimated ultimate cost of between $4,000,000 and $5,000,000 have been announced by officials of the company. Included in the company's program is an extension of the present power development at Thomson on the St. Louis River, 18 miles north of Duluth, from 80,000 hp. to 150,000 hp.

The development program provides for the building of an additional dam in the vicinity of Fond-du-lac, Minn., at a point where a 70-ft. fall is available. The water from the power house there will be used over again in the reservoir to furnish the supply for the new buildings to be built at the dam. Additional pipe lines will be from that power house to the head gates of the company's present development at Thomson.

The Fond-du-Lac end of the project is estimated to cost $1,500,000. With a 375-ft. fall from the main reservoir to the present power house and a 70-ft. fall contemplated at the new dam, it is believed sufficient power will be furnished to operate Duluth and Superior street railways, and for industrial and electric lighting use in those cities for years to come.

Arrangements for financing the development program have been made with the Electric Bond & Development Co., New York.

Le Roy M. Pharris, of Salt Lake City, Utah, has arrived in Duluth to take charge of the company's plants and proposed extensions as chief engineer. He will direct the development program to its completion under the joint direction of the Duluth corporation and the Electric Bond & Share Co.

All the property necessary to carry through the power development has been purchased and it is expected that a start will be made next spring upon the Fond-du-Lac dam.

Dearborn Terminal Station at Chicago Burns

A short but spectacular fire in the headhouse of the Dearborn terminal station at Polk and Dearborn Sts., Chicago, practically destroyed the building on Dec. 21. This prominent structure, built in 1884, had heavy walls of brick and stone masonry, including a tall tower, but the floors and roof were of timber framing which burned rapidly. The main trainshed and a brick annex of the headhouse were not damaged. As the fire occurred about 4 p.m. it interfered seriously with the heavy rush-hour suburban service, but suburban and main-line trains were operated from the yards just outside the station.

It is thought probable that the first floor of the main building can be utilized temporarily for passenger facil ties until decision is made as to reconstruction, but the office portion of the building is gutted. This station, which is owned by the Chicago & Western Indiana R.R., is the terminal for several important trunk lines and has an exceedingly heavy business.

Five Central States Announce Engineering Society Meetings

The Michigan Engineering Society will hold its annual meeting at Muskegon, Mich. Feb. 7 to 9, 1923. An exhibit of appliances and supplies is to be one of the features. C. B. Huff, Detroit, Mich., is secretary.

The Engineering Society of Wisconsin will hold its annual meeting at Madison, Wis., Feb. 22 and 23, 1923. L. S. Smith, Madison, Wis., is secretary.

The Iowa Engineering Society will hold its 35th annual convention at the Chamberlain Hotel, Des Moines, Iowa. Jan. 23 to 26. It is expected that 400 engineers will attend, including electrical, mechanical, mining, municipal, county, and drainage and structural engineers; and there will be an exhibit in connection with the meeting. M. L. Patzig of Des Moines is secretary of the society.

The Indiana Engineering Society announces the place and time of its annual meeting as the Lincoln Hotel, Indianapolis, Jan. 18 and 19, 1923. The preliminary program includes the following papers: "The Bates Experimental Road" by Clifford Older, state highway engineer of Illinois; "Hydraulic Power Development on the Tippecanoe River" by R. N. Freeman, New York; "Power Plant Progress" by Prof. A. W. Cole, Purdue University; "The Engineer License Law" by C. W. Cole, South Bend, Ind.; "The Railroad and the Public" by C. W. Paquette, chief engineer of the C., C., C. & St. L. Ry. There will be an excursion to the new dam and automatic hydraulic power plant of the Noblesville Light & Power Co., at Noblesville, Ind. Charles Brossmann, Indianapolis, is secretary of the society.

The Illinois Society of Engineers will hold its annual meeting Jan. 23 to 25 at Peoria, Ill.

Texans Urge Passage of Flood Control Bill

Messages have been sent to Representative J. P. Buchanan at Washington by Governor Neff of Texas and John A. Norris chairman of the state board of water engineers, urging support of the appropriation bill for topographic and flood-control work in Texas now before the House Finance Committee, of which Mr. Buchanan is a member. The measure, it is said. will assist Texas in carrying out its flood-control program. Similar messages are being sent by others interested in the program.

Colorado Supreme Court Upholds Moffat Tunnel Commission

On Dec. 18 the Supreme Court of Colorado denied to opponents of the Moffatt Tunnel project an injunction seeking to restrain the tunnel commission from entering upon the tunnel's construction. Ninety days are allowed in which appeal may be taken to the U. S. Supreme Court. It is not known yet whether an appeal will be made.

B. H. Bryant: A Tribute

By Charles Hansel

Consulting Engineer, New York City

I hope that every engineer can look back along the years to the time when he started his creative work under the direction of his first chief and be profoundly thankful that circumstances led him to begin his life's work under a man that he forever after looked upon with the same respect and admiration that I have continuously felt for my first chief, B. H. Bryant, who died July 8, 1922.

The years are many since I first looked upon him at Alamosa, Colo., in 1879. and each year has added to my knowledge and appreciation of his great ability as a railroad location engineer; tireless in energy and thoughtless of self, always a gentleman, always an engineer. His professional achievements were so varied and so important that I shall not here attempt to mention more than a few outstanding achievements.

As locating engineer, Denver & Rio Grande Ry. from Espanola, N. M. to El Paso, Tex., he located and built 400 miles of road. Later he was constructing engineer for the Canadian Pacific Ry. on the Kicking Horse and Columbus Rivers, and locating engineer, for the Great Northern Ry., from Helena to Great Falls. As chief engineer, Colorado Midland R.R., in 1887, he built the Buck Tunnel, 9,400 ft. long, then the second longest tunnel in the world. He served as chief engineer of the Colorado Southern during 1904 and 1905.

Mr. Bryant's work was not limited to the States. He left the Colorado Southern to accept the position of chief engineer of the Sao Paulo and Rio Grande R.R., Brazil; and while in Brazil he located more than 1,000 miles of line. From Brazil he went to Mexico with Dr. Pearson, where he explored and located several hundreds of miles. From Mexico he journeyed to Central America, where as chief location engineer for the International Railways of Central America he located projected lines in Guatemala, Salvador and Honduras.

During Mr. Bryant's later years he lived in New York and it was my great privilege frequently to receive him at my office, where my staff and I saluted him as chief. His picture honors my offices and I daily look upon it with pride—pride in his splendid character, ability and achievements, pride in having my first chief the intimate friend of my later years.

He was a man; he kept a holy faith in God and man. Work was his happiness, achievement his compensation; he loved his profession, he was loved. This fills the cup of contentment. The longest life contains no more.

New Niagara Gorge Bridge to Be Built by Michigan Central

Plans have been completed by the Michigan Central R.R. for a new double-track bridge crossing the Niagara gorge at Niagara Falls, N. Y., alongside the existing cantilever bridge of the railroad. Contract for construction of the superstructure has been let to the American Bridge Co. Active construction is expected to be started early in the coming season.

Cowper Nominated A.G.C. President

John W. Cowper, president of the John W. Cowper Co., Buffalo, N. Y., was nominated by the Board of Directors of the Associated General Contractors as president of the association for 1923 at a special meeting in Washington, D. C., on Dec. 12. The new nomination was made necessary by the death by accident of W. E. Wood of Detroit, Mich., previously nominated. Mr. Cowper is a member of the advisory board of the A.G.C., chairman of the committee on contracts, and vice-chairman of the joint conference on standard construction contracts.

St. Louis Engineers Will Talk on Bond Issue Items

To help inform the public as to the needs and purposes of the works covered by the proposed $88,000,000 bond issue at St. Louis, Mo., the Associated Engineering Societies of St. Louis have undertaken to have a series of short addresses given by engineers specially familiar with the several subjects. There are twenty-one items to be voted on separately and there will be a talk on each of these items. The series will begin in January, as a preparation for the public vote on Feb. 9, 1923.

In addition to this, a special committee organized by the Chamber of Commerce, with Baxter L. Brown, consulting engineer, at its head, has prepared a pamphlet explaining the items of the bond issue and giving the distribution of cost for the different works covered by these items.

Rio Power Plant Visited by American Engineers

An excursion to Lages, the source of hydro-electric power for the city and the state of Rio de Janeiro and the federal district in general, was arranged by the Brazilian Club de Engenharia for the visiting American engineers at the international exposition held in Rio de Janeiro in October, writes V. L. Havens, editor of *Ingenieria Internacional*, who represented the Am. Soc. C. E. at the congress.

The Lages installation, 13 miles from Lages and 58 miles from Rio de Janeiro, was reached by the Central Ry. of Brazil. The working head at the time of this visit was 304 m. The load in Rio de Janeiro averages about 900,000 kilos a day, among 80,000 light and 4,000 power customers. An outdoor substation supplies the state of Rio de Janeiro and a small interior department of the power house distributes to the works and to nearby farms and towns.

The electrical equipment at the plant is chiefly Westinghouse, with some Escher-Weiss hydraulic equipment and eight Pelton wheels. One of the wheels was idle for a time, and it was noted that the badly worn buckets had been built up by electric welding and later ground smooth with abrasive wheels.

The party made a trip by mule to the dam, which is built on a radius of 100 m., is about 45 m. high and stores 210,000,000 cu. m. of water. The lake above the dam follows a narrow canon for nearly 20 miles and runs back into many tributary gulches.

Are There Any Other State Engineering Societies?

In collecting information for its proposed booklet of engineering society data, Engineering News-Record has so far recorded only twenty-three state engineering societies. These, under various styles of name, are in the following states: Arkansas, Colorado, Connecticut, Florida, Illinois, Indiana, Iowa, Kansas, Louisiana, Massachusetts (Western), Michigan, Minnesota, Montana, New Jersey, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Vermont, and Wisconsin. If there are any others, notice of their existence and data concerning them would be appreciated. Please address letter to Editor, Engineering News-Record, and give name of society, secretary, president, location of home office, date and place of next annual meeting, and number of members.

Contractors' Insurance Claims Valid; A.G.C. to Handle Cases

Claims of contractors who built cantonments and other cost-plus works for the War Department during the war and were not reimbursed for the money they paid as premiums for surety bonds and liability, hold-up and burglary insurance, may be handled direct or through the Washington headquarters of the Associated General Contractors of America, such claims having been declared legitimate by the U. S. Supreme Court.

Following the high court's decision in the test cases brought before it by Mason & Hanger and the North-Eastern Construction Co., in which the ruling of the Court of Claims was upheld, the A.G.C. perfected arrangements to handle such claims for its members.

The cases decided by the Supreme Court grew out of a ruling by the Comptroller of Currency that money paid for bonds and insurance premiums could not be charged by contractors against the government on cost-plus contracts. The War Department had made a number of payments of this character before the ruling was handed down. The contractors who had thus been paid reimbursed the government. However, most of these claims were never paid. The Court of Claims and now the Supreme Court held that the government is obligated to repay the contractors for such expenditures.

Claims aggregating between $2,000,000 and $3,000,000 are said to be outstanding under this classification.

Texas Plans Drainage Reservoir To Benefit 100,000 Acres

A project involving the construction of a reservoir at Bronte, Texas, that will hold 250,000 acre-ft. of water and drain approximately 100,000 acres of land situated in Coke, Brown, and Runnels counties, has been approved by the state board of water engineers, according to Chairman Norris of the board.

Hearing on Louisville Dam Is Set for January 22

Washington Correspondence

The Secretary of War will hear on Jan. 22 the arguments of representatives of each party to the controversy over the power which will become available with the completion of dam No. 41 in the Ohio River at Louisville. Contenders for this power are the city of Louisville and the H. M. Byllesby Co.

Both the War Department and the Federal Power Commission are anxious to have a decision reached in this matter, since the construction of the dam is being delayed pending the outcome of the controversy. The appropriation necessary for the construction of the dam is available to the Chief of Engineers. It is felt that the successful applicant should co-operate with the district engineer in the preparation of the designs for the dam so that the maximum utilization may be made of the 35 ft. of head which will be developed.

The plan whereby the city of Louisville expects to make use of this power was worked out by the chief engineer of the city water-works. The city officials have been interested sufficiently to retain General William L. Sibert to investigate the proposition for them.

It is believed, however, that the city cannot make full utilization of the power unless it is prepared to take over the steam plant and distribution system of the Louisville Gas and Electric Co. Furthermore, Louisville probably cannot secure rights to own property and do business in Indiana. Indiana has the right to utilize one-half of the power which the dam will make available. Since the city is not in a position to make full utilization of the power, it is anticipated that the Federal Power Commission will decide the case in favor of the Louisville Hydro-Electric Co., which is the Byllesby subsidiary, and the actual applicant.

Report on Dirigible Design

A technical committee to report on the design of the U. S. Navy dirigible ZR 1 has made a preliminary report indicating that the design is satisfactory. This conclusion is specially reassuring because the vessel is rather similar in design to the British dirigible R 38 (American number ZR 2), which failed while flying over the Humber River. The committee, composed of Henry Goldmark, New York, as chairman, and W. W. Pagon, Baltimore, as secretary, both civil engineers, and Prof. William Hovgaard, Boston, Dr. L. B. Tuckerman, Bureau of Standards, and Dr. M. M. Munk, of the National Advisory Committee for Aeronautics, is expected to render a final report within a few weeks, having been engaged in the investigation since June. Its preliminary statement says that in the design of the vessel all available information on the subject has been applied with good judgment; that the quality of materials used and the methods of construction are satisfactory; that the strength of individual parts has been demonstrated by tests; that the vessel is stronger than the R 38; that the reasons for the failure of the latter have not been definitely established (by the British report); and that the design of the ZR 1 contains careful provision for possible causes of failure other than structural weakness.

Erie County, New York, Appoints Traffic Engineer

Erie County, N. Y., the county in which Buffalo is located, is to have a traffic engineer. George C. Diehl, county engineer and also president of the American Automobile Association, has been urging the establishment of a department in traffic engineering in his county for a number of years. His efforts have finally brought about the appointment of Howard H. Parsons as traffic engineer for the county.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7 to 9, 1923.

The San Francisco Section, Am. Soc. C.E., held its annual meeting on Dec. 19 and elected the following officers for the ensuing year: President, George A. Elliott, chief engineer, Spring Valley Water Co.; vice-president, H. H. Wadsworth, consulting engineer; secretary-treasurer, Henry D. Dewell, consulting engineer. The paper of the evening was read by Frank G. White, chief engineer, state Board of Harbor Commissioners, on "The China Basin Terminal."

Personal Notes

H. BURDETTE CLEVELAND, for the last three years secretary and consulting engineer of the Barth Engineering & Sanitation Co., and before that for fourteen years principal assistant engineer New York State Department of Health, will become associated with C. C. Vermeule, consulting engineer, New York City, on Jan. 1. Mr. Cleveland will devote himself to water supply and purification, sewerage and sewage treatment.

R. M. COOLEY, for ten years a member of the engineering staff of the Minnesota State Highway Department, St. Paul, except for fourteen months spent in France during the World War with the 33rd Engineers, has resigned to represent the Holt Manufacturing Co. in Minneapolis. J. T. ELLISON, assistant highway commissioner and chief bridge engineer, has assumed the bulk of Mr. Cooley's duties as superintendent of equipment for the highway department.

F. M. MANN, head of the department of architecture in the College of Engineering and Architecture, University of Minnesota, has been appointed a member of the Minneapolis City Planning Board.

LIEUT.-COL. GEORGE B. PILLSBURY, Corps of Engineers, U. S. Army, has been awarded a Distinguished Service Medal for exceptionally meritorious and distinguished service as an engineer officer. A similar decoration has been awarded to LIEUT.-COL. JOHN P. HOGAN, of the Officers' Reserve Corps, for services as chief of the topographic sections of the Fifth Army Corps and of the Second Army in France. A similar decoration was awarded MAJOR HOWARD S. BENNION, Corps of Engineers, for his services in organizing and placing the camouflage service on a high basis.

DAVID A. DECKER, engineer of water and sewers, Norfolk, Va., has resigned to accept a position with the Lock Joint Pipe Co., of Ampere, N. J. His first work will be the construction of 52 miles of reinforced-concrete pressure pipe for this company at Tulsa, Okla. With the completion of this work he will represent the company in the South. He has just completed the construction of the Lake Prince water supply project for Norfolk, at a cost of approximately $4,000,000, and in addition to this has had charge of all water-works and sewer construction and maintenance in that city. He has been with the Norfolk Department of Public Works since 1911, with the exception of ten months in 1917, when he resigned to enter private work, but was recalled in January, 1918, during the war, to take charge of water construction.

W. D. BARKHUFF has been appointed by the Board of Public Works as superintendent of streets and sewers of Seattle, Wash., following the recent resignation of LT.-COL. GEORGE M. RICE. Mr. Barkhuff is a civil engineer, having served as district engineer in the city engineering department from 1908 to 1911.

A. N. JOHNS, who for the past several years has been connected with the engineering department of the California State Railroad Commission, has severed his connection with that organization to take the position of chief engineer with the Associated Telephone Co., of Long Beach, Calif.

G. I. BATELLE, formerly with the engineering department of the city of San Francisco; CHARLES WORDEN, of the firm of Lloyd and Worden, Quincy, Calif., and E. W. ROBERTS, formerly with the Western States Gas and Electric Co., are now in the employ of the California State Highway Commission.

J. R. VERNON has resigned his position as assistant division engineer for the Wisconsin Highway Commission at Lancaster, Wis., and has accepted a position in the Chicago office of the Johnson Service Co.

THE THOMPSON & LICHTNER CO., engineers, Boston, announce the addition to their firm, as partners, of W. B[illegible] WESCOTT and FREDERICK F. BRYANT, both formerly of the firm of Kalmus, Comstock & Wescott, Inc., Boston, and ERNEST R. SHARPE, formerly of the Industrial Service Department, Boston.

THE HIGHWAY CONSTRUCTION CO., Elyria, Ohio, has been incorporated with a capital of $250,000 to do general construction work, the incorporators being M. Mendelson, Fred E. Altfelt, H. C. Cheney, F. L. Hamel, and L. B. Fauver.

ROBERT JEMISON, JR., of Birmingham, Ala., has been appointed a member of the Alabama Highway Commission to succeed S. R. Batson, who resigned in order to devote his entire time to private practice. Mr. Batson was for many years county engineer of Jefferson County, Ala.

C. W. BEST, Canonsburg, Pa., who has been a structural detailer with the McClintic-Marshall Construction Co., has taken up the same kind of work for the Fort Pitt Bridge Works.

F. W. WARD has been made superintendent of construction for the H. P. Cummings Construction Co., Ware, Mass., after having worked for the Fitzdale Paper Co. in the same capacity.

ROBERT D. SHORT, formerly concrete designing draftsman with the Kentucky Highway Department, is now concrete designer for the Sinclair Refining Co., an oil refining firm in Chicago.

RICHARD J. HALE has been appointed county engineer of Missoula County, Mont. He was formerly engineer with the Pioneer Construction Co.

MAJOR VIRGIL L. PETERSON, of Providence, R.I., has been awarded a Distinguished Service Medal for his work, as Colonel of Engineers, in reorganization training at Camps Lee and Humphreys, Va.

Obituary

HAROLD HOWALD, city engineer of Massillon, Ohio, was burned to death at Little Wadsworth, Ohio, in a fire which destroyed a cottage near the west reservoir. Mr. Howald had been city engineer of Massillon for ten years.

FRANK S. TAYLOR, consulting engineer of Austin, Texas, died at his home Dec. 15 from the effects of a stroke of apoplexy suffered a few days previous. He was 54 years old. Mr. Taylor was born in San Antonio, Texas, and resided for the greater part of his life in Austin. He was a graduate of Vanderbilt University.

GEORGE SEARS GREENE, JR., former director, treasurer and vice-president of the American Society of Civil Engineers, and a consulting engineer of New York City, died at his home in South Orange, N. J., Dec. 23, at the age of 85 years. Mr. Greene was prominent in the early engineering development of New York's port, having been in charge, as chief engineer of the Department of Docks, of building the sea-wall which partially surrounds the Island of Manhattan. An extended obituary will be published in next week's issue.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

The following article amplifies some of the points regarding cement production, prices, and seasonal demand discussed by L. R. Burch, of the Atlas Portland Cement Co., in "Engineering News-Record" Sept. 14, p. 456 and Sept. 7, p. 404.—Editor.

Cement Producing Capacity in United States Is Ample

Seasonal Demand, However, Restricts Output of Mills to 80 per Cent of Maximum

By Blaine S. Smith

General Sales Manager, Universal Portland Cement Co., Chicago

Difficulty in securing cement through the summer and fall of this year was due not only to the coal and railroad strikes, but to other reasons that applied this year and in many previous years. Purchasers demand large shipments of cement in summer and fall and decline to take deliveries in winter and spring. As a result, cement mills are idle or run only part time in the former season and are unable to produce enough to supply the demand in the latter season. Transportation usually is available in winter and spring, while the railroads are congested in summer and fall. Obviously the cement user's remedy is to order out shipments when cement and transportation to move it are available.

The cement manufacturing capacity of the country is from 130 to 140 million barrels a year. The country, however, has never used in any year prior to 1922 as much as 100 million barrels. The country fails to use as much as 80 per cent of its manufacturing capacity, even in a year of abnormal building activity, because, to a large extent, cement is considered a seasonal product.

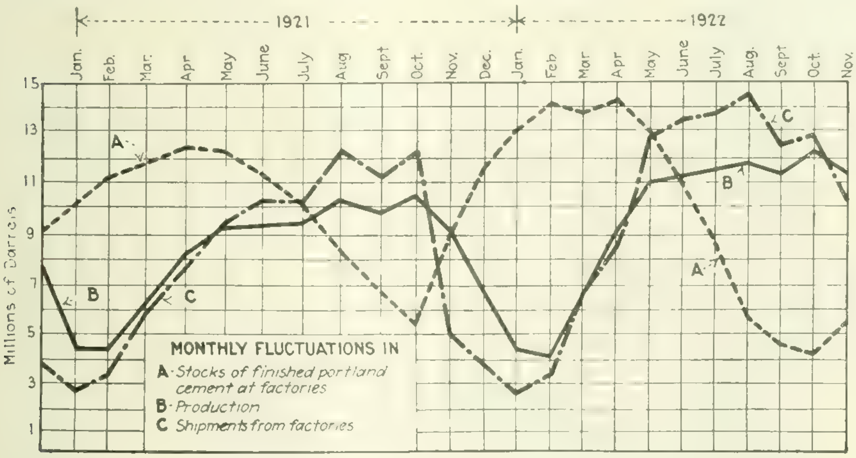
Mills, therefore, manufacture and store large quantities of cement in the off season to be able to ship more than can be produced in the busy season. One manufacturer with a mill capacity of 12 million barrels a year, had in storage the latter part of April more than 4 million barrels, or over a third of a full year's output. This practice, of course, involves a very heavy investment by the manufacturer which of necessity is reflected in the price of his product.

Aside from this important feature, there is another of equal importance. The average cement mill operating at capacity will fill its storage space in about three months if it makes no outgoing shipments. All mills, of course, make some shipments in all months of the year but shipments through the winter and early spring are usually so light that storage bins becomme full, necessitating curtailment of production. In a year of ordinarily heavy demand for cement production lost by a cement mill in the early months is lost forever.

To illustrate: A mill with a producing capacity of 12 million barrels a year can produce a million barrels a month—and no more. If it loses a month's production from any cause it cannot the next month make up the loss by producing 2 million barrels. This year one manufacturer lost upwards of three-quarters of a million barrels of production in August and September because of the coal strike. When this manufacturer's mills later began to receive sufficient coal for full operations the mills could not make up the lost production because even at full operation they were not capable of turning out more than a million barrels a month. Their shipments were 2 million barrels in July and nearly as much in August, although in the latter month a large part of their producing capacity was shut down because of lack of coal. The heavy shipments were made from stocks produced in earlier months.

All this means that while the capacity of the country's cement mills is more by 20 to 30 per cent than the

(Concluded on page 1140)



More Suggestions—

For Better Equipment and Repair Parts Service

In the Dec. 14 issue was begun a discussion of "Better Equipment Maintenance and Repair Parts Service." Its object is to show how some of the misunderstandings between maker and user of construction machinery can be avoided. This week's contribution is a recital of experiences by a manufacturer of air compressors and pneumatic tools:

Sullivan Machinery Co., Chicago

Our instructions to customers, printed in our part lists and instruction books, read as follows:

> *Always give the name of the part desired, the number stamped or cast on it, and the name, type and shop number of the machine on which it is used. With these identification marks before us, we shall be able to fill your repair orders promptly and without confusion.*

If we can get the customer to give us this information everything is lovely. In the case of certain machines, particularly those having a large number of parts, we have found it more convenient to use a reference number on a chart or group photograph of parts and the customer orders by the reference number, or by the telegraph code word identified with it, if he prefers. In every case we keep an exact duplicate part list corresponding with the machine which the customer has, and this list is referred to in making out repair orders which come in in this way.

Proper Repair Stock Base

We find that most customers do not know what a proper repair stock base is for their machine. This base varies with the number of machines which a customer has in use, the likelihood of breakage or wear requiring replacement, also with the size and expense of the part.

The troubles here discussed are old ones with us, and yet, in spite of all our pains, they keep recurring.

> **NOTICE**
>
> Please keep the enclosed detail part list in a prominent place where it can be easily referred to. When ordering duplicate parts for the machinery recently sent you, USE THIS LIST and give the following data, which will enable us to fill your order promptly and without mistakes:
>
> **1. Symbol letters and shop number of machine.**
>
> **2. Name of part and piece number stamped or cast on part to be replaced.**
>
> 3. State whether machine uses steam, air or electricity.
>
> Sullivan Machinery Co.
>
> Form 1228

We ship a book of instructions with each machine and a repair part list which is either a group photo list or an outline cut of the machine with arrows and reference numbers.

In addition, when the customer's part list is sent to him, a label is attached to it in such a way that it can hardly be overlooked. The part list should be placed in the hands of the proper clerk who has to do with ordering.

If we could get the acceptance of the idea of keeping proper stock of repairs on hand it would eliminate many troubles. The larger concerns are more intelligent about this than the smaller ones.

A tendency which has to be combatted is that of carrying too many repairs on hand. Machine design changes, and it is dangerous to carry too large a stock, as well as to carry too small a stock of parts. Manufacturers are not very receptive when they are asked to take back several hundred dollars worth of repairs which a customer has been cherishing on his shelf for eight or ten years, and which are for machines no longer built. This could be avoided by keeping suitable stock bases. Manufacturers' salesmen and engineers are always ready to indicate what adequate and safe bases are.

Further comment on better equipment maintenance and repair parts service will appear in an early issue.—EDITOR.

Cement Production

(*Concluded from p. 1139*)

country has ever used, it is impossible to utilize it.

The U. S. Geological Survey issues monthly statistics on cement production, shipments and stocks. Commenting on these statistics for August the Portland Cement Association says:

"That the portland cement industry has capacity sufficient to take care of a very marked increase in construction activity is evidenced by U. S. Geological Survey production figures for August and preceding months this year.

"Notwithstanding the inability of some companies to secure coal, which is a very important item in the cement manufacturing process (200 lb. of coal being required for manufacture of each 376-lb. barrel of portland cement), August was the best production month on record—11,664,000 bbl. being produced. This is the fourth successive month in which production has exceeded 11,000,000 bbl., and that figure had never heretofore been exceeded.

"Total production since the active construction season opened on April 1 has been approximately 55,000,000 bbl., or at the rate of 132,000,000 bbl. per year. Shipments for the best previous year on record totaled slightly under 100,000,000 bbl."

The rate of 132 million barrels a year is based on the average production of 11 million barrels a month for the five months beginning April 1, as reported by the Geological Survey. A further analysis of the Survey's figures shows stocks on hand at the beginning of the year about 13 million barrels and production in the first three months of this year 15¼ million barrels, some 17 to 18 million barrels short of the productive capacity of 11 million barrels a month for the following five months. If shipments in January, February and March had been at a rate sufficiently high to have permitted the production of all or a substantial part of the 17 or 18 million barrels just referred to, that quantity of cement would have been available later at a time of so-called cement shortage or would have been used in work earlier in the year thus reducing the later demand which was beyond the ability of cement mills to satisfy.

> Next Week
>
> Review of the developments, during 1922, in the field of Construction Equipment and Materials.

Still further analysis of the Geological Survey's figures shows that production up to the end of April was about 24½ million barrels, which added to stocks on hand at the beginning of the year of about 13 million barrels gives a total of about 37 million barrels available for shipment in the first four months of the year. Actual shipments in those four months were less than 22 million barrels, an excess of available cement over shipments of about 15 million barrels. For the next four months, from May 1 to Aug. 31, production was about 45½ million barrels and shipments about 54½ million, an excess of shipments over production of about 9 million barrels. In other words, purchasers took from cement companies in the first four months considerably less cement than was manufactured and a great deal less than the country's mills were capable of manufacturing. In the next four months they took more cement than was manufactured, a practice made possible by the fact that manufacturers carried in stock at the beginning of the year about 13 million barrels and produced in the first four months considerably more cement than purchasers allowed them to ship.

Effect of Regulation

Regulation of production, therefore, is most important in its effect on the cement purchaser who, unable to secure all the cement he wants in the late summer and early fall months, forms the opinion that the cement manufacturing capacity of the country is insufficient to supply the country's needs. That opinion is incorrect, as demonstrated by the Geological Survey's figures.

The next most important feature entering into the situation is transportation. It is a well known fact that in years of even normal business activity the railroads have difficulty in late summer and early fall in moving the traffic offered them, and in years of more than normal business activity the transportation system suffers an almost complete breakdown. In these conditions, it is clear that cement users cannot hope for as prompt deliveries in the late months as in the early months of the year. Yet they insist on demanding heavy shipments in summer and fall when deliveries are difficult to get because of lack of transportation facilities, and decline to take deliveries in winter and spring, when transportation is available.

Realizing the situation as affected both by production and by transportation, the Illinois State Highway Department is incorporating the following provision in its contracts with contractors who are to build roads next year:

Storage of Cement—It is understood and agreed that the contractor shall store during the months of January, February, March and April, 1923, not less than thirty-three and one-third (33⅓) per cent of the total amount of cement needed to complete this section, and that this rate of storage shall be maintained until the completion of the work, or until the end of the construction season of 1923.

Indiana also is incorporating a similar provision in its agreements with contractors. The highway departments of these two and other states have learned from bitter experience that they and their contractors cannot hope to carry out their extensive highway-building programs each year if they insist on trying to confine shipments of cement to the five months June to October inclusive, and decline to take out any cement in the remaining seven months.

Nor can the state highway departments alone, even if all the other states follow the lead of Illinois and Indiana, provide all the relief necessary. They can improve the situation vastly, but not relieve it entirely. The help of all other cement buyers also (dealers, railroads, industrial plants, contractors on both public and private work, all branches of federal, state and municipal government, etc., etc.) is needed.

Existing cement mills are amply able to supply the country's needs but they must be allowed to ship their output with some degree of regularity through all the months of the year. If more cement mills are built to supply the peak load in five or six months and remain idle or partly so in the other six or seven months it is inevitable that the price of cement will be higher than if the industry were conducted on a more businesslike basis. A mill running only part time cannot produce cement as cheaply as one operating continuously. The excess cost must be passed on by the manufacturer to the dealers in and users of cement.

Business Notes

FRED A. MARSH, general purchasing agent of the Link-Belt Co., Chicago, died in that city Dec. 11.

Mr. Marsh, who was 52 years old, had been a member of the Link-Belt organization for over 33 years; was one of the organizers of the Purchasing Agents Association of Chicago and served as its first president; and had been for years a director in the National Association of Purchasing Agents.

W. L. ALLEN has resigned as vice-president and general manager of Laclede Steel Co., St. Louis, Mo., to become associated after Jan. 1 with Frank H. Johnson of Chicago, Ill., in the sale of the Laclede and other steel companies' products. Mr. Allen was formerly

president of the Valley Steel Co. of East St. Louis, Ill., which was taken over by the Laclede Company in 1918. He was one of the early sales engineers of the armor plate department of Carnegie Steel Co. in the promotion of chrome-vanadium and alloy steels. He later acted as commercial engineer of the R. D. Nuttall Co. in the development of heat-treated gearings.

RICHARD H. CATLETT, formerly New England representative of the Cal Chemical Co., Inc., Hagerstown, Md., has been made general manager of that company and transferred to Hagerstown. The company will be represented in New England by William S. Simpson, Inc., distributors, Boston.

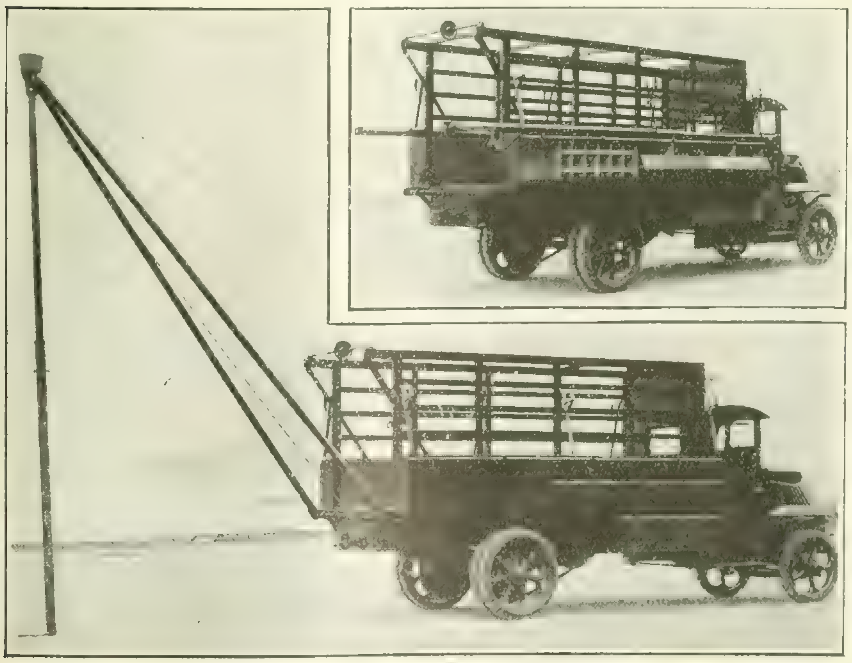
T. W. LACKIE, superintendent for the Texas Bitulithic Co. at Paris, Texas, for a number of years, is now superintendent for the West Texas Construction Co. at Abilene.

Equipment and Materials

Truck Specially Equipped for Electric Line Repair

For service on electric line repair, cable pulling, erection of poles, and general construction maintenance work, the International Motor Co., New York, has provided special equipment for its 5 and 3½-ton Mack motor trucks. One of these units is in service for the Flatbush Gas Co. of Brooklyn, N. Y. Along the sides of the body are box compartments for holding materials, such as insulators and other parts ordinarily employed in work of this sort, in addition to locker compartments for the clothing of the workmen, and a special compartment for a gas furnace plant. Underneath the floor of the truck are box compartments for heavy tools, such as crowbars, shovels, pickaxes, etc. Supports are furnished also for carrying along the side of the truck 10-ft. ladders.

One of the features of the equipment is a demountable derrick, shown in the accompanying photograph, which consists of steel tubing forming an A-frame with a vertical support as shown. This equipment is employed for erecting poles, power for hoisting being supplied by the motor truck engine. This derrick has a capacity of 3,000 lb.



Portable Air-Electric Device Drills Concrete or Stone

For drilling or chipping concrete or stone a portable drill operated by a combination of electric and compressed air power has been developed by the Pneumelectric Corp., Syracuse, N. Y. It is intended particularly for contractors, electricians, plumbers, steamfitters, and millwrights. According to statements of its manufacturer, this machine has drilled a 1-in. hole 10 in. deep in a concrete ceiling in 3 min. 22 sec. for the purpose of suspending an electric motor.

The drill is of the hammer type, striking 1,000 blows per minute and the drill steel is rotated 100 r.p.m. by positive drive from the motor. When used for chipping purposes the rotating gear is removed. The hammer is operated by air expanding in the same cylinder in which it is compressed. The motor is inclosed and when working in an upright position a dust guard and jacket are used to protect the machine from the drill cuttings. The drill weighs 56 lb.

All parts are machined and gears are of alloy steel, heat-treated, with cut teeth. The air cylinder is an aluminum casting bushed with a steel sleeve.

Publications from the Construction Industry

Rock Crushers and Screens—SMITH ENGINEERING WORKS, Milwaukee, in a 26-p. bulletin, illustrates and describes its line of rock-crushing and gravel-pit machinery. Several new sizes of Telsmith primary breakers are shown, ranging in rated hourly capacity from 12 to 325 tons. A new size of reduction crusher with a rated hourly capacity of from 30 to 45 tons with discharge openings of from 1 to 1½ in. is listed. In the Telsmith rotary screen there has been introduced a renewable steel tracker ring and angle-iron frame. Similar changes have been made in the heavy-duty washing screen and a new 24-in. size has been added. There is also announced a new line of sand-settling tanks with improved tilting discharge designed to produce a dewatered product.

Deaeration of Water—H. S. B. W.-COCHRANE CORP., Philadelphia, discusses the deaeration of water to prevent corrosion in piping, economizers and boilers, in a 15-p. booklet. The apparatus described is designed to deliver water free of dissolved oxygen, at any temperature from 140 deg. F. up, as required for hot water heating and service systems and for feeding to economizers and boilers. The method consists in heating the water by spraying in a chamber under vacuum and then vigorously agitating or scrubbing the water by blowing steam through it.

Charts are given showing the amount of iron converted into rust by water containing different amounts of oxygen, vapor pressures corresponding to water temperatures and solubilities of oxygen and nitrogen in water at various temperatures and pressures. The Winkler test for detecting dissolved oxygen in water is also described.

Trench Machine—POTTER MANUFACTURING CO., Indianapolis, Ind., features its trench machine for sewer work in a 20-p. illustrated pamphlet. The equipment consists of a carriage which operates on a track supported above the trench by steel bents, forming a long trestle. Power for operating the equipment is supplied by a hoisting engine at one end of the trestle. Buckets for the excavated material are handled from the overhead carriage. The pamphlet contains a number of photographs of the trench machine in operation on contract work.

Steel Conveyor Belts—SANDVIK STEEL, INC., New York, in a 24-p. illustrated booklet, describes its steel conveyor belts which are manufactured in one-piece lengths of from 250 to 325 ft. and various widths and thicknesses. The belts may be arranged to run either on roller supports or to slide on wood runners. The steel belt, it is pointed out, cannot be troughed in the same manner as a textile belt, but, for non-abrasive material the conveying strand may be made the bottom of a trough, with fixed sides $\frac{1}{16}$ in. clear of the belt, the carrying capacity being increased thereby from three to four times that of ordinary flat belt.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Industrial Activity Nears 1919 Peak Level

Production and Car Loadings Increased —Fewer Business Failures—Stronger Foreign Exchanges

In its ninth bi-monthly review of industrial-economic conditions in the United States, just issued, the National Industrial Conference Board says:

The recovery of business in the United States since the severe depression late in 1920 and early in 1921 has been unusually rapid, and industrial activity today is fast approaching the level at the peak of the boom of 1919-1920. General business is probably not quite up to this point, but the general situation is sound and far better than could have been reasonably expected at the beginning of 1921 or even at the beginning of 1922.

The business and industrial situation as a whole has shown a remarkable degree of improvement since the slump of 1920 and 1921. An index of industrial activity compiled by the National Industrial Conference Board and including seventeen of the principal basic industries of the United States showed that, compared with the monthly average for 1919-21 as a base, industrial activity for the month of October stood at 124.8. This compares very favorably with 65.7, the index number for January, 1921, and the low point since the beginning of 1915. The peak was reached in October, 1919 and the high point for 1922 so far was reached in June, when the index stood at 119.9.

Fundamental Conditions Sound

This index of industrial activity shows that the index rose 10 per cent from September to October and was 22.6 per cent higher in October, 1922 than in October, 1921. These facts indicate that industry has recovered much more rapidly than is generally supposed and that it is now at a very high point. In fact, it has been higher only on two occasions, namely, in July, 1918 and during the after-war boom in 1919 and 1920.

During October and November there was a steady improvement in the industrial situation. Fundamental conditions have become more sound. The evidence of this is to be found in those indices which are commonly accepted as measuring business conditions. The production of pig iron and steel ingots has increased, and during October it reached the highest point since the beginning of 1921. The unfilled tonnage of the United States Steel Corporation also rose considerably, indicating that even the increased production of iron and steel during October is by no means keeping pace with demand, which continues at a high rate. Commercial failures have decreased. Railroad car loadings have reached almost record-breaking figures; in fact, car loadings for the first ten months of 1922 are higher than for any similar period.

Prices have somewhat advanced and the tendency during the past two months, has been slightly upward. Wholesale prices have increased appreciably and in most lines seem to be firm and strong. Prices of staple raw materials have shown a considerable advance. Retail prices, however, have not as yet reflected the increase in wholesale prices and, with the exception of those of coal and food, remain almost stationary.

The agricultural crops of the country are larger than usual. Prices, however, except for cotton, are relatively low. As a group, prices of agricultural products have advanced less beyond pre-war levels than prices of any other of the principal commodity groups. This condition has caused criticism and unrest in agricultural sections of the country, where it is felt that the general prosperity of the industrial districts has not been shared.

Coal Output Normal

During October and November the coal industry again developed production to the normal amount. The danger of a serious coal famine seems past, though there may be some difficulty in distributing adequate supplies for domestic use, particularly of anthracite. Prices, however, are high and business is paying heavy toll for the recent discord in coal mining.

Money conditions have been characterized by relatively low rates of interest and re-discount, large availability of credit, increased specie reserves, and continuance of heavy investment activity. The increasing strength displayed by some of the principal foreign exchanges may be explained partly by the fact that absorption by American investors of foreign securities, both governmental and private, amounted to \$653,000,000 during the first half of 1922, compared with \$626,000,000 during the whole of 1921. The growth of commercial loans of banks and expansion in note circulation are due rather to an increase in fundamental business than to the seasonal demand of agriculture.

Foreign trade is still at a low level. Exports consist largely of raw materials, foodstuffs, and staple commodities, and those of highly manufactured merchandise are much restricted. Considerable quantities of coal and iron have been imported from abroad, but such imports are scarcely normal and with the increased production of coal and improvement in transportation, will probably largely decline.

The Near East problem continues to unsettle the international situation and has probably had some part in discouraging the development of export business.

Financial Situation

Stocks active in a professional way, with little trading by the public. Bond market dull.

Money market quiet and steady. Demand loans on the stock exchange varied from 4 to 5 per cent, compared with 3¾ to 5 per cent the week before. Time money remains at 4¾ to 5 per cent.

Steel Fabricating Shop Capacity Increased Since 1913

A considerable increase in the capacity of the structural steel fabricating shops of the United States since 1913 is shown in a special survey made by the Department of Commerce. A preliminary report, based on data received from 143 firms with a total revised capacity rating of 208,440 tons per month, shows an increase since 1913 of 45,025 tons in monthly capacity, or about 22 per cent.

The following table shows the total monthly capacity for each year as reported by the above firms, representing about 83 per cent of the present estimated capacity of the United States, and the increase over the preceding year and over 1913:

	Total Monthly Capacity	Increase over Previous Year	Increase over 1913
1913	163,415		
1914	164,265	850	850
1915	166,500	2,235	3,085
1916	170,900	4,400	7,435
1917	175,935	5,035	12,520
1918	185,060	9,125	21,645
1919	188,800	3,740	25,385
1920	194,675	5,875	31,260
1921	197,575	2,900	34,160
1922	208,440	10,865	45,025

The increase noted in the year 1922 was largely due to the entrance of ship-building concerns into the fabrication of structural steel. In this connection, the Department of Commerce points out that the capacity of structural steel shops is quite elastic in that, when not busy on structural steel, a shop is often used for tank work, railroad cars, shipbuilding, etc., and, similarly structural work may be turned out in tank shops, shipbuilding plants, etc. The capacity figures given in the report refer to that portion of the fabricating capacity that is usually used for structural work; it is capable of expansion or contraction.

The following table shows the tonnage booked each month by these firms and the percentage of their revised capacities:

	Tonnage Booked	Per Cent of Capacity*
April	193,520	91.5
May	173,588	82.1
June	154,770	73.2
July	[illegible]	68.0
August	146,621	69.3
September	137,485	65.0
October	121,150	57.3
November	99,040	46.8

* Increased percentages over previous reports for past months due to revision of capacities.

On the basis of these revised capacity reports and of known or reliably estimated capacities of other concerns, the Department of Commerce places the present capacity of the fabricated structural steel shops at 250,000 tons per month.

The capacity as reported for this survey was defined as the amount of structural steel work that actually could be turned out running single turn on the character and class of structural work that the plant ordinarily secures. Structural work was considered for this purpose as all work uses structural shapes.

A considerable seasonal decline oc-

curred in the sales of fabricated structural steel in November, according to reports received by the Department of Commerce through the Bureau of the Census. November sales amounted to 46.8 per cent of shop capacity as against 57.3 per cent reported for October.

These percentages are based on a uniform capacity rating recently reported to the Bureau by almost all the reporting fabricators. Through these new ratings, the total monthly capacity of the 140 identical firms reporting each month from April through November has been reduced from 223,685 tons to 211,510 tons.

Wholesale Prices Rising

The trend of wholesale prices of commodities was upward in November, according to information gathered in representative markets by the U. S. Department of Labor through the Bureau of Labor statistics. Measured by the Bureau's weighted index number, which includes 404 commodities or price series, the increase from the general level of the month before was 1⅓ per cent.

Farm products again lead in price increases, due to advances in grains, cotton and cottonseed, wool, etc. Prices in this group averaged 3½ per cent higher in November than in October. Food articles and cloths and clothing advanced over 2 per cent and chemicals and drugs advanced almost 2½ per cent in average price from October to November. Smaller increases were recorded for building materials, housefurnishing goods, and miscellaneous commodities.

Further decreases took place in the group of fuel and lighting materials, soft coal and coke averaging less than in the month before. Metals and metal products, due to the drop in pig iron and steel billets, also showed a decline from the October level.

Of the 404 commodities or series of quotations for which comparable data for October and November were obtained, increases were shown in 189 and decreases in 71 instances. In 144 commodities no change in price was reported.

INDEX NUMBERS OF WHOLESALE PRICES BY GROUPS OF COMMODITIES
(1913=100.)

	1921 November	1922 October	1922 November
Farm products	121	138	143
Foods	139	140	143
Cloths and clothing	180	188	192
Fuel and lighting	197	226	218
Metals and metal products	114	135	133
Building materials	163	183	185
Chemicals and drugs	129	124	127
Housefurnishing goods	178	176	179
Miscellaneous	119	120	122
All commodities	141	154	156

Comparing prices in November with those of a year ago, as measured by changes in the index numbers, it is seen that the general level has increased over 10½ per cent. Farm products show the largest increase, 18¾ per cent, with metals and metal products coming next with an incresae of 16¾ per cent. Building materials increased 13½ per cent, fuel and lighting materials 10¾ per cent, and cloths and clothing 6¾ per cent in average price in the year. Foods and miscellaneous commodities each show an increase of over 2½ per cent. A slight increase is shown for housefurnishing goods, while chemicals and drugs were cheaper than in November of last year.

Change in Examination of Immigrants Proposed

Selection of immigrants seeking admission to the United States by examination before they leave their foreign home countries was proposed by Secretary of Labor Davis in a recommendation which would revolutionize the present system of immigration examination, as set forth in the Secretary's annual report recently made public. Secretary Davis declared that the present system gives to foreign nations the privilege of selecting the immigrants whom they will permit to come to the United States.

The Secretary stated, in part, that "the passport system at the present time is, with reference to immigration, ill adapted to our needs. It is time that we ourselves had something to say—if we are to continue to rely upon alien labor for the development of our resources—about the kind of emigrants to be given the privilege of taking part in our national affairs. Instead of accepting the passport given by foreign Governments we should set a standard. Those qualified to enter should be selected on the other side and given our certificate of qualification. To accomplish this purpose legislation should be enacted providing for the examination abroad of prospective emigrants by giving the following tests:

"1. Blood: To determine the general condition of health, latent diseases, etc.

"2. A physical inventory of the strength and condition, brawn and muscle, affecting ability to earn a living.

"3. Mental: That our public institutions may not be filled with men, women, and children to whom we owe no national duty, while our own are not properly cared for; but further still, that our good American blood shall not become polluted with imbecility, insanity, and idiocy. We must keep the American race sturdy in mind as well as in body."

Texas Highway Contracts Reach Two Million in Three Months

Approximately $2,000,000 worth of paving contracts have been let during October, November and December for construction of state highways between San Antonio, Texas; points on the Rio Grande River and on the Gulf Coast, according to T. R. Spence, division engineer of the State Highway Department, in charge of State District No. 6, in which San Antonio is located. Contracts let during the week of Dec. 22, called for construction of twenty-five miles of highway in Medina County by the Kuykendall & Shelton Company of Temple, Texas, at a cost of $149,388.15; and building of two miles of road in Atacosa County, at Lytle, Texas, by the C. M. Kelly Company of San Antonio, at a cost of $16,348.32. Both contracts call for grading, graveling and drainage work. Completion of the Medina County construction will be followed by letting of contracts for placing rock asphalt topping. When the two miles in Atacosa County are finished the San Antonio-Laredo highway will be completed to the La Salle County line and contracts for hard surfacing will be let.

Extensive Improvements Announced by M., K. & T.

An extensive program of improvement involving a total expenditure of approximately $15,000,000 will soon be put into execution by the Missouri, Kansas and Texas Railway Co., according to W. H. Landman, commercial agent at Ft. Worth, Texas. The undertaking is the greatest to be announced by any of the Southwestern roads in recent years and will include vast additions and improvements along the Katy's lines. New locomotive shops are to be built at Waco, Texas at a cost of $1,500,000; the Ray freight terminal at Denison, Texas, started a year ago, will be completed at a cost of $350,000; and new freight depots will be erected at Ft. Worth, Waco, and Wichita Falls, Texas. New freight depots have recently been completed at Dallas, Texas and Oklahoma City, Oklahoma.

Lumber Industry Approaches End of 1922 in Good Condition

A composite of the views of the different softwood lumber manuacturing associations, received by wire Dec. 21, by the National Lumber Manufacturers' Association, as to the present business position of the industry, indicates a sound condition at the close of the year. On the whole transportation conditions are much improved; labor is more plentiful, although there is still a tendency toward higher wages; and demand seems to be unusually strong for what is ordinarily a dull season in the lumber industry. As weather conditions compel a degree of suspension of production in the north and on the West Coast, the new business is keeping step with production.

Shipments Improved

The Southern Pine Association wires from New Orleans that although the orders of Southern Pine manufacturers have piled up heavily because of the car supply stringency, "this situation has been generally alleviated and shipments during November were approximately 25 per cent higher than in October, and this tendency appears to be continuing. Last week's reports show record-breaking demand and reflect more favorable conditions than in any similar period of any previous year. Although it is customary for mills to let up at this time of year, our 'barometer' shows that orders received were 78 per cent higher than the average of the same week for the past four years, shipments 40 per cent larger, production 19 per cent greater. December sales prices for Southern Pine show little change from prices of sales in the preceding month but represent an advance of about 30 per cent over January 1, 1922."

The West Coast Lumbermen's Association telegraphs from Seattle: "Heavy snow and cold weather of the past ten days are responsible for the decreased production of mills. For past three days weather has been warmer with chinook wind rapidly removing snow; if it continues a few days will permit resumption of logging operations immediately after Christmas. The available log supply in the water is limited. Both domestic rail and water-borne shipments demand is good. The offshore demand continues steady and heavy inquiries are reported from lumber yards. The

car supply has been slightly better for the past three weeks but is now being curtailed by middle western snow and cold weather which are retarding the movement of empties as well as of loaded cars. It is the general understanding that demand and stock conditions will cause a shortening of customary Christmas shut-down."

The Northern Pine Manufacturers' Association wires from Minneapolis: "Of the nine mills reporting this week only four are sawing. Stocks are rather broken and two mills report them to be below normal; with the others they are normal. There is a scarcity of lower grade boards. The car supply is about sufficient to meet requirements. There is still a shortage of labor in the woods but conditions are improving and the weather is favorable to logging operations. Total shipments of Northern pine for 1922 will exceed production by from 30 to 35 million feet."

From San Francisco, the California Redwood Association wires that the labor supply is satisfactory, the car supply short but slightly better and weather conditions unfavorable, but orders and shipments still well above normal. The California and foreign demand is heavy and the eastern demand is satisfactory.

Telegraphing from San Francisco also, the California White and Sugar Pine Manufacturers' Association reports the labor supply to be normal and likewise the car and log supply. "But most mills in the California pine region are closed as usual at this season on account of weather conditions. Stocks are below normal. The largest demand is from Missouri River points."

The total number of mills reporting to the National Lumber Manufacturers' Association for the week ending Dec. 16 was 395, as against the revised number of 406 for the preceding week. Due almost, if not wholly, to weather conditions, both of a seasonal and exceptional nature, the production of these mills fell off about 18,000,000 feet from that of the preceding week.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. [illegible] costs of work can be had [illegible] actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 7; the next, on January 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.14	$3.55	$4.40	$3.02½	$3.15	$3.85	$3.25	$3.80	$3.50
Structural rivets, 100 lb.	3.85	4.60	5.25	3.75	4.00	4.80	4.75	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.04	3.55	3.45	2.92½	3.05	3.62½	3.35	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	52.50%	45%	59½%	57–5%	41%	39.2@51.8%	40%	30.00
Cast-iron pipe, 6 in. and over, ton	—54.50	46.32	+57.00	51.67	+55.50	64.11	—52.00	53.50	55.00
Concreting Material:									
Cement without bags, bbl.	2.60@2.70	2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd.	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd.	1.00	1.32	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	—2.00	1.65	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59.00	36.00	40.00	52.00	40.75	39.75	35.00	23.50	90.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	+23.50	—10.00	10.90	11.00	18@19	12.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0796	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1230	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	.93	—.97	+1.07	.95	1.01	1.08	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	......	....	.50@.55	.56¼	.50@.60	....
Common labor, non-union, hour	.45@.60	.30	.20@.50	72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2 ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags, common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Hollow tile 5¾ [illegible]. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.15). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

The general situation in the lumber market is at present very firm; with a shortage of cars as the principal factor in holding prices up. The National Lumber Trade Barometer shows production for the entire country at 17 per cent; shipments, 9 per cent and orders, 3 per cent below normal, for the week ending Dec. 22, 1922. This represents a gain of about 2½ per cent in orders; a fraction of one per cent in shipments; and a falling off of 7 per cent in output, during the week. Higher spot coke prices and firmness in pig iron, have combined to force cast-iron pipe quotations $1.50 per ton higher in Dallas and $1, in Minneapolis.

Current business on steel shapes, plates and bars, firm at $2 per 100 lb., Pittsburgh, despite weakening of market in light rails and forging billets. On especially attractive tonnages $1.90 is possible, particularly for car material. The minimum on bars, however, is placed at $1.95, and that to large buyers only.

Common brick advanced slightly in New York market during week due to sustained and unseasonal demand. Quotations now stand at $20 as against $17@20 per M., alongside dock.

Linseed oil market sluggish but prices steady in most cities. Atlanta, however, reports drop of 3c. and Dallas an advance of 2c. per gal., during week.

CONSTRUCTION NEWS

PROPOSALS

For proposals Advertised see the pages immediately following the "Construction News" Section.

WATERWORKS

Bids Close		See Eng. News-Record
Dec. 29	Phila., Pa.	Dec. 21
Jan. 2	New Ulm, Minn.	Dec. 28
Jan. 3	Rapid City, S. D.	Dec. 21
Jan. 11	Albemarle, N. C. Adv. Dec. 28	Dec. 21
Jan. 12	Cleveland, O.	Dec. 21
Jan. 15	Cyril, Okla.	Dec. 14
Jan. 22	Hinsdale, Ill.	Dec. 21
Feb. 1	Spokane, Wash.	Nov. 16

SEWERS

Dec. 30	Lakewood (Cleveland P. O.), O.	Dec. 21
Jan. 2	Wilkes Barre, Pa. Adv. Dec. 14 to 28.	Dec. 14
Jan. 3	Brooklyn, N. Y.	Dec. 28
Jan. 9	Newark, N. J.	Dec. 21
Jan. 15	St. Petersburg, Fla. Adv. Dec. 28.	Dec. 28
Jan. 15	Wash., D. C. Adv. Dec. 28.	Dec. 23
Jan. 16	Richmond, Va. Adv. Dec. 21 and 28.	Dec. 21

WASTE DISPOSAL

Jan. 24	Fargo, N. D.	Dec. 7

BRIDGES

Jan. 9	Ft. Wayne, Ind.	Dec. 28
Jan. 13	Cambridge, Mass. Adv. Dec. 28.	Dec. 28
Jan. 23	Spokane, Wash.	Sept. 21
Apr. 1	Wilkes-Barre, Pa.	Dec. 14
Sept. 1, 1923	Sydney, New South Wales, Australia	Aug. 3

DAMS

Jan. 5	Bluefield, W. Va. Adv. Nov. 30 to Dec. 28.	Nov. 30

RAILWAYS

Jan. 1	Washington	Dec. 7

EXCAVATION, DRAINAGE, IRRIGATION

Dec. 29	Logansport, Ind.	Dec. 21
Dec. 30	Greenfield, Ind.	Dec. 14
Jan. 3	Brooklyn, N. Y.	Dec. 28
Jan. 9	Glencoe, Minn.	Dec. 14

STREETS AND ROADS

Dec. 29	Long Island City, N. Y.	Dec. 21
Dec. 29	Winamac, Ind.	Dec. 21
Dec. 30	Logansport, Ind.	Dec. 21
Dec. 30	Quebec	Nov. 23
Dec. 30	Quebec	Nov. 2
Dec. 30	Quebec	Nov. 9
Dec. 30	Quebec	Nov. 16
Dec. 30	Quebec	Nov. 30
Jan. 2	St. Louis, Mo.	Dec. 7
Jan. 2	Tacoma, Wash.	Dec. 21
Jan. 2	Richmond, Va.	Dec. 28
Jan. 3	Independence, Kan.	Dec. 21
Jan. 4	Rio Vista, Calif.	Dec. 21
Jan. 4	Vincennes, Ind.	Dec. 28
Jan. 4	Marion, Ind.	Dec. 28
Jan. 4	Brooklyn, N. Y.	Dec. 23
Jan. 4	Columbia City, Ind.	Dec. 28
Jan. 5	Washington, Ind.	Dec. 28
Jan. 5	Larned, Kan.	Dec. 7
Jan. 5	Ohio	Dec. 28
Jan. 5	Elizabethtown, Ind.	Dec. 28
Jan. 6	Albion, Ind.	Dec. 28
Jan. 6	Lafayette, Ind.	Dec. 28
Jan. 7	Duluth, Minn.	Sept. 28
Jan. 8	San Diego, Calif.	Dec. 28
Jan. 9	Modesto, Calif.	Dec. 28
Jan. 10	Albemarle, N. C. Adv. Dec. 28	Dec. 21
Jan. 10	San Francisco, Calif.	Dec. 28
Jan. 10	Florida	Dec. 28
Jan. 10	Elkader, Ia.	Dec. 28
Jan. 11	Wichita, Kan.	Dec. 21
Jan. 11	Atlantic City, N. J. Adv. Dec. 28.	Dec. 28
Jan. 11	Louisiana	Dec. 28
Jan. 11	Virginia Adv. Dec. 28.	Dec. 28
Jan. 16	Michigan	Dec. 28
Jan. 23	Spokane, Wash.	Dec. 21
Jan. 24	Faribault, Minn.	Dec. 14
Jan. 25	Ft. Smith, Ark.	Dec. 28
Jan. 30	Quebec	Dec. 28

INDUSTRIAL WORK

Jan. 2	St. Louis, Mo.	Dec. 7
Jan. 4	Delaware, O.	Dec. 14
Jan. 10	Waco, Tex.	Dec. 28
Jan. 15	Great Falls, S. C.	Dec. 28

BUILDINGS

Jan. 2	Olean, N. Y.	Nov. 9
Jan. 2	Duluth, Minn.	Nov. 23
Jan. 2	Lawrence, Kan.	Dec. 14
Jan. 2	Providence, R. I.	Dec. 21
Jan. 2	Rome, Ga.	Dec. 21
Jan. 2	Dover, Del.	Dec. 21
Jan. 3	Cleveland, O.	Dec. 14
Jan. 3	Farmersville, O.	Dec. 21
Jan. 3	Baltimore, Md.	Dec. 28
Jan. 4	Arlington, O.	Dec. 14
Jan. 4	Baker, La.	Dec. 14
Jan. 5	Bath, N. Y.	Dec. 14
Jan. 5	Detroit, Mich.	Dec. 21
Jan. 6	Newark, N. J.	Dec. 21
Jan. 10	Nashville, Tenn.	Dec. 7
Jan. 10	Grand Rapids, Mich.	Dec. 21
Jan. 10	Baltimore, Md.	Dec. 28
Jan. 11	Elizabeth, N. J.	Dec. 14
Jan. 15	Dallas, Tex.	Dec. 21
Jan. 19	Monticello, Ia.	Dec. 21
Feb. 1	Chicago, Ill.	Dec. 21
Mar. 23	Shreveport, La.	Nov. 9

FEDERAL GOVERNMENT WORK

Dec. 30	Power House — Huntington, W. Va. Adv. Dec. 7 to 28.	Dec. 7
Dec. 30	Dredging Pump—Florence, Ala. Adv. Dec. 7 to 28.	Dec. 7
Jan. 3	Piers—Pearl Harbor, H. T.	Nov. 16
Jan. 3	Drainage System—Del Rio, Tex.	Dec. 14
Jan. 3	Alterations—El Paso, Tex.	Dec. 21
Jan. 5	Dredge—Cincinnati, O. Adv. Dec. 7 to 28.	Dec. 7
Jan. 9	Fuel Oil—Wash., D. C.	Dec. 21
Jan. 9	Extension — St. Cloud, Minn.	Dec. 21
Jan. 10	Extension—Elmira, N. Y.	Dec. 21
Jan. 12	Remodeling—Boston, Mass.	Dec. 21
Jan. 15	Metal Work — Key West, Fla. Adv. Dec. 21 and 28.	Dec. 21
Jan. 15	Pipe Line Dredge—Cincinnati, O.	Dec. 14
Jan. 15	Dredging—Virginia	Dec. 28
Jan. 15	Scows—Wilmington, Del. Adv. Dec. 28.	Dec. 28
Jan. 15	Scows—Phila., Pa.	Dec. 28
Jan. 16	Hospital—Tacoma, Wash. Adv. Dec. 14 to 28.	Dec. 14
Jan. 16	Hull—Nashville, Tenn. Adv. Dec. 21 and 28.	Dec. 21
Jan. 17	Dredging—Phila., Pa.	Dec. 28
Jan. 17	Piers—Astoria, Ore.	Dec. 28
Jan. 18	Remodeling—Boston, Mass. Adv. Dec. 28.	Dec. 28.
Jan. 18	Furnishing and Placing Rock —New Orleans, La.	Dec. 21
Jan. 22	Bridges—Alaska	Dec. 28
Jan. 23	Lock Operating Machinery, etc. — Huntington, W. Va. Adv. Dec. 28.	Dec. 28
Jan. 24	Levee Work—St. Louis, Mo. Adv. Dec. 28.	Dec. 28
Jan. 24	Refrigerating and Ice-Making Plant—Pearl Harbor, H. T.	Dec. 14
Feb. 15	Furnishing Stone, etc.—Crescent City, Calif.	Dec. 28

MISCELLANEOUS

Dec. 29	Crane—Phila., Pa.	Dec. 21
Dec. 29	Coal Handling Equipment — Phila., Pa.	Dec. 21
Dec. 29	Motor Trucks—Long Island City, N. Y.	Dec. 21
Dec. 30	Grain Elevator—Port Arthur, Ont.	Dec. 21
Dec. 30	Asphalt, Crushed Stone, Sand, etc.—Phila., Pa.	Dec. 28
Dec. 31	Crushed Stone — Toronto, Ont.	Dec. 21
Jan. 1	Transmission Line—Spokane, Wash.	Nov. 9
Jan. 2	Steel Water Pipe, etc.—Terra Bella, Calif.	Dec. 21
Jan. 2	Road Levee and Bridge—Redwood City, Calif.	Dec. 28
Jan. 3	Portland Cement — Wisconsin	Dec. 28
Jan. 3	Motor Gasoline — New York, N. Y.	Dec. 28
Jan. 8	Rock Crusher and Grader — Minneapolis, Minn.	Dec. 28
Jan. 8	Wharf—Detroit, Mich.	Dec. 28
Jan. 9	Gravel—Louisiana	Dec. 28
Jan. 11	Structural Steel—New Orleans, La.	Dec. 21
Jan. 15	Bulkhead — Jersey City, N. J. Adv. Dec. 21 and 28.	Dec. 21
Jan. 31	Dry Dock Machinery—Esquimalt, B. C	Dec. 21

Where name of official is not given inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

O., Bexley (Columbus P. O.) — See "Streets and Roads.'

O., Fairview—Preparing plans 12,000 ft. 6 in. and 21,000 ft. 12 in. c.i. mains. $70,000. Frazier-Ellms-Sheal Co., 2000 B. F. Keith Bldg., Cleveland, engrs. Noted Oct. 19.

Mich., Jackson—Plans new pumping station. $150,000. Engineer not selected.

Ill., Lyons—See "Sewers."

Ind., Bloomington — Having plans prepared new water supply system. $600,000. Pearce, Greeley & Hansen, 39 West Adams St., Chicago, engrs.

Wis., Iron River—Iron River Water & Light Co. plans to rebuild pump house and power plant, brick, rein.-con. and steel, plain foundation, and 2 rein.-con. and steel dams, recently destroyed by flood. $150,000. L. H. Callahan, mgr. Architect not selected.

Wis., Racine—Having plans prepared new waterworks intake, 7,000 ft. 36 in. c.i. pipe, crib and intake well. $280,000. Alvord, Burdick & Howson, 8 South Dearborn St., Chicago, engrs.

Tex., Highland Park—Jan. 16 to vote on $125,000 bond issue for extensive waterworks improvements. M. Costello, city secy.

Okla., Canton — Had plans prepared waterworks system, incl. tank, tower, mains, well and pumping equipment. $53,000. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs. Noted Nov. 2.

Okla., Clinton—Having plans prepared water works and electric light extensions. $45,000. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs.

Okla., Guthrie—Voted $22,000 bonds for extending waterworks and $18,000 bonds for sewers. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs. Noted Nov. 2 under Sewers.

Okla., Nowata—Jan. 23, to vote on $111,000 bonds, new pumps, 2,000,000 gal. reservoir, power plant and mains. Engineer not selected.

Okla., Pauls Valley—Having plans prepared waterworks extensions incl. complete new supply and filter plant. $165,000. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs.

Okla., Poteau—Voted $15,000 bonds for replacing present mains with c.i. pipe and extending present system. J. E. Davis, Poteau, engr.

Okla., Roosevelt—Plans water purification plant, mains, etc. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs.

Okla., Snyder—Having plans prepared waterworks extensions. $15,000. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs.

Okla., Weatherford — See "Industrial Works."

Okla., Wetumka — Had plans prepared water purification plant, mains and pumping equipment. $83,000. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs.

Wash., Usk — W. F. Cochrane plans canals, pumping plant, diversion dam, dike, concrete pipe line. $35,000. R. M. Sandersen, South 321 Lincoln St., Spokane, engr.

Waterworks (Continued)

Ore., The Dalles—[illegible] 8 mi. 16 in. pipe, and new high level reservoir. $375,000. Contract will probably be let next spring. Stevens & Koon, Spalding Bldg., Portland, engrs.

Calif., Palo Alto—[illegible] works system. J. F. Byxbee, Jr., city engr.

Ont., Brantford—Having plans prepared waterworks pumping plant. F. Adams, city engr. $30,000. Prices wanted on equipment.

Ont., Galt—City retained James, Proctor & Redfern, engrs., 36 Toronto St., Toronto, to report on waterworks system. It is probable that new mains will be laid and more pumps installed. $[illegible].

Ont., Lansing—North York Twp. having plans prepared waterworks system, incl. pumps, pumphouse, c.i. mains, hydrants, valves, reservoir and tank. $125,000. James, Proctor & Redfern, 36 Toronto St., Toronto, engrs.

Ont., Sandwich—See "Streets and Roads."

Ont., Ottawa—Plans water main extensions in Burnham Rd. $2,620, Letchworth Rd. $2,500, Beckwith Rd. $3,230, Glengarry Rd. $2,980, Belgrave Rd. $2,950, Bower St. $4,100, Clegg St. $2,500, Onslow Crescent $4,220, Leonard Ave. $715. A. F. Macallum, city engr.

Ont., Shawville—Takes bids [illegible] building waterworks system. I. D. McCrea, Ottawa (street address not available), engr.

Ont., Scarboro—Scarboro Twp. plans to expend $34,000 on new waterworks area, incl. 8,000 ft. 12 in. c.i. trunk. C. E. Fraser, twp. engr.

B. C., Vancouver—Voted $50,000 by law and soon takes bids for waterworks. C. E. Tisdall, mayor.

BIDS DESIRED

Minn., New Ulm—Jan. 2 by H. Hunvelmann, supt. Waterworks Dept., pump equipment for well, 250 g.p.m. pump. F. D. Manum, city engr.

Que., Greenfield Park—Mayor taking bids till end of January for 13,820 ft. watermains in several streets. $34,327. A. Vincent, Longueil, engr.

BIDS RECEIVED

N. Y., Brooklyn—Bd. Water Supply, Municipal Bldg., New York, opened bids Dec. 19, constructing Mt. Prospect conduit a portion of city conduits of Catskill aqueduct from Shaft 24 of city tunnel in Ft Greene Park, along Cumberland St., Lafayette, Washington and Flatbush Aves., to Clarkson Ave., here, from A. Paino, 32 Court St., $995,305 Beaver Eng. & Contg. Co., 51 Chambers St., New York, $995,355; T. A. Gillespie Co., 5 Dey St., New York, $1,013,656. Noted Nov. 30.

CONTRACTS AWARDED

Mich., Detroit—Furnishing and installing 289,000 bronze strainer caps for strainer system of filtration plant, to Michigan Valve & Fdry. Co., 13631 Parkinson St., $30,400. Noted Nov. 16.

Mich., Detroit—Water Bd. will lay [illegible] ft. 6 in. and 1,000 ft. 8 in. c.i. mains in Jane, Robinwood, Josephone, Buena Vista, Meadowbrook, Larkins and Harding Aves., by day labor. $15,000. T. A. Leisen, Water Works Park, engr.

Que., Montreal—[illegible] x 58 x 103 ft. rein.-con., brick and steel distribution control building for new pumping station, Atwater Ave., to E. G. M. Cape & Co., Cathcart St., $167,000. Noted Dec. 14.

WATERWORKS—CLEVELAND, O.

Following are lowest three bids opened Dec. 1, by Dept. of Pub. Utilities, Div. Water, for furnishing and laying Park Lane, Carnegie Ave. and Frank Ave. mains, Baldwin-Fairmount Project, Contr. No. 17. (A) D. Lowensohn, Davis & Farley Bldg. (awarded contract); (B) P. F. Connolly, Commonwealth Bldg.; (C) Stange-Walsh Constr. Co., 2315 Fairmount Rd. The unit bids were as follows:

	A	B	C
[illegible]	$2.40	$3.24	$3.15
[illegible] place	30 00	50 00	20 00
[illegible] bell and spigot pipe	71 00	69 90	70 00
[illegible] bell and spigot standard fittings	165 00	150 00	150 00
[illegible] bell and spigot special fittings	170 00	150 00	165.00
[illegible] by the city	250 00	100 00	200 00
Setting eleven 36-in. gate valves, furnished by the city	200.00	75.00	150.00
Setting two 30-in. gate valves, furnished by the city	150.00	75.00	125.00
Setting one 24-in. gate valves, furnished by the city	125.00	75.00	100.00
Setting one 16-in. gate valve, furnished by the city	100.00	50.00	75.00
[illegible]	27 00	30 00	27 00
25 cu.yd. concrete masonry	27.00	20.00	27.00
1,000 lb. steel reinforcement and miscellaneous wrought iron	.07	.10	.06
100 lin.ft. furnishing and laying 12-in. vitrified pipe drains	3.00	3.50	2.50
200 lin.ft. furnishing and laying 6-in. vitrified pipe drains	1.25	2.00	1.50
Furnishing and setting eight 2-in. brass drains; and setting 2-in. valves and valve boxes, furnished by the City	50.00	50.00	50.00
200 lin.ft. furnishing and laying 2-in. galvanized iron pipe	1.25	1.00	1.00
Estimated total	$234,690	$238,819	$239,460

Sewers

PROPOSED WORK

O., Bexley (Columbus P. O.)—Preparing plans 8 in. concrete sewer in various alleys. $16,000. Jennings-Lawrence Co., Hartman Bldg., Columbus, engrs.

O., Bexley (Columbus P. O.) — See "Streets and Roads."

Ind., Miller — Plans sewerage system. $300,000. W. P. Cottingham, Gary, engr.

Ill., Lyons—Making plans and takes bids about Jan. 29 for sewer and waterworks project. $130,000. E. Hancock, 2047 Ogden Ave., Chicago, engr.

Ia., Mechanicsville — Takes bids about Feb. 1 [illegible] Currie Eng. Co., Webster City, engrs. Noted Dec. 21.

Kan., Jetmore—See "Streets and Roads."

Kan., Wichita — Resolution passed for storm sewers in Dist. 24. $120,000. P. L. Brockway, city engr.

Tex., Rosenberg—Jan. 10 to vote on $50,-[illegible] sewer-[illegible] E. E. Sands, Mason Bldg., Houston, consult. engr.

Okla., Guthrie—See "Waterworks."

Colo., Denver—Takes bids about Jan. 10, 26,000 ft. 8-10 in. concrete pipe sewer. $34,-000. A. K. Vickery, City Hall, engr. Noted Nov. 23.

Wash., Pullman—Having plans prepared sewerage system $[illegible]. C. H. and H. S. Green, Nо17 Lincoln St., Spokane, engrs.

Calif., Palo Alto—Plans election to vote on $50,000 bonds extending sewerage system. J. F. Byxbee, Jr., city engr.

Calif., San Mateo — See "Streets and Roads."

Que., Montreal—Plans 6 mi. of 12 ft. sewer from north end of city to Cartierville. $500,000. E. Fusie, supt. Sewer Dept.

Ont., Gravenhurst — Having plans prepared sewerage system and concrete sewage disposal plant, vitr. tile pipe 8 in. [illegible] James, Proctor & Redfern, 36 Toronto St., Toronto, engrs.

Ont., Hamilton—Had plans prepared complete intercepting sewerage system and sewage disposal plant, $2,500,000. First report calls for expenditure of $300,000 for sewage disposal plant, rein.-con. tanks and sedimentation tanks, at west end of city. E. R. Gray, city engr. Gore, Nasmith & Storrie, Confederation Life Bldg., Toronto, consult. engrs.

Ont., Sandwich—See "Streets and Roads."

Ont., Toronto—See "Streets & Roads."

BIDS DESIRED

N. Y., Brooklyn—Jan. 3, by E. Riegelmann, boro pres., Boro Hall, sewers in 40th, East 10th, Malta and Bristol Sts., Vanderbilt and Hegeman Aves., Lenox Rd., and Rutherford Pl.

D. C., Wash.—Jan. 15 by Dist. Comrs., 509 Dist. Bldg., for 660 ft. sewer; adv. this issue.

Fla., St. Petersburg—Jan. 15, at office [illegible] mechanical equipment for sewage screening plant; adv. this issue.

Mich., Lansing — Taking bids storm [illegible] ft. 66 in., 4,816 ft. 60 in., 672 ft. 54 in., 391 ft. 48 in., 506 ft. 30 in. and 663 ft. 24 in. rein.-con. or segmental block pipe. $130,000. Private plans.

Calif., San Francisco—T. McDougall (Star [illegible] St., receiving bids 2 story, rein.-con. addition to garage. $60,000. J. L. Stewart, Claus Spreckels Bldg., archt. Noted Nov. 23.

CONTRACTS AWARDED

N. Y., Syracuse—[illegible] alternate bids for electric driven sewage pumps, received Oct. 10, are given on page 1121. The bids were for motors and equipment of the slip-ring against the brush-shifting type and were compared on the basis of yearly capi-[illegible] annual charges for current.

Pa., Pittsburgh—To T. Cronin Co., South 18th St., sewers in Ravenna and Spohr [illegible] Williams and [illegible] South Dallas and [illegible], $61,554.

Mont., Winnett—[illegible] trunk and lateral sewer, to Two Miracle Concrete Co., Ford Bldg., Great Falls, $37,000.

Ont., Hamilton—G. C. Coppley, chn. Bd. Control, 2,480 ft. sewer in King and McKittrick Sts., to Hamilton Contg. Co., Home Bank Bldg., $61,770. Noted Nov. 30.

Ont., Toronto—To Murphy Contg. Co., Toronto, (street address not available), sewers in Farnum Ave. $5,760, Balmoral Ave. $7,940, Grenadier Rd. $3,552; to John McKnight Constr. Co., 88 St. Davids St., sewer extension in Dundas St. $2,285; to Natl. Contg. Co., 9 Garnock Ave., sewer in Riverdale Ave. $2,158, Duplex Ave. $5,898; to F. F. Fry Ltd., 43 Scott St., sewer in Blvd. Drive $20,312. Work involves 10,000 ft. 8-12 in. glazed tile sewers.

Ont., Toronto—Furnishing two 2,880,000 gal. centrifugal electric sewage pumps, and one Venturi meter, to John Inglis Co. Ltd., Strachan Ave., $14,171.

Waste Disposal

PROPOSED WORK

Calif., Fresno—Soon takes bids garbage disposal, bids for collection and disposal, separate bids for collection, city to provide for disposal, by either incinerator or sanitary fill method. W. Stranahan, city comr. pub. wks.

BIDS RECEIVED

Pa., Allentown—M. W. Gross, mayor, Room 301 City Hall, opened bids Dec. 18, garbage incinerator, from Davis Garbage Furnace Co., 110 West 40th St., New York City, $20,594; Roberts-Filter Mfg. Co., Darby, $49,500; Universal Destructor Co., Fulton Bldg., Pittsburgh, $70,000. Noted Nov. 23.

CONTRACTS AWARDED

N. Y., Mayfield—Water system, to H. W. Golden & Son, Inc., Troy, $32,629; steel water tank, to Pittsburgh Des Moines Steel Co., Curry Bldg., Pittsburgh, Pa., $11,000. Noted Oct. 12.

Bridges

PROPOSED WORK

N. Y., Binghamton—Plans 3 span concrete arch bridge from Riverside Dr. to Water St. $375,000. W. E. Weller, Municipal Bldg., engr.

Pa., Pittsburgh—Allegheny Co. having plans prepared rein.-con. bridge 750 ft. main span, with 310 ft. concrete approaches and abutments, California Ave. over Jacks Run to connect city with Bellevue. $400,000. V. R. Covell, Court House, engr.

W. Va., Huntington — Huntington Ohio Bridge Co., c/o W. E. Kellegen, Huntington, plans steel toll bridge over Ohio River, 2 or 3 steel trusses, concrete posts, 2,000 ft. span, double deck, concrete flooring. C. A. Turner Co., Jewelers Exch., Minneapolis, Minn., engrs.

O., Akron—Having plans prepared 700 ft. steel deck girder bridge encased in concrete, 60 ft. wide, 36 ft. roadway, 12 ft. walks on each side, on State St., $250,000; plans three through plate steel girder bridges encased in concrete, 88 ft. wide, with 58 ft. roadway and two 15 ft. walks, over Baltimore & Ohio, Pennsylvania, and Erie Rail Roads on Exchange St., $250,-000; through plate girder bridge encased in concrete, 38 ft. roadway and two 14 ft. walks over Baltimore & Ohio, Pennsylvania, and Erie Rail Roads on Center St., $175,-000; wood trestle as temporary bridge while new Exchange and Center St. bridges are being built, $50,000; plans prepared for rein.-con. trestle, concrete beam and slab top, on West Market St., $180,000. E. A. Kemmler, Delaware Bldg., engr.

Bridges (Continued)

Kan., Jetmore—See "Streets and Roads."

Kan., Sedan—Chautauqua Co. has plans prepared 120 ft. steel truss span (known as Ford Bridge). C. E. Sperry, Sedan, engr.

Mo., Kansas City—Kansas City Terminal Ry. Co. having plans prepared 1,470 ft. steel and rein.-con. railway and highway bridge; curved bridge $300,000, straight bridge $400,000. J. V. Hanna, ch. engr.

Okla., Pauls Valley—Voted $32,000 bonds for 270 ft. rein.-con. bridge, concrete piers. T. B. Mathews, Durant, engr.

Wash., La Center — State Hy. Comn., Olympia, having plans prepared steel and concrete bridge, viaduct type, about 1,000 ft. long, across east fork of Lewis River on Pacific Highway, south of here. $100,000. J. Allen, state highway engr.

Ontario—See "Streets and Roads."

Ont., Prairie Siding—Kent Co. plans 375 ft. steel lift bridge, about 20 ft. wide, here. $125,000. Kellar & Harrington, Chicago, Ill. (street address not available), engrs.

Ont., Toronto—W. A. Clarke, clk. York Twp., 40 Jarvis St., receiving competitive sketches and plans for 200 ft. rein.-con. arch highway bridge to connect Astley Ave. and Oakdale Crescent. $135,000.

BIDS DESIRED

Mass., Cambridge—Jan. 13, by L. M. Hastings, city engr., furnishing and erecting single leaf movable draw span for 1st St. Bridge over Broad Canal; adv. this issue.

Virginia—See "Streets and Roads."

Florida—See "Streets and Roads."

Ind., Ft. Wayne—Jan. 9, by Auditor Allen Co., steel girder bridge on Coldwater Rd., 111 ft. long, 20 ft. wide. A. W. Grosvenor, Ft. Wayne, engr.

Calif., Redwood City—See "Miscellaneous."

BIDS RECEIVED

North Carolina—State Hy. Dept., Raleigh, constructing rein.-con. bridges and culverts on State Project 201, Carteret Co., from Boney & Hostetler, Williamston, $24,956, Batson-Cook Co., West Point, Ga., $25,396, O. A. Mann & Co., La Grange, Ga., $29,271; constructing 3 rein.-con. bridges on State Project 256, Lenoir Co., from Englehard & Kuelin, Camp Bragg, $52,553, Cornell-Young Co., 4th Natl. Bank Bldg., Macon, Ga., $53,720, Rhyne & Kitchen, Blacksburg, S. C., $57,268; rein.-con. bridge with steel draw span, over Roanoke River at Edwards Ferry, State Project 138 B, Northampton Co., from Pensacola Shipbuilding Co., Amer. Natl. Bank Bldg., Pensacola, Fla., $349,688, Hardaway Constr. Co., 909 Elizabeth Ave., Charlotte, $350,679, Atlantic Bridge Co., Roanoke, Va., $356,102. Noted Nov. 30, under Streets and Roads.

Ohio—See "Streets and Roads."

Kan., Columbus—Cherokee Co., 2 rainbow arch bridges, one 80 ft. other 130 ft., concrete abutments, near Baxter Springs, from Harrison Eng. Corps, Wichita (street address not available) $35,414; Maxwell Constr. Co., Columbus, $37,855; Koss Constr. Co., 2818 5th St., Des Moines, Ia., $41,569. Noted Dec. 7.

S. D., Yankton—Meridian Hy. Bridge Co., opened bids Dec. 11, steel superstructure for double deck bridge 5,820 ft., incl. approaches, 1,680 ft. span length over Missouri River, from Amer. Bridge Co., 208 South LaSalle St., Chicago, $362,570; Mt. Vernon Bridge Co., Mt. Vernon, O., $366,370; Bethlehem Steel Co., Bethlehem, $381,350. Noted Nov. 30.

Missouri—State Hy. Dept., Jefferson City, opened bids Dec. 2, (1) one 20 ft. rein.-con. slab span, 20 ft. roadway, concrete abutments, over Meeks Branch on road from Neosho to Arkansas State line, State Project Route 1, Sect. 106, Newton Co. (2) three 30 ft. rein.-con. deck girder spans, 20 ft. roadway, concrete abutments and piers over Cedar Creek on road from Neosho to Joplin, State Project Route 1, Sect. 104, Newton Co. (3) one 55 ft. steel truss, one 35 ft. and one 45 ft. I-Beam spans, 20 ft. roadways, concrete abutments, on road from Malden to Risco, State Project Route 82, Sect. 3, New Madrid Co. (4) one 160 ft., one 80 ft. and one 60 ft. steel truss spans, concrete substructure, 20 ft. roadway, over north fork of White River on road from Gainesville to West Plaines, Federal Aid Project 111, Sect. C, Ozark Co. (5) ten 20 ft. I-Beam spans, 20 ft. roadway, cresoted wood pile bent substructure, over overflow of Crooked River on Sta. 364 plus 95 on road from Richmond to Carrollton, State Project 10, Sect. 13, Ray Co. (6) two 160 ft. and one 80 ft. steel truss spans, 20 ft. roadway and f. r [illegible] ft rein.-con. deck girder spans, concrete substructure, over Big Piney River, on Sta. 5 plus 135 on road from Springfield to St. Louis, State Project Route 14, Sect. 45, Pulaski Co. (7) two 20 ft. rein.-con. slab spans, 20 ft. roadway, 2 rein.-con. abutments, 1 concrete pier, on Sta. 7 plus 29 on road from Springfield to St. Louis, State Project Route 14, Sect. 76, St. Louis Co., (8) one 14 ft. rein. con. slab, one 80 ft., one 60 ft. and two 50 ft. steel truss spans, 20 ft. roadways, concrete substructures, on road from St. Louis to Kansas City, State Project Route 2, Sect. 71, St. Charles Co. (9) three 60 ft. steel truss and two 20 ft. rein.-con. slab spans, 20 ft. roadway, concrete substructure on Sta. 440 plus 00 on road from Centerville, to Ellington, State Project Route 21, Sect. 25, Reynolds Co. (10) one 20 ft. rein.-con. slab span, 20 ft. roadway, etc. on Sta. 26 plus 30, on road from Memphis to Edina, State Project Route 15 Sect. 4, Scotland Co. (11) one 16 ft. rein.-con. slab span, 20 ft. roadway, etc. over branch of Brush Creek, on Sta. 119 plus 83, on road from Jefferson City to Eldon, State Project Route 15, Sect. 56, Miller Co. (12) two 60 ft. steel truss spans, 18 ft. roadway, concrete piers and abutments, over Wild Cat Creek, on Sta. 22 plus 01.3 on road from Princeton to Trenton, State Project Route 3 Sect. 6, Mercer Co. (13) one 80 ft., one 60 ft. and one 50 ft. steel truss, eight 20 ft. rein.-con. slab and one 30 ft. rein.-con. deck girder spans, 20 ft. roadway, on road from Chillicothe to Trenton, State Project Route 3, Sect. 16, Livingston Co. (14) one 30 ft. rein.-con. deck girder span, 20 ft. roadway, concrete abutments, on Sta. 273 plus 55, on road from Jefferson City to Eldon, State Project Route 15, Sect. 56, Miller Co. (15) one 40 ft. I-Beam span, 20 ft. roadway, rein.-con. abutments on Sta. 647 plus 80 on road from Charleston to New Madrid, State Project Route 55 A, Sect. 2, Mississippi Co. (16) one 50 ft. one 100 ft. and one 120 ft. steel truss spans, 20 ft. roadway, rein.-con. abutments, etc. on road from Kansas City to St. Louis, State Project Route 2, Sect. 7, Lafayette Co. (17) two 160 ft., one 120 ft. and one 80 ft. steel truss and five 20 ft. rein.-con. slab spans, 20 ft. roadway, etc. on road from Kansas City to Springfield, State Project Route 14, Sect. 38, Laclede Co. (18) one 20 ft. rein.-con. slab span, 20 ft. roadway, concrete abutments, on Sta. 111 plus 39 on road from Lone Jack to Warrensburg, State Project Route 12 Sect. 5, Johnson Co. (19) one 25 ft. rein.-con. deck girder span, 20 ft. roadway, rein.-con. abutments, over Skunk Creek, on Sta. 206 plus 60, on road from Warrensburg to Clinton, State Project Route 13, Sect. 26, Johnson Co. (20) one 30 ft. and one 40 ft. rein.-con. deck girder spans, 20 ft. roadways, 4 rein.-con. abutments, on road from Warrensburg to Clinton, State Project Route 13, Sect. 27, Johnson Co. (21) one 25 ft. rein.-con. deck girder and three 50 ft. steel truss spans, 20 ft. roadways, etc., on road from St. Louis to Kansas City State Project Route 2, Sect. 6, Jackson Co. (22) two 20 ft. rein.-con. slab, one 60 ft., one 100 ft. and two 50 ft. steel truss spans, 20 ft. roadways, concrete piers and abutments, on road from St. Louis to Kansas City, State Project 2, Sect. 4, Jackson Co. (23) one 80 ft. steel truss and two rein.-con. slab spans, 20 ft. roadway, concrete abutments and piers, over middle fork of Tebo Creek, on Sta. 31 plus 60 on road from Windsor to Clinton, State Project Route 24 Sect. 4, Henry Co. (24) one 20 ft. and two 60 ft. steel truss spans, 20 ft. roadways, rein.-con. abutments and piers, over Big Creek on Sta. 23 plus 80, on road from Bethany westward, State Project Route 4, Sect. 34, Harrison Co. (25) one 80 ft. steel truss and two 20 ft. rein.-con. slab spans, 20 ft. roadway, concrete piers and abutments, over dry fork of Merramec River, on Sta. 349 plus 59 on road from Salem to Licking, State Project Route 32, Sect. 4, Dent Co. (26) one 40 ft. rein.-con. deck girder and one 50 ft. steel truss spans, 20 ft. roadways, concrete abutments, over Spring Creek on road from St. Louis to Springfield, State Project Route 14, Sect. 66, Franklin Co. (27) one 30 ft. rein.-con. deck girder and two 20 ft. rein.-con. slab spans, 20 ft. roadway, concrete piers and abutments, over Linley Creek, on Sta. 827 plus 70 on road from Bolivar to Buffalo, State Project Route 15, Sect. 80, Dallas Co. (28) one 40 ft. rein.-con. deck girder and one 20 ft. rein.-con. slab spans, 20 ft. roadway, etc., on road from Jefferson City to Tuscumbia, State Project Route 15 Sect. 52, Cole Co. (29) one 30 ft. rein.-con. deck girder, one 50 ft. and one 60 ft. steel truss spans, 20 ft. roadways, concrete abutments, on road from Jackson to Perry Co. line, State Project Route 25 Sect. 19, Cape Girardeau Co., from J. P. Wolfenbarger, Neosho, (1) $6,283; Wimstead & Gonter, Siloam Springs, Ark. (1) $6,440; Allhands & Davis, 705-6 Frisco Bldg., Joplin, (1) $6,458 (2) $9,936 (27) $9,152; Independent Constr. Co., Pittsburg, Kan. (2) $9,068; Koss Constr. Co., 2818 5th Ave., Des Moines, Ia., (2) $9,890 (21) $21,992 (22) $36,511; A. Creek, Gideon, (3) $12,909; Novaculite Constr. Co., Marion, Ill., (3) $12,363 (15) $4,832; Pioneer Constr. Co., 101 New York Life Bldg., Kansas City, (4) $46,476 (17) $77,724; Parham Constr. Co., East St. Louis, Ill. (4) $61,026 (6) $62,384; Natl. Constr. Co., Inc., Kansas City (street address not available) (5) 90,318; Cook & O'Brien Constr. Co., 305 Ry. Exch. Bldg., Kansas City, (5) $8,018; A. Hood, Independence, (5) $8,070; M. E. Gillioz, Monett, (6) $62,718; Kansas City Bridge Co., 510 Orear-Leslie Bldg., Kansas City, (6) $62,962; Moreno-Burkham Constr. Co., 1213 Syndicate Trust Bldg., St. Louis, (7) $8,162 (8) $45,757; Louis Rich Constr. Co., East St. Louis, Ill., (7) $6,684; S. M. Timberlake Co., 236 Amer. Central Life Bldg., Indianapolis, Ind., (7) $6,622 (8) $39,148; Alzina Constr. Co., Unity Bldg., Springfield, Ill. (8) $39,905 (22) $40,102; E. A. Luck, Black Rock, Ark., (9) $32,375; Coopers Constr. Serv. Co., Federal Reserve Bank Bldg., St. Louis (9) $23,406; Muskogee Contg. Co., Muskogee, Okla. (9) $25,169; W. H. and G. H. Turner, Memphis, (10) $5,842; F. F. O'Dell, Farmington, (10) $6,404; Fogleman & Thompson, Eugene, (11) $2,559 (14) $4,034; Massman-Scott Constr. Co., 3663 Madison Ave., Kansas City, (11) $2,662 (14) $4,163; Doehla-Kolkmeyer, Jefferson City, (11) $2,719 (28) $12,828; Pittsburg-Des Moines Steel Co., Tuttle and Southwest 10th Sts., Des Moines, Ia., (12) $12,972 (13) $57,296; Monarch Eng. Co., Falls City, Neb., (12) $13,822; Illinois Steel Bridge Co., 608 Laclede Gas Bldg., St. Louis, (13) $53,207 (25) $16,185; Campbell Bros., Kansas City (street address not available), (13) $55,539; J. W. Newton, Eldon, (14) $4,528; R. F. Williams, Wyatt, (15) $5,301; Keeley Bros. Constr. Co., 2100 State St., East St. Louis, Ill., (15) $4,829; Spitcaufsky Bros., 2452 Benton Blvd., Kansas City, (16) $44,239; F. E. Marsh & Co., Des Moines, Ia. (street address not available), (16) $47,199; J. O. Patterson, 310 Ridge Bldg., Kansas City (16) $48,674; Wausau Iron Wks., Wausau, Ia., (17) $78,390; General Constr. Co., Syndicate Trust Bldg., St. Louis, (17), $78,499 (25) $16,176; J. E. Ridge, Warrensburg, (18) $7,174; A. T. Cook, Ottawa, Kan., (18) $7,196 (19) $7,278 (20) $12,377; J. W. Wilson, Warrensburg, (18) $7,677; G. A. Woods Constr. Co., Smithville, (19) $8,184 (20) $16,123; C. T. Johnson, Warrensburg, (19) $8,207; Maxwell Constr. Co., Columbus, Kan., (20) $15,053; Harrison Eng. & Constr. Co., Wichita, Kan., (street address not available) (21) $22,075 (22) $37,215; J. J. Dunnegan, Shenandoah, Ia., (21) $24,855; Harrison Constr. Co., Des Moines, Ia. (street address not available), (23) $16,013; A. M. Highnote, Columbus, Kan., (23) $16,734; Carterville Constr. Co., Carterville, (23) $16,901; Rand Constr. Co., 1007 New York Life Bldg., Kansas City (24) $27,547; C. T. Fogle Constr. Co., Jefferson City, (25) $16,241; Frazier Davis Constr. Co., Arcade Bldg., St. Louis, (26) $14,802; Felix Kersting Co., Jefferson City, (26) $15,611 (28) $12,094; C. F. Johnson & Son, Buffalo, (27) $8,886; J. E. Hartley, Mt. Vernon, (27) $9,386; Carroll, Bedwell & Hartell, Cape Girardeau, (29) $14,536.

Colorado—State Hy. Dept., Denver, steel and timber bridges at Huffman Crossing of Sand Creek about 5 mi. east of Colorado Springs on State Highway 30, El Paso Co., from J. R. Donaghy, 416 North Nevada Ave., Colorado Springs, $23,747 Colorado Bridge & Constr. Co., Gas & Electric Bldg., Denver, $23,945; W. O. Morrison, 409 Cooper Bldg., Denver, $26,016. Engrs. est. $26,399.

Calif., Redwood City — San Mateo Co., constructing rein.-con. arch and slab culvert over San Mateo Creek, between B and Griffith Aves., 3,000 cu.yd. excav, 1,400 cu. yd. Class A rein.-con. for arch, 135 cu.yd. Class A rein.-con. for walls, 105 cu.yd. Class A concrete for slabs, etc., 650 sq.ft. cement surfacing, etc., from C. J. Lindgren, El Cerrito Ave., Burlingame, $41,568; Union Constr. Co., Balfour Bldg., San Francisco, $44,022; H. G. Vansano, 58 Sutter St., San Francisco, $44,640.

CONTRACTS AWARDED

Alabama—State Hy. Dept., Montgomery, 566 ft. concrete girder bridges with one 80 ft. steel span, on Opelika-Waverly Rd., Lee Co., to Stanley & Singer Constr. Co., Lafayette, $37,221; 1,017 ft. concrete bridges, slab girder type, on Montgomery-Birmingham Highway, from Jefferson Co. line to Chilton Co. line, Sects. A and B, Federal Aid Project 99, Shelby Co., to J. W. Gwin, Jefferson

Bridges (Continued)

[illegible] Noted Dec. 14 and 21.

S. D., Forestburg — [illegible] Pierre, 168 ft. rein. con. [illegible] River, here, incl. 515.3 cu.yd. concrete, 43,-[illegible] lb. reinforcing [illegible] structural steel, to Pioneer Bridge Co., Mitchell, $24,216.

Ia., Mt. Ayr—[illegible] bridge, to C. J. Kramme & Co., Ft. Dodge, $41,973. Noted Nov. 30.

Wash., Spokane—Spokane Co., concrete bridge consisting of one 150 ft. and two 80 ft. spandrel arches with 16 ft. concrete girder approaches at each end, 24 ft. clear roadway, over Spokane River on Trent Rd., to W. J. Doust, Lindelle Bldg. $60,370. Engrs. est. $70,000. Noted Nov. 30.

Dams

PROPOSED WORK

Ind., Ft. Wayne—Having plans prepared and takes bids in about 60 to 90 days, 550 ft. dam across Maumee River near Walton Ave. Bridge, rein.-con. permanent spillway, 2 steel movable rollers, each approximately 100 ft. long, 10 ft. diam., hoisting machinery and adjustable gates. Engineers desire to get in touch with manufacturers who can figure on steel rollers, also manufacturers who can build heavy hoisting machinery for same. F. Randall, city engr. C. Brossman, 1503 Merchants Bank Bldg., Indianapolis, consult. engr. A. W. Grosvenor, 710 Packard St., civil engr. This corrects report in Dec. 14 issue.

Wis., Iron River—See "Waterworks."

Kan., Jetmore—See "Streets and Roads."

Tex., Ballinger—See "Streets and Roads."

Que., Montreal—Back River Power Co., c/o J. R. Walker, 35 Common St., had plans prepared dam across Riviere des Prairies just below Visitation Island, to develop 50,000 hp. $2,000,000. T. Pringle & Son, 20 St. Nicholas St., engrs.

Railways

PROPOSED WORK

Florida—Florida Citrus Highlands Ry., Stovall-Nelson Bldg., Tampa, plans 4½ mi tracks and spurs from Bareah to Frostproof, and station at Frostproof. $25,000. Engineers of Seaboard Airline Ry., Wilmington, N. C., will supervise construction.

Wisconsin—Madison Rys. Co., 2302 Fair Oakes Ave., Madison, plans railroad from Madison to Sturgeon Bay, through Sun Prairie, Oakfield, Fond du Lac Kiel and Manitowoc. $2,600,000. D. Montgomery, mgr.

Ontario—Toronto Transportation Comn., Ryrie Bldg., Toronto, plans to extend Parliament St. car tracks from Prospect to Bloor Sts., Toronto, 1,800 ft. double track, 100 lb. rails on 12 in. concrete with granite pavement between tracks. $150,-000. H. H. Couzens, Ryrie Bldg., Toronto, mgr.

Excavation, Drainage, Irrigation

PROPOSED WORK

Tex., Ballinger—Colorado Irrigation Dist., Runnels Co., plans to vote on $1,000,000 bonds to irrigate 100,000 acres, work includes dam, etc. A. N. Norris, member of State Bd. Water Engrs., Austin, engr.

Nev., Lovelocks — Pershing Co. election Jan. 20 to vote on $40,000 bonds for drainage work in lower Humboldt Valley.

Ariz., Maricopa—Maricopa Irrigation Dist. rejected bids opened Nov. 27, furnishing material and labor, and construction of necessary machinery and installation of general irrigation system. Will revise plans and readvertise. Reed & Baker, 119 Fleming Bldg., Phoenix, engrs. Noted Nov. 16.

Ont., Barrie—Simcoe Co. and Provincial Government, Toronto, having plans prepared dredging Nottawasaga River, reclaiming 20,000 acres land. $200,000. G. A. McCubbin, 135 King St., Chatham, engr.

Ore., Mollala—Mollala Municipal Impvt. Dist. incl. [illegible] acres surrounding same, has been organized to drain and irrigate said tract. $100,000 to $125,000. L. A. Shaver, O. W. Robbins and S. A. Knapp, Mollala, dir. Engineer not selected.

BIDS DESIRED

N. Y., Brooklyn—Jan. 3 (change of date) by E. Riegelmann, boro pres., Boro Hall, dredging Fresh Creek from head of Fresh Creek Basin to Channel of Jamaica Bay. Noted Dec. 7.

Tex., Houston—Harris Co. D. D. No. 1, [illegible] $75,-000. Howe & Wise, 1st Natl. Bank Bldg., co. engrs.

CONTRACTS AWARDED

Mont., Luther — Red Lodge — Rosebud Irrigation Dist., J. A. Fiveland, dir., 300,000 cu.yd. excav., 2,000 cu.yd. rein.-con., 15,000 lb. structural steel, 2,500 sq.yd. paving, 2,000 ft. corrugated metal pipe, 700 ft. vitr. pipe, 3,600 ft. flume, etc., to W. C. McCloud, Livingston $219,800.

Calif., Merced—Merced Irrigation Dist., drilling and lining 30 wells, 110 ft. each, to J. B. Rogers, 110 Sutter St., San Francisco, boring 16 in. wells $2.75 per lin.ft., 18 in. wells $3, 20 in. wells $3.25; casing 16 in. wells $2.82, 18 in. wells $4, 20 in. wells $4.41. Noted Nov. 30.

Streets and Roads

PROPOSED WORK

N. Y., Bath—Steuben Co. plans $200,000 bond issue for new highway.

N. Y., Elmira—Chemung Co. plans to construct highways. $26,250. Engineer not announced.

N. Y., Westfield—Chautauqua Co. plans paving 2 mi. Westfield-Barcelona Rd., 16 ft., concrete. $25,000. S. E. Fitch, co. engr.

Pa., Pittsburgh — Plans widening Cherry Alley from 6th to Liberty Aves., will include wrecking buildings on southern side of street. $1,000,000. F. W. Lyon, City County Bldg., engr.

Pa., Sewickley—Plans repaving 1 mi. Lincoln Highway, brick on old base, 30 ft. $50,000. J. C. Hiteshow, Municipal Bldg., engr.

Pa., Waynesburg — Greene Co. plans $200,000 bond issue for new roads.

Florida — State Hy. Dept., Tallahassee, takes bids about Jan. 15, surfacing 10 mi. road from Frostproof to Avon Park, Highlands Co., 2½ in. bituminous macadam on 8 in. crushed rock. J. S. Boggs, state highway engr.

Fla., De Land—Volusia Co. plans election to vote on $30,000 bonds paving 4 mi. road from Allanhurst to Brevard Co. and Canal Ave. near New Smyrna, 15 ft., 7 in. coquina or other rock, tarvia or asphalt and sand surface. R. J. Bisnop, chn.

Kentucky — State Hy. Dept., Frankfort, having plans prepared grading 9.717 mi. road from Rowan Co. line to Olive Hill, 24 and 28 ft., Federal Aid Project 68, Carter Co. J. S. Boggs, state highway engr.

O., Akron—Plans to issue $315,000 bonds resurfacing, repairing and improving various streets. Total amount of money to be spent for highway improvement in city of Akron in 1923 will amount to at least $1,500,000. E. A. Kemmler, Delaware Bldg., engr.

O., Bexley (Columbus P. O.)—Preparing plans grading, curbing, laying 8 in. water mains, making necessary sewer connections and paving 2,200 ft. Ardmore Rd. from Broad St. to north line of Ardmore addition, 24 ft., $45,000, 2,200 ft. Cassingham Rd. from Broad St. to north line of Ardmore addition, 24 ft., $45,000, 2,200 ft. Remington Rd. from Broad St. to north line of Ardmore addition, 24 ft., $45,000, 2,000 ft. Fair Ave. from Cassidy Ave. east, 36 ft., roadway with 18 ft. parkway between 2 sides, $60,000, all brick, concrete, asphalt or tarvia. Jennings-Lawrence Co., Hartman Bldg., Columbus, engrs.

O., Dayton—Montgomery Co. plans paving 1 mi. Gettysburg Ave. from Jalappa Rd. to Eaton Pike, 20 ft., 11,700 sq.yd. asphalt or concrete. $30,000. W. O. Pease, Dayton, co. surv.

Ind., Evansville — Vanderburgh Co. rejected bids grading and graveling 15,400 ft. E. I. Smith Rd., 16 ft. $26,947. Will readvertise. Noted Dec. 7.

Mich., Detroit — Plans prepared grading and paving 16 alleys, 20,480 sq.yd. one course 6 in. concrete, with 2 x 6 in. retaining plank. $51,200. J. W. Reid, city engr.

Mich., Jackson—Election in spring to vote on $200,000 bonds sheet asphalt pavements on 6 in. concrete, on 8 main streets. P. Arnold, city engr.

Ill., Elmhurst—Making plans and takes bids about Jan. 19, concrete sidewalks. $25,-000. E. Hancock, 2047 Ogden Ave., Chicago, engr.

Ill., Posen (Harvey P. O.)—Making plans and takes bids about Feb. 6, concrete sidewalks. $80,000. E. Hancock, 2047 Ogden Ave., Chicago, engr.

Ill., Villa Park—Making plans and takes bids about Jan. 15 concrete paving various streets. $40,000. E. Hancock, 2047 Ogden Ave., Chicago, engr. Noted Mar. 16.

Wisconsin—Following is outline of proposed concrete road construction program (subject to bond issue) in Div. 2, during 1923, comprising following counties:

Fond du Lac Co., 5 mi. State Trunk Highway 56, 10.5 mi. State Trunk Highway 55, 5 mi. State Trunk Highway 103, 6.5 mi. State Trunk Highway 23, 5.5 mi. State Trunk Highway 91, 3.5 mi. State Trunk Highway 49. G. Treleven, Fond du Lac, comr.

Kenosha Co., 1.75 mi. State Trunk Highway 116, widening 2 mi. of 9 ft. pavement on State Trunk Highway 50. J. F. Herzog, Kenosha, comr.

Milwaukee Co., 10 mi. road, location not as yet determined. W. F. Cavanaugh, Milwaukee, comr.

Ozaukee Co. 3 mi. State Trunk Highway 17, 5 mi. State Trunk Highway 57. W. J. Ubbink, Port Washington, comr.

Racine Co., 1 mi. State Trunk Highway 36, 1.25 mi. State Trunk Highway 36, 4 mi. River Rd., 4.2 mi. County Trunk Highway C. 2 mi. Browns Lake Rd. W. A. Bechthold, Racine, comr.

Sheboygan Co., 0.25 mi. Main St, Village of Elkhart Lake, 0.25 mi. Main St., Village of Random Lake. G. W. Ubbelohoe, Sheboygan, comr.

Walworth Co., 5 mi. State Trunk Highway 20, 4.5 mi. State Trunk Highway 12, 9 mi. State Trunk Highway 12, 1.5 mi. County Trunk Highway H, 1.5 mi. County Trunk Highway C. H. J. Peters, Elkhorn, comr.

Washington Co., 2.5 mi. State Trunk Highway 29, 0.5 mi. State Trunk Highway 68, 1.75 mi. State Trunk Highway 68, West Bend east, 2.75 mi. State Trunk Highway 55, 1.6 mi. State Trunk Highway 15, 3 mi. Sheboygan Rd., 2 mi. Richfield Spur, 3.5 mi. Milwaukee-Germantown Rd., 2.5 mi. Jackson-Cedarburg Rd., 3 mi. Hartford-Thompson-Hartford Rd.

Waukesha Co., 5.5 mi. State Trunk Highway 67, 2.5 mi. State Trunk Highway 83, 6.5 mi. State Trunk Highway 74, 4.5 mi. Merton-North Lake Rd., 3.5 mi. Waukesha-Prospect Rd., 2 mi. State Trunk Highway 41, Wales relocation. C. J. Hahn, Waukesha, comr.

Wisconsin—Following are county appropriations for state and county aid road and bridge construction during 1923. Polk Co. $108,735, C. W. Nystrom, Balsam Lake, comr.; Florence Co. $36,534, O. F. Soderberg, Florence, comr.; Marinette Co. $167,-849, A. Eklund, Pestigo, comr.; Shawano Co. $209,861, W. F. Meyer, Shawano, comr.; Ozaukee Co. $368,041, W. J. Ubbink, Port Washington, comr.; Chippewa Co. $113,136, P. O. Lokrantz, Chippewa Falls, comr.

Ia., Dyersville—Takes bids about Feb. 1 for 52 blocks brick paving. N. B. Barber, Waterloo, engr. Noted Dec. 21.

Minn., Slayton—Murray Co. having plans prepared grading 10 mi. State Rd. 6 from Curry to Cottonwood County line, $10,000; 13.5 mi. State Rd. 11, from Dovray to Walnut Grove, $18,000; 9 mi. State Rd. 4, from Avoca to Cottonwood County line, $10,000; 6 mi. State Rd. 10, from Fulda to Wirock, $7,500. J. A. Myron, Slayton, engr.

Minn., Thief River Falls—Pennington Co. plans grading 6 mi. State Rd. 5, from here east.

Kan., Emporia — Comrs. Lyon Co. soon take bids concrete paving 1.9 mi. Olpe Rd., 18 ft. $100,000. W. S. Ruggles, co. engr.

Kan., Girard—Comrs. Crawford Co. soon take concrete paving 2 mi. Walnut Englevale Rd., 18 ft., $70,000; 4.937 mi. Radley Ringo Rd., 18 ft., $125,000. C. M. Cooper, Girard, engr.

Kan., Girard—Crawford Co. rejected bids received Dec. 11, concrete paving 0.942 mi. Arcadia Branch to Commercial Highway, 18 ft. $32,182. C. M. Cooper, co. engr.

Kan., Jetmore—Making plans paving sewers, bridge and dam. A. T. Archer & Co., 609 New England Bldg., Kansas City, Mo., engrs.

Kan., Wichita — Comrs. Sedgwick Co. soon take bids paving 0.8 mi. Tyler Rd., 9 ft., concrete or brick. $25,000. M. Roseberry, co. engr.

South Dakota—State Hy. Comn., Pierre, takes bids in January, grading 5.66 mi. road in Todd Co. $40,203. F. D. Hudgins, state engr.

S. D., Sioux Falls—Plans paving 12,730 sq.yd. 6th St. from Weber to Van Eps Aves., $34,000; 4,745 sq.yd. Weber Ave. from 6th to 8th Sts., $13,040. S. B. Howe, city engr.

Streets and Roads (Continued)

North Dakota — State Highway Comn., Bismarck, plans grading and graveling 17.8 mi. in northeast section of state. $700,000. H. C. Frahm, Minot, div. engr.

Missouri—State Hy. Dept., Jefferson City, opened bids Dec. 2 improving (1) road from Centerville southward, State Project Route 21, Sect. 25, Reynolds Co. (2) road from Gainesville eastward, State and Federal Aid Project 111 C, Ozark Co. (3) road from Kansas City to St. Louis, State Project Route 20, Sect. 10, Lafayette Co. (4) road from Warrensburg to Clinton, State Project Route 13, Sect. 26, Johnson Co. (5) road from Festus to St. Genevieve Co. line, State Project Route 29, Sect. 2, Jefferson Co. (6) road from Opolis to Asbury, State Project Route 57, Sect. 2, Jasper Co. (7) road from Kansas City to St. Louis, State Project Route 2, Sect. 6, Jackson Co. (8) road from Kansas City to St. Louis, State Project Route 2, Sect. 5, Jackson Co. (9) road from Bethany, westward, State Project Route 4, Sect. 24, Harrison Co. (10) road from Ava southeastwardly, State Project Route 5, Sect. 94, Douglas Co. (11) road from Ava southeastwardly, State Project Route 5, Sect. 93, Douglas Co. (12) road from Memphis to Edina, State Project Route 15, Sect. 4, Scotland Co., from E. A. Luck, Black Rock, Ark., (1) $64,999 (10) $12,389 (11) $13,836; Coopers Constr. Service Co., Federal Reserve Bank Bldg., St. Louis, (1) $53,162; Muskogee Contg. Co., Muskogee, Okla. (1) $54,922; Pioneer Constr. Co., 101 New York Life Bldg., Kansas City, (2) $56,693; Parham Constr. Co., East St. Louis, Ill. (street address not available) (2) $74,115; Cook & O'Brien Constr. Co., 305 Ry. Exch. Bldg., Kansas City (3) $112,535 (7) $201,839 and $222,931 (8) $159,998; C. T. Johnson, Warrensburg (3) $112,816 (4) $35,974; J. O. Patterson & Co., 310 Ridge Bldg., Kansas City, (3) $116,700 (7) $224,273; G. A. Woods Constr. Co., Smithville, (4) $35,863; A. T. Cook, Ottawa, Kan. (4) $33,721; W. J. Knorpp and J. Richardson, De Soto, (5) $28,902; J. P. Sparks, Kirkwood, (5) $31,410; M. E. Gillioz, Monett, (5) $36,332; V. E. Koch, Box 604, Joplin, (6) $76,200; Carterville Constr. Co., Carterville, (6) $78,336; Du Bois & Co., 126 East 1st St., Wichita, Kan., (6) $80,385; Harrison Eng. & Constr. Co., Wichita, Kan. (street address not available) (8) $163,544; J. J. Dunnegan, Shenandoah, Ia., (8) $166,429; Rand Constr. Co., 1001 New York Life Bldg., Kansas City, (9) $142,392; Summerfield, Jones & Co., Springfield (street address not available), (10) $11,795 (11) $13,247; W. H. and G. H. Turner, Memphis, (12) $54,616; F. F. O'Dell, Farmington, (12) $54,148. Noted Nov. 23.

Tex., Ballinger—Runnels Co. plans to construct State Highway 7 A, from here to county line. $40,000. State Highway Comn., Austin, granted $20,000 aid not to exceed 50 per cent of cost of project. U. Stephens, co. engr.

Tex., Bay City — Matagorda Co. voted $110,000 bond issue Nov. 18 for highway improvement. J. C. Carrington, co. engr.

Tex., Center—Shebly Co. making plans grading and gravel surfacing 12.5 mi. State Highway 35 from Bobo to west line of Joaquin Rd. Dist. 5, 16 ft. $160,000. T. H. Dillon, co. engr.

Tex., Columbus — Fayette Co. election Jan. 27 to vote on $100,000 bonds for grading, raising, filling and gravel topping 15 mi. roads in Dist. 3, 18 ft. $100,000.

Tex., Conroe—Attorney Generals Dept., Austin, approved $40,000 bond issue for road and highway improvement in Montgomery Co. W. H. Lee, co judge.

Tex., Conroe—Montgomery Co. plans to construct State Highway 19. $150,000. State Highway Comn., Austin, granted $70,000 aid, not to exceed 50 per cent of cost. W. H. Lee, co. judge.

Tex., Dallas—See "Miscellaneous" under Park Improvements.

Tex., Highland Park—Jan. 16, to vote on $100,000 bonds for street paving and improvements. M. Costella, city secy.

Tex., Jefferson—State Hy. Comn., Austin, alloted $75,338 aid to Marion Co. for construction of 14.42 mi. State Highway 35, on condition that county surface State Highway 8 with bituminous topping, present plans calling for gravel road. T. B. Warden, co. engr.

Okla., Chandler—Had plans prepared for brick paving 13 blocks. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs. Noted Nov. 16.

Okla., Sayre—Plans paving 13 blocks in residence district, 18,000 sq.yd. concrete. $87,000. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs.

Calif., Crescent City—Soon takes new bids grading and paving various streets, 23,900 cu.yd. grading excav., 316,300 sq.ft. grading surface, 316,300 sq.ft. asphaltic macadam pavement, 168,418 sq.ft. asphaltic macadam pavement to be rebuilt, etc. Former contract rescinded. C. C. Kennedy, Call Bldg., San Francisco, engr. Noted Sept. 28.

Calif., Fresno—Soon takes bids improving portions of Tuolumne, Divisadero, R and S Sts., etc., 198,940 sq.ft. grading, 186,427 sq.ft. asphaltic paving, 12,012 sq.ft. concrete gutter, 7,504 lin.ft. concrete curb, 13,725 sq.ft. concrete walks, etc. W. Stranahan, city engr.

Calif., San Diego — Had plans prepared paving with 1½ in. topeka asphalt on 2½ in. asphaltic concrete, Maple, Nutmeg and Olive Sts., 389 lin.ft. cement curbing, 1,033 sq.ft. cement sidewalks, 19,879 sq.yd. bituminous concrete; paving with 2 in. bituminous concrete on 4 in. cement concrete base, 1 in. binder, A St. from 4th St to Kettner Blvd., and 2nd St. from A to R Sts., 551 lin.ft. cement curbing, 2,263 sq.ft. cement sidewalks, 13,297 sq.yd. paving. F. A. Rhodes, City Hall, engr.

Calif., San Mateo—Plans improving various streets, involving 25,000 sq.ft., 40,000 sq. ft., 120,000 sq.ft., 244,500 sq.ft. 1½ in. asphalt on 6, 5, 4½ and 4 in. concrete respectively, 6,970 cu.yd. excav., 1,000 cu.yd. fill, 16,000 lin.ft. standard concrete curb, 1,050 lin.ft. parkway concrete curb, 660 sq.ft. concrete gutter, 3,100 lin.ft. 6 in. sewers, 3,650 lin.ft. 4 in. sewer laterals, 2,130 lin.ft. 18 in. drain, 34,800 sq.ft. cement walks, removing 3,400 lin.ft. curbs, 770 sq.ft. driveway approaches, etc. G. S. Whitehead, San Mateo, engr.

Ontario—Dept. Pub. Highways, Parliament Bldg., Toronto, plans paving 11 mi. provincial highway between St. Thomas and Aylmer, asphalt on concrete. $400,000. G. Hogarth, ch. engr.

Ontario — Provincial Highway Dept., Parliament Bldgs., Toronto, plans to take over county road between Orangeville and Arthur and build 22 mi. gravel or stone macadam highway, bridges and culverts. $500,000. G. Hogarth, ch. engr.

ROAD WORK—FLORIDA

Following are lowest three bids opened Nov. 14, by State Rd. Dept., Tallahassee, for constructing road between Pensacola and Roberts, Project No. 34, Escambia Co., (A) C. H. Turner Co., Pensacola; (B) S. S. Fulghum, Pensacola; (C) W. D. Winchell & Co., Columbus, Ohio. The unit bids were as follows:

	A	B	C
100 acres clearing and grubbing	$35.00	$55.83	$60.00
59,154 cu yd. regular excavation	.37	.43	.52
105,600 sq.yd. plain cement concrete	2 08	2.25⅓	2.36
17,785 lb reinforcing steel	09	046	.07
8,100 lin ft corrugated metal pipe, 15 in	2 02	2 21	1.60
600 lin ft corrugated metal pipe, 24 in	3 05	3 54	3.00
213.3 cu.yd. class "A" concrete	25 80	16 40	18.00
Extended totals	$250,808	$270,265	$287,136

ROAD WORK—COLORADO

Following are lowest three bids opened by State Highway Comn., Denver, for constructing Federal-Aid Project No. 116-A, El Paso Co., (A) Standard Eng. & Constr. Co., 518-19 E. & C. Bldg., (awarded contract); (B) J. F. Roberts Constr. Co., 206 Tramway Bldg.; (C) Colorado Bridge & Constr. Co., 501 Gas & Electric Bldg. The unit bids were as follows:

	A	B	C
1 acre clearing and grubbing	$100 00	$80 00	$50.00
98,000 cu yd common excavation	18	22	25
16,400 cu yd rock excavation	95	80	1.25
12,300 cu.yd. borrow fill	.18	.22	.25
42,000 sta. yd. overhaul	.02	.02	.02
3,110 cu yd gravel shoulder	80	2 00	3 75
345 cu.yd. sand cushion	.90	1.50	2.25
43,776 sq.yd. concrete pavement	2.15	2.10	2.25
837 cu.yd. concrete class "A"	15.50	16.50	21.00
91,710 lb. reinforcing steel	.05	.05	.07
5.8 M bd. ft. timber headers	60.00	60.00	70.00
200 sq.yd. rip rap	.80	2.00	1.25
7,352 lin.ft. timber guard fence	.48	.50	.75
650 lin.ft. 8 in. vitrified tile underdrain	.40	.80	2.20
Sub-totals	$155,147	$160,313	$163,742
Cottonwood Creek Bridge			
916 cu.yd. concrete class "A"	$17.50	$18 50	$25.00
3,500 lb. structural steel	.08	.06	.08
119,400 lb reinforcing steel	05	C5	.07
264 handrail spindles	1.50	1.00	2.00
Sub-totals	$22,676	$23,390	$26,330
10 per cent for engineering and contingencies	17,782	18,370	19,007
Extended grand totals	$195,605	$202,073	$209,079

ROAD WORK—OREGON

Bids were opened by State Highway Comn., Nov. 21, for constructing .94 mi. Oregon-City-Canemah Sect., Pacific Highway, Clackamas Co., (A) Rajotte, Winton, Inc., Realty Bldg., Spokane; (B) D. Samuels, Salem; (C) A. D. Kern, Portland. The unit bids were as follows:

Unit A	A	B	C
3 2 acres clearing and grubbing	$1,200 00 A & B	$75.00	$300.00
600 cu.yd. common excavation	1.00	.40	.80
600 cu.yd. intermediate excavation	1 00	.60	1.10
1,800 cu.yd. solid rock excavation	2.25	1.40	2 00
3,150 cu.yd. disposal of waste	.20	.25	.25
80 cu.yd. class "B" concrete	30.00	30.00	20.00
150 cu.yd. excavation for culverts	2.50	1.50	
Extended totals	$8,655	$6,608	$7,728
Unit B			
4 acres clearing and grubbing (lump sum)		475.00	500 00
5,000 cu.yd. common excavation	50	.50	.90
7,000 cu.yd. intermediate excavation	70	70	1.25
25,000 cu.yd. solid rock excavation	1 50	1.60	1.85
35,000 cu.yd. overhaul over 500 ft. over 100 ft.	05	.05	.05
13,900 cu.yd. disposal of waste	20	.20	.25
50 lin.ft. 18-in. reinforced-concrete pipe	4 00	3 00	3.00
130 lin.ft. 24-in. reinforced-concrete pipe	5 00	4 00	4.00
500 lin.ft. 6-in. drain tile	75	25	.40
100 cu.yd. rock or gravel backfill	1 50	3.00	3.00
1,000 lin.ft. wood guard fence	1 00	1.25	.90
650 cu.yd. class "B" concrete	25 00	25 00	20 00
1,250 cu.yd. rubble and cement masonry	10 00	15.00	12.00
1,200 lin.ft. parapet walls	3 50	3 00	3.50
2,000 cu.yd. excavation for culverts	2 00	1 50	2 00
Extended totals	$89,955	$96,350	$103,495
Extended grand totals	$98,610	$102,958	$111,223

Streets and Roads (Continued)

Ont., Oshawa — [illegible] pavement on [illegible] St. [illegible] Drew St., 24 ft. wide, with concrete curbs and gutters, [illegible] concrete walks on various streets, $8,300. F. E. Hare, city clk.

Ont., Ottawa — [illegible] early in spring, tarvia macadam on Waverly Rd. from [illegible] to [illegible] Carling Ave. from Parkdale to Fairmont Aves., $50,000. A. F. Macallum, city engr.

Ont., Owen Sound — [illegible] pavement, average width 30 ft. $300,000. [illegible] city engr.

Ont., Sandwich—Takes bids in January for new pavements, [illegible] and watermains. $106,500. E. R. North, town clk.

Ont., Stratford—Plans to expend [illegible] on asphalt and concrete pavements, and concrete sidewalks. A. B. Manson, city engr.

Ont., Toronto — Plans paving, curbing, guttering and laying storm sewers in Kingston Rd. from Dixon Ave. to Main St., 4,800 ft. long, 40 ft. wide. $330,089. R. C. Harris, city engr.

Ont., Toronto—Plans paving 600 ft. Dundas St. from Yonge to Victoria Sts., asphalt on concrete with storm sewers and provision for double car tracks, $25,512. R. C. Harris, city engr.

Ont., Toronto—Plans grading 3,000 ft. Glendonwynne Rd., 66 ft. wide, $16,335, also 2,000 ft. 4 ft. 6 in. concrete sidewalks, $3,275; extending and grading Pailton Crescent from Baliol St. to Davisville Ave., 600 ft. long, 66 ft. wide, $10,750; extending and grading Heather St., 1,200 ft. long, 66 ft. wide, and St. Clair Ave. E. across Rosedale Ravine to Inglewood Dr., 2,000 ft. long, 86 ft. wide, $50,000. R. C. Harris, city engr.

Ont., Toronto — Having plans prepared widening Parliament St., incl. asphalt pavements and concrete sidewalks. $155,000. R. C. Harris, city engr.

B. C., Vancouver—Voted $150,000 by law and soon takes bids for new roads. C. E. Tisdall, mayor.

BIDS DESIRED

N. Y., Brooklyn—Jan. 4, by Park Bd. at office Dept. Parks, Municipal Bldg., New York City, improving Bay Parkway from 59th to 78th Sts., here. F. D. Gallatin, pres.

N. J., Atlantic City—Jan 11, by Bd. City Comrs., City Hall, improving portions of Fairmount Ave. and other avenues. J. W. Hackney, City Hall Annex, city engr.; adv. this issue.

Virginia — Jan. 11, by State Hy. Comn., Richmond, constructing 6.28 mi. Project F-186A, Route 12, Pittsylvania Co.; 8.44 mi. Project S-185, Route 7, alternate bids requested for soil roadway; 1.98 mi. Project S-256, Route 11, Tazewell Co.; bridges over Massaponax Creek, Project F-2053, Route 1; 0.84 mi. Project F-32, Route 6; 11.53 mi. Project S-208, Route 11; repairs to bridges, Project SR-298, Route 7, Warren Co. G. P. Coleman, Richmond, highway comr.; adv. this issue.

Va., Richmond—Jan. 2, by Clerk Henrico Co., paving 6.6 mi. Nine Mile road from here to Seven Pines, 16 ft., 15,000 cu.yd. excav., 62,000 sq.yd. surface.

Florida—Jan. 10, by State Hy. Dept., Tallahassee, grading, constructing timber bridge and placing rock base on 8.75 mi. Rd. 8 from Sta. 243, south of Lake Stearns to line between Townships 35 and 36, Project 562, Highlands Co.; placing 77,000 cu. yd. dredged embankment on 2.65 mi. Rd. 125 from Sta. 308 to Sta. 448, Project 534, Brevard Co. W. F. Cocke, state highway engr.

Louisiana—Jan. 11, by State Hy. Comn., Reymond Bldg., Baton Rouge, grading and gravel surfacing 5 mi. Federal Aid Project 43, Sect. A, Vinton-Orange Highway, Calcasieu Parish.

Ohio—Jan. 5, by L. C. Herrick, dir. highways, Columbus, paving 1.39 mi. Sect. M, Cleveland-Massillon Rd., I. C. H. 17, [illegible] rein.-con. and brick $73,082, bituminous concrete and brick $73,436, brick $76,962; 1.7 mi. Sect. L, Cleveland Massilon Rd., I. C. H 17, rein.-con $72,672, bituminous concrete $74,290, brick $78,175; 3.44 mi. Sect. K, Cleveland-Massilon Rd., I. C. H. 17, rein.-con. and brick $158,239, bituminous concrete and brick $159,171, brick $167,992; 2.7 mi. Sect. J, Cleveland-Massillon Rd., I. C. H. 17, rein.-con. $116,085, bituminous concrete, $116,934, brick, $124,668; 1.49 mi. Sect. I Cleveland-Massillon Rd., I. C. H. 17, rein.-con. and brick $76,902, bituminous concrete and brick $77,352, brick, $81,073.

Ind., Albion — [illegible] Noble Co., grade and gravel 15,125 ft. Clarence Leiter Rd., 16 ft., $26,650; 27,258 ft. F. L. Grady Rd., 16 ft., $25,652; concrete and gravel 8,310 ft. William Appleman Rd., 16 ft., 5,421 sq.yd. concrete on concrete, $27,389. W. T. Knox, Albion, engr. Noted Dec. 21.

Ind., Columbia City—Jan. 4, by Auditor Whitely Co., grading and graveling 45,158 ft. Aaron Mishler Rd., 16 ft., $49,868; 18,577 ft. Austin Hibely Rd., 16 ft., $29,304; 10,585 ft. County Rd. 3, Sect. 2, 18 ft., $25,245; paving 7,992 ft. County Rd. 3, 30 ft., crushed stone, $26,769. C. M. Auspaugh, Columbia City, engr. Noted Dec. 21.

Ind., Elizabethtown—Jan. 5, by Auditor Bartholomew Co., grading and graveling 29,154 ft. Sawyer Rd., 16 ft. $50,000. H. C. Thomas, Elizabethtown, engr.

Ind., Lafayette—Jan. 6, by Auditor Tippecanoe Co., grading and graveling 19,201 ft. John Gushwa Rd., 16 ft. $25,741. E. C. Minton, Lafayette, engr.

Ind., Marion—Jan. 4, by Auditor Grant Co., paving 2,125 ft. Dempsey Seybold Rd., 30 ft. crushed stone and asphalt, $26,035. G. Swisher, Marion Engr. Noted Dec. 21.

Ind., Vincennes—Jan. 4, by Auditor Knox Co., grading and graveling 7,920 ft. John R. McClure Rd., 30 ft., $30,543; 12,885 ft. Royse Davis Rd., 16 ft., $25,348; 11,300 ft. Obermeyer Rd., 16 ft., $27,712. G. A. Haskin, Vincennes, engr. Noted Dec. 21.

Ind., Washington — Jan. 5, by Auditor Daviess Co., grading and graveling 17,530 ft. Andrew T. Myers Rd., 16 ft. $26,231. W. L. McCormick, Washington, engr. Noted Dec. 21.

Michigan—Jan. 16, by State Hy. Dept., Lansing, grading and surfacing 7.255 mi. Federal Aid Project 64, Crawford and Otsego Counties incl. 31,821 cu.yd. excav., 76,612 sq. yd. gravel or stone-gravel.

Ia., Elkader—Jan. 10, for 21,650 sq.yd. vitr. brick, asphalt or concrete pavement, 11,000 lin.ft. curb and gutter, 6,450 cu.yd. grading. $65,000. M. Tschirgi & Son, 712 Amer. Trust Bldg., Cedar Rapids, engrs. Noted Sept. 7.

South Dakota — Jan. 4, by State Hy. Comn., reinforcing at office of Auditor Yankton Co., Yankton grading 13.199 mi. Project 65, incl. 125,980 cu.yd. excav., 272 cu.yd. concrete, 24,800 lb. reinforcing steel, also graveling 19.95 mi. Project 77, incl. 5,000 cu.yd. excav., 30,000 cu.yd. gravel, both projects in Yankton Co.; also taking bids at office Auditor Clay Co., Vermilion, grading 5.98 mi. Project 97, incl. 37,233 cu.yd. excav., 124 cu.yd. concrete, 9,949 lb. reinforcing steel, Clay Co.

Ark., Ft. Smith — Jan. 25, paving 22 blocks in Street Impvt. Dist. 16, vitr. fiber block and asphalt filler or bitulithic. W. L. Winters, Ft. Smith, engr.

Calif., Modesto—Jan. 9, by Supervs. Stanislaus Co., paving 7 mi. West Side Highway from West Co. line, and 3.5 mi. Escalon-Oakdale Rd. between Burnett Station and San Joaquin Co. line, 16 ft. wide, 5 in. portland cement concrete in center, 7 in. concrete on edges, or 1½ in. topeka on 2½ in. black base, or 1½ in. warrenite on 3½ in black base. J. H. Hoskins, co. surv.

Calif., San Diego—Jan. 8, by A. H. Wright, city clk., improving Ivy St. F. A. Rhodes, city engr. Noted Nov. 23.

Calif., San Francisco—Jan. 10, by Bd. Pub. Wks., improving 8th St. between Carolina and 16th Sts., incl. crossings of Hooper, Irwin and Wisconsin Sts., 1,077 cu.yd. excav., 1,091 lin.ft. concrete curb, 14,778 sq.ft. artificial stone walks, 338 lin. ft. 12 in. pipe sewers, 355 lin.ft. 10 in. pipe culvert, etc; Coleridge St. between Eugenia and Lizzie Sts., incl. crossings of Eugenia and Lizzie Sts., 320 cu.yd. excav., 355 lin.ft. concrete curb, 786 sq.ft. artificial stone walks, 8,709 sq.ft. concrete pavement, etc., for City and San Francisco Co. M. M. O'Shaughnessy, city engr.

Quebec—Jan. 20 by J. L. Boulanger, deputy minister of highways, Quebec, 4.54 mi. Quebec-St. Simeon, in Giffard and St. Joachim, tar macadam. M. Nectkar, ch. engr.

BIDS RECEIVED

West Virginia—State Hy. Dept., Charleston, grading 7 mi. Charleston-Kearneysville Rd., Project 3026, Jefferson Co., 35,000 lin. ft. clearing, 38,200 cu.yd. unclassified excav., 1,500 sta.yd. overhaul, 320 cu.yd. concrete, 1,800 lb. reinforcing, 1,490 lin.ft. 15-24 in. corrugated metal pipe, 8,600 cu.yd. stone subbase course, 8,900 cu.yd. broken stone base course, 62,200 sq.yd. waterbound macadam surface course, from Moore & [illegible] Martinsburg, $150,769, Edwards-Dunn Co., Greenburg, Pa., $142,317, 6 mi. Shady Springs-Summers Co. line Rd., Project 3052, Raleigh Co., 27,300 lin.ft. clearing, 91,000 cu.yd. unclassified and 500 cu.yd. borrow excav., 20,000 sta.yd. overhaul, 1,060 cu.yd. concrete, 29,000 lb. reinforcing, 1,750 cu.yd. cement rubble masonry, 1,400 lin.ft. 18 in. vitr. clay pipe, 10,000 cu.yd. borrow of rock for special rock fill, etc., from E. K. Newell Co., Maysville, Ky., $82,697, Waugh Bros., St. Albans, $86,300, Sutton Constr. Co., Ashland, Ky., $87,311. All bids rejected. Noted Nov. 30.

North Carolina—State Hy. Dept., Raleigh, clearing and grading 14.1 mi. State Project 201, Carteret Co., from Duplin Constr. Co., Warsaw, $49,273; Eagle Eng. Co., New Bern, $55,865; O. A. Mann & Co., La Grange, Ga., $72,779. Noted Nov. 30.

Kentucky—State Hy. Dept., Tallahassee, grading (1) 8.8385 mi. Louisville-Paducah Rd. from Marion to Livingston Co. line, Federal Aid Project 91, State Project 8, Sect. A, Crittenden Co. (2) 17.045 mi. Louisville-Paducah Rd., Federal Aid Project 92, State Project 8, Sect. B, Livingston Co. (3) 9.639 mi. Frenchburg-West Liberty Highway, Federal Aid Project 83, Menifee Co. (4) 5.018 mi. Stanton-Winchester Rd., Federal Aid Project 87, Sect. A, Powell Co., paving with water bound macadam (5) 9.55 mi. Vanceburg-Maysville Rd. from Tollesboro to Valley, State Project 20, Sect. A, Lewis Co., paving with rein.-con., (6) 8.501 mi. Jackson Highway from Jefferson Co. line to Bloomfield, Federal Aid Project 86, Sect. A, Bullitt, Spencer and Nelson Counties, (a) concrete masonry and vitr. pipe (b) concrete masonry and concrete pipe (c) cement rubble masonry and vitr. pipe (d) cement rubble masonry and concrete pipe (e) concrete masonry and c.i. pipe (f) cement rubble masonry and c.i. pipe (g) Class A concrete (h) Class B concrete (i) wooden post guard rail and vitr. pipe (j) wooden post guard rail and concrete pipe (k) wooden post guard rail and c.i. pipe (l) concrete post guard rail and vitr. pipe (m) concrete post guard rail and concrete pipe (n) concrete post guard rail and c.i. pipe, from Brantley & Cosle, Knoxville, Tenn., (street address not available), (1a) $86,757 (1b) $87,462 (1c) $86,494 (1d) $87,198; Corunn Bros., Madisonville, (1a) $91,201 (1b) $90,013 (1c) $89,398 (1d) $88,210; Ellis & Smeathers, Owensboro, (2a) $129,041 (2b) $130,084 (2c) $120,600 (2d) $121,643 (3a) $100,005 (3b) $98,256 (3c) $84,009 (3d) $82,260 (3e) $98,750 (3f) $82,753 (4c) $61,754 (4d) $59,870 (4f) $60,478; Costello Bros., Henson Bldg., Knoxville, Tenn., (2a) $134,493 (2b) $136,473 (2c) $125,861 (2d) $127,841; Z. A. Walters, Salyersville, (3a) $91,531 (3b) $92,552 (3c) $82,494 (3e) $93,590; Codell-Byans, Winchester, (4a) $66,398 (4b) $65,094 (4c) $61,188 (4d) $59,884 (4e) $67,701 (4f) $62,492; Vermillion Constr. Co., Barboursville, (4a) $66,173 (4b) $65,502 (4e) $67,207; J. W. Harris, Covington, (5g) $96,268 (5h) $95,828; Crippen Constr. Co., Mercantile Bldg., Knoxville, Tenn., (5g) $108,664 (5h) $108,096; Mills & Connolly, (5g) $127,384 (5h) $127,316; J. H. Cahill, 1540 9th St., Louisville, (6i) $521,495 (6j) $499,519 (6k) $501,911 (6l) $526,816 (6m) $504,841 (6n) $507,233. Noted Dec. 14.

Ohio—Dept. Highways and Pub. Wks., Columbus, opened bids Dec. 22, grading, bridging and paving roads in following counties:

Licking-Knox Co., Sect. "K" Columbus-Millersburg Rd., 1.42 mi. rein.-con. from Walsh & McDaniel Co., Columbus, $47,391; Newark Paving & Const. Co., Newark, $47,422; H. Strodbeck, Ashland, $48,047. (Street addresses not available.)

Medina Co., Sect. "Medina West," Ashland-Medina Rd., .83 mi., H. Strodbeck, Ashland, rein.-con., $33,912; brick, $40,521.

Lorain Co., Sect. "N," "O," "P" Oberlin-Norwalk Rd., 5.14 mi. brick, Ohio Contg. Co., Elyria, $245,623, Hill & Hill, Elyria, $240,937, Highway Const. Co., Elyria, $232,108 bituminous concrete, (a-2a) Franklin Asphalt Paving Co., 209 South High St., Columbus, $166,751, Ohio Contracting Co., Elyria, $186,270, General Asphalt Paving Co., (no address), Cleveland, $169,040; bituminous concrete, (a-2b) Franklin Asphalt Paving Co., Columbus, $178,986, McArthur & Co., Kenton, $205,846, Cleveland Trinidad Paving Co., The Arcade, Cleveland, $205,855, bitulithic, Highway Constr. Co., Elyria, $227,207; Hinkle & Sullivan, Cincinnati, (street address not available), $252,195. Noted Dec. 14.

Ohio—Dept. Highways and Pub. Wks., Columbus, opened bids Dec. 19, grading, bridging and paving roads in following counties:

Ashland Co., Sect. "B-2," Ashland-Norwalk Rd., 1.093 mi., rein.-con., from Allen County Paving Co., Lima (street address

Streets and Roads (Continued)

not available), $32,037, H. Strodbeck, Ashland, $32,315. E. A. Freshwater & Sons, Painesville, $32,819; brick, H. Strodbeck, Ashland, $37,549, E. A. Freshwater & Sons, Painesville, $38,873, Allen County Paving Co., Lima, (street addresses not available.) $39,998.

Lake Co., Sect. "B," Cleveland-Buffalo Rd., 1.089 mi., brick, G. Keener, Jr., Madison, $53,969, Gould & Mayback, Cleveland, $58,147, E. A. Freshwater & Sons, Painesville, (street addresses not available), $57,042.

Lake Co., Sect. "A" Medina-Norwalk Rd., 3.42 mi., asphalt macadam oil, Losey Road Constr. Co., Kenton, $49,245, H. J. Hart, Elyria, $54,397; tar macadam, Losey Rd. Const. Co., Kenton, $49,840, Barnes & Tabbert, Rocky Ridge, $54,011 rein.-con., Losey Rd. Constr. Co., Kenton, $66,691, Barnes & Talbert, Rocky Ridge (street addresses not available), $65,173

Lorain Co., Sect. "E" Cleveland-Sandusky Rd., 2.11 mi., brick, Ohio Contracting Co., Elyria, $207,954, E. A. Freshwater & Sons, Painesville, $211,929, McArthur & Co., Kenton, $212,224; bituminous concrete oil, Highway Const. Co., Elyria, $165,129, Franklin Asphalt Paving Co., 209 South High St., Columbus, $170,946, McArthur & Co., Kenton, $180,681; bituminous concrete, lake, McArthur & Co., Kenton, $180,681, Franklin Asphalt Paving Co., Columbus, $181,544, Cleveland Trinidad Paving Co., The Arcade, Cleveland, $190,878; bitulithic, Hinkle & Sullivan, Sullivan, $222,911. Noted Dec. 7.

Tex., Coleman — Coleman Co. grading, gravel surfacing, etc., (1) 8 mi. Coleman-Comanche Rd., 16 ft., 526 cu.yd. concrete, 23,435 cu.yd. borrow and 19,431 cu.yd. roadway excav., 15,295 cu.yd. gravel surfacing, 31,904 lb. reinforcing, (2) 6 mi. Santa Anna-Comanche Rd., 16 ft., 175 cu.yd. concrete, 21,623 cu.yd. roadway and 5,295 cu yd. borrow excav., 6,133 cu.yd. gravel surfacing, (3) 9 mi. Santa Anna-Buffalo Rd., 16 ft., 422 cu.yd. concrete, 49,000 cu.yd. earth excav., 10,480 cu.yd. gravel surfacing, 34,209 lb. reinforcing, (4) 12 mi. Santa Anna-Trickham Rd., 16 ft., 1,200 cu.yd. concrete, 74,500 cu.yd. earth excav., 15,775 cu.yd. gravel surfacing, 122,000 lb. reinforcing, (5) 11 mi. Santa Anna-Red Bank Rd., 16 ft., 749 cu.yd. concrete, 12,821 cu.yd. gravel, 47,294 lb. reinforcing, from Womack Constr. Co., Sherman, (1) $52,986 (2) $23,120 (3) $42,990 (4) $92,877 (5) $32,627; McClung Constr. Co., Cleburne, (1) $53,213 (3) $45,308 (4) $94,586; Smith Bros., Crockett, (1) $53,757 (2) $23,075 (5) $33,616; Scarborough & Davis, Gaston Bldg., Dallas, (3) $44,671 (4) $93,968; McCoy & Richards, Arlington, (5) $33,926. Engrs. ests. (1) $57,500 (2) $25,500 (3) $47,500 (4) $100,000 (5) $37,500.

Tex., Jefferson—Marion Co. grading, claying, gravel surfacing and bridging (1) 8.8 mi. State Highway 8, from here to Cass Co. line, 16 ft., (2) 3.56 mi. State Highway 8, from here to Marion Co. line, 16 ft., from Henderson & Co., Omaha, (1) $53,752 (2) $34,115; Womack Constr. Co., Sherman, (1) $56,524 (2) $36,490; Cocke & Turner, Marshall, (1) $57,666 (2) $39,176. Engrs. est. (1) $100,980 (2) $66,945. Noted Nov. 23.

Tex., Kerrville—Kerr Co. grading, gravel surfacing, etc., 4.45 mi. State Highway 41, 16 ft., 639 cu.yd. concrete, 15,425 cu.yd. roadway and 11,883 cu.yd. borrow excav., 9,458 cu.yd. gravel surfacing, 73,940 lb. reinforcing, from G. Alvis, Winnsboro, $30,953; McCall-Moore Eng. Co., Amicable Bldg., Waco, $32,823; R. G. Buckner & Son, Cleburne, $32,502. Engrs. est. $35,000.

Tex., Waco — McLennan Co. grading, gravel surfacing, sledged stone base with bituminous topping 3 7 mi. State Highway 7, McGregor Rd., 16 ft., from Wear & Thomas, Rogers, $29,947; D. H. Buchanan, City Natl. Bank Bldg., Temple, $31,736; McCoy & Richards, Arlington, $31 902. Engrs. est. $32,075. Noted Dec. 7.

Oklahoma—State Hy. Comn., Oklahoma City, hardsurfacing 9.684 mi. Federal Aid Project 74, Murray Co., from Western Constr. Co., Ardmore, $80,992, T. C. Ottinger, Hinton, $124,468, Allen & Harrison, 315 Empire Bldg., Oklahoma City, $110,985; 12.278 mi. Federal Aid Project 82, Latimer Co., from V. C. Cossata, Oklahoma City (street address not available); 1.986 mi. Federal Aid Project 90, Carter Co., from Baum Constr. Co., Durant, $34,993. V. C. Cossata, Oklahoma City (street address not available), $63,345, Rheinhart & Donovan, 803 Tradesmen Natl. Bldg., Oklahoma City, $60,979.

California—State Hy. Dept., Sacramento, grading and asphalt macadam paving (1) 8.2 mi. road between Morrisons Crossing and Marysville, Yuba Co. (2) 8.2 mi. between Hollister and Pacheco Pass Rd., San Benito and Santa Clara Counties, (3) 14.2 mi. road between westerly boundary and Califa, Madera Co., grading and concrete paving (4) 1.8 mi. between Hercules and Rodeo, Contra Costa Co., grading (5) 7.4 mi. between Hueneme Rd. and Rindge Ranch, Ventura Co., from Blumenkranz & Vernon, Farmers & Merchants Bank Bldg., Stockton, (1) $141,275 (3) $238,172; W. E. Hall, 500 Market St., Riverside, (1) $190,575 (2) $164,636 (3) $224,494; Granite Constr. Co., Watsonville, (2) $131,732; J. Phillips, 637 Santa Rey Ave., Oakland, (2) $210,412; R. T. Shea, 169 West 7th St., Riverside, (3) $193,648; L. Tagnon, 1735 Napa St., Vallejo, (4) $33,519; Lord & Bishop, Cloverdale, (4) $40,851; T. M. Burns, 2207 N St., Sacramento, (4) $41,620; Hauser Constr. Co., 1109 Hobart Bldg., San Francisco, (5) $598,085; W. B. Arndt, Chronicle Bldg., San Francisco, (5) $599,644; Utah Constr. Co., 824 Phelan Bldg., San Francisco, (5) $627,285. Noted Dec. 7.

Calif., Daly City—Grading 37,000 cu.yd. in Vista Grand Park, from C. J. Lindgren, El Cerrito Ave., Burlingame, $1.25 per cu.yd.

Calif., Los Angeles—Improving Melrose Ave. between Seward and Gower Sts., (1) grading (2) 184,455 ft. concrete pavement (3) 57,200 ft. grading, oiling and rolling (4) 5,418 ft. curb (5) 8,752 ft. sidewalks, from W. Liddington, 420 East 60th St., (1) $7,309 (2) $0.23 (3) $0.059 (4) $0.52 (5) $0.195; Fairchild-Gilmore-Wilton Co., Los Angeles Ry. Bldg., (1) $9,300 (2) $0.25 (3) $0.08 (4) $0.60 (5) $0.21; W. D. McCray, Amer. Bank Bldg., (1) $6,500 (2) $0.24 (3) $0.07 (4) $0.54 (5) $0.20.

CONTRACTS AWARDED

N. Y., St. George—J. A. Lynch, pres. Richmond Boro, Boro Hall, repaving roadway of Bay St., granite block on 6 in. concrete, to M. I. Sachs, 246 South 9th St., Brooklyn, $34,128. Noted Dec. 14.

West Virginia—State Hy. Dept., Charleston, grading 5 mi. Union-Rock Camp Rd., Project 3045 Monroe Co., 26,250 lin.ft. clearing, 32,400 cu.yd. unclassified and 8,000 cu.yd. borrow excav., 839 cu.yd. concrete, 25,200 lb reinforcing, 1,410 lin.ft. 18 in. vitr. clay pipe, to J. Carola, Ronceverte, $62,972; 6 mi. Gilboa-Drennen Rd., Project 3047, Nicholas Co., 31,680 lin.ft. clearing, 73,700 cu.yd. unclassified and 3,450 cu.yd borrow excav., 618 cu.yd. concrete, 13,350 lb. reinforcing, 450 cu.yd. cement rubble masonry, 1,920 lin.ft. 18 in. vitr. clay pipe, to Tincher & Landacre, Richwood, $75,734; 6 mi. Sunset-Frost Rd., Project 3182 A, Pocahontas Co., 31,450 lin.ft. clearing, 61,400 cu.yd. unclassified and 1,100 cu.yd. borrow excav., 647 cu.yd. concrete, 9,265 lb. reinforcing, 2,030 lin.ft. 18 in. vitr. clay pipe, to B. C. Cornett, Independence, Va., $62,367; 5½ mi. Marrowbone-Crum Rd., Project 3188, Wayne Co., 27,300 lin.ft. clearing, 91,000 cu.yd. unclassified excav., 20,000 sta.yd. overhaul, 1,060 cu.yd. concrete, 28,000 lb. reinforcing, 1,750 cu.yd. cement rubble masonry, 1,400 lin.ft. 18 in. vitr. clay pipe, 10,000 cu.yd. borrow of rock for special rock fill, to C. E. Price, Huntington, $113,288; 8.3 mi. Gassaway-Frametown Rd., Project 3157, Braxton Co., 43,800 lin.ft. clearing, 125,000 cu.yd. unclassified and 43,721 cu. yd. borrow excav., 18,038 sta.yd. overhaul, 1,845 cu.yd. concrete, 138,638 lb. reinforcing, 2,994 cu.yd. cement and 2,363 cu.yd. dry rubble masonry, to Sutton Constr. Co., Ashland, Ky., $210,478; 8.2 mi. West Union-Ritchie Co. line Rd., Project 3160, Doddridge Co., 42,967 lin.ft. clearing, 90,000 cu.yd. unclassified and 15,570 cu.yd. borrow excav., 13,146 sta.yd. overhaul, 731 cu.yd. concrete, 9,001 lb. reinforcing, 3,016 lin.ft. 18-36 in. rein.-con. pipe, etc., to Rogers & Shumway, Worthington, $109,615; Valley Head-Webster Co. line Rd., Project 3033, Randolph Co., 62,840 lin. ft. clearing, 160,000 cu.yd. unclassified and 6,000 cu.yd. borrow excav., 5,000 sta.yd. overhaul, 1,340 cu.yd. concrete, 30,000 lb. reinforcing, 2,000 cu.yd. cement and 2,700 cu.yd. dry rubble masonry, 4,500 lin ft. 15-24 in. corrugated metal pipe, etc., to Belasco Constr. Co., Webster Springs, $187,244; 7 mi. Upper Tract-Grant Co. line Rd., Project 3014, Pendleton Co., 31,020 lin.ft. clearing, 50,000 cu.yd. unclassified and 3,900 cu.yd. borrow excav., 3,300 sta.yd. overhaul, 723 cu.yd. concrete, 9,000 lb. reinforcing, 1,820 lin.ft. 15-24 in. corrugated metal pipe, etc., to J. J. Battershell & Son, Virgilina, Va., $64,525; Northwestern Turnpike, Project 122 A, Mineral Co., 42,670 lin.ft. clearing, 55,000 cu.yd. unclassified excav., 19,000 sta. yd. overhaul, 1,050 cu.yd. concrete, 10,600 lb. reinforcing, 3,350 lin.ft. 15-24 in. corrugated metal pipe, etc., to J. J. Battershell & Son, Virgilina, Va., $79,032; grading and gravel surfacing 3 mi. St. Marys-Belmont Rd., Project 3078 A, Pleasants Co., 12,474 lin.ft. clearing, 36,000 cu.yd. unclassified and 5,425 cu.yd. borrow excav., 1,000 sta. yd. overhaul, 590 cu.yd. concrete, 410 cu. yd. cement rubble masonry, 706 lin.ft. 15-30 in. rein.-con. pipe, 7,400 cu.yd. gravel surfacing, etc., to Rogers & Shumway, Worthington, $54,707; 2.12 mi. New Martinsville-North Rd., Project 3082, Wetzel Co., 11,240 lin.ft. clearing, 9,350 cu.yd. unclassified excav., 129 cu.yd. concrete, 2,250 lb. reinforcing, 274 lin.ft. 15-18 in. rein.-con. pipe, 6,700 cu.yd. gravel surface, etc., to Ritchie & Ritchie, Ravenswood, $19,546; grading and paving with rock asphalt 7.5 mi. War-Newhall Rd., Project 3226, McDowell Co., to W. J. Weakland Co., Charleston, $290,421. Noted Nov. 30.

Fla., Chipley — For 20,000 sq.yd. one course concrete sidewalks, to J. F. Morgan Paving Co., Woodward Bldg., Birmingham, $1.33 per sq.yd.

Fla., Miami—Dade Co. paving with macadam Miami-Gardens Rd., to H. F. Duval, Miami, $11,891; Lemon City Rd., to H. L. Clark, Miami, $4,640; Ave. L and 42nd St. Rds., to S. Roundtree, Miami, $33,634; 83,500 sq.yd. oiling, to L. H. Lehman, Miami, $0.105 per sq.yd.

Alabama—State Hy. Dept., Montgomery, grading, surfacing and constructing creosoted timber bridges on 18.67 mi. highway from Montgomery Co. line to Union Springs, Federal Aid Projects 1 and 68, Bullock Co., to D. R. Cook & Co., Selma, $326,228; grading and gravel surfacing 13.897 mi. Opelika-Waverly Rd., Lee Co., to R. D. Chambers & Co., West Point, Ga., $172,049. Noted Dec. 21.

Alabama—State Hy. Dept., Montgomery, grading and paving with warrenite bitulithic on stone macadam 11.175 mi. Montgomery-Birmingham Highway from Calera to Chilton Co. line, Federal Aid Project 99, Sect. B, and 11.408 mi. Montgomery-Birmingham Highway, from Calera to Jefferson Co. line, Federal Aid Project 99, Sect. A, to W. T. Taylor Constr. Co., Wilsonville, $412,857 and $362,760 respectively. Noted Dec. 14.

Miss., McComb City—Pike Co., curbing, guttering, grading and building sidewalks, to Lawrence, Nixon & Phillips, Jackson, $100,000.

Ind., Laporte—Laporte Co., gravel surfacing 28,000 ft. Bear Rd., 16 ft., to G. M. Gross Constr. Co., Laporte, $43,900, engrs. est. $57,188; 9,000 ft. Bell Rd., 16 ft., to Taylor & Alkire, Laporte, $25,449, engrs. est. $26,000; grading and graveling 14,300 ft. Sellers Rd., 16 ft., to F. C. Teach, Rensselaer, $25,800, engrs. est. $32,489. Noted Sept. 28.

Ind., Terre Haute — Vigo Co. to Carpenter Constr. Co., Terre Haute (street address not available), graveling 8.5 mi. John N. White Rd., 30 ft., $84,002, engrs. est. $110,983; 13,400 ft. J. A. Crabb Rd., 16 ft., $25,978, engrs. est. $27,800; 11,220 ft. Fromme Rd., 30 ft., concrete, $80,762, engrs. est. $112,769; to J. M. Robertson, Terre Haute (street address not available), 2.25 mi. George Woodsmall Rd., 16 ft., $25,834, engrs. est. $25,512. Noted Dec. 7.

Ind., Warsaw—Paving 12,321 ft East Market St., 45 ft., 61,633 ft. asphalt on concrete, to Indiana Constr. Co., Warsaw, $93,951. Engrs. est. $97,500.

Ia., Mt. Ayr—Ringgold Co. grading Federal Aid Project 123, 37,900 cu.yd. excav. in connection with overhead crossing over Chicago Great Western tracks, also Project 141, 6 mi. road from Union Co. Line south toward here, 69,046 cu.yd. excav., to C. C. Barnes Co., 323 5th St., Des Moines, $29,099. Noted Nov. 30.

Ia., Mt. Ayr—Ringgold Co. grading 5.9 mi. primary road west and northwest of Kellerton, to B. N. Dilts & Son, Mason City, 111,868 cu.yd. excav. $0.265 per cu. yd., etc., total $29,645 Noted Dec. 7.

S. D., Canton—E. A. Jones, aud. Lincoln Co., gravel surfacing 17 mi. State Project 8, to Western Bridge & Constr. Co., 748 Peters Trust Bldg., Omaha, Neb. Noted Nov. 23.

Tex., Hondo — Medina Co. grading and gravel surfacing 23.53 mi. highway, 18 ft., to Kuykendall & Shelton, Temple, $149,388. Noted Dec. 7.

Oklahoma — State Hy. Dept., Oklahoma City, grading and concrete paving 3.492 mi. Federal Aid Project 86, Tulsa Co., to Standard Paving Co., 1742 East 6th St., Tulsa, earth excav. at $0.25, loose rock $0.60, overhaul $0 05, borrow $0.27, concrete $18.50, concrete paving $2.35, total $127,150. Noted Nov. 23.

Okla., Oklahoma City—Paving from Main to Linwood Sts., 1½ in. sheet asphalt. 1 in.

Streets and Roads (Continued)

[illegible] Co. [illegible] Natl. [illegible] $28,513.

Arizona—State Hy. Comn., [illegible] asphaltic concrete surfacing 5 mi. road in Pinal Co. from junction of Mesa-Superior Highway [illegible] westward toward Mesa, 18 ft., to Pacific Constr. Co., Home Builders Bldg., Phoenix, $61,776, [illegible] per cu.yd. and $0.30 per ton per mi. haulage.

Oregon—State Hy. Comn., Salem, cement concrete paving 5.67 mi. Holmes Gap-Rickreall Sect. state highway, Polk Co., 16 ft., to Oregon Contract Co., Blake-McFall Bldg., Portland, $135,000; 9.8 mi. Monmouth to Polk Co. line section, 16 ft., to Cummings & Lapoint, 922 Kelly St., Portland, $249,000.

Calif., Los Angeles—[illegible] between Crenshaw Blvd. and Arlington Ave., to G. R. Curtis, 2440 East 26th St., $114,417. Noted Nov. 23.

Calif., Los Angeles — Paving Lexington Ave. between Western Ave. and Gordon St., 123,513 sq.ft. warrenite bitulithic paving, 1,420 sq.ft. grading, oiling and rolling, 2,723 ft. curb, [illegible] sq.ft. walks, 6,842 sq. ft. gutter, etc., to G. H. Oswald, 366 East 5th St., $44,000.

Calif., San Diego—Improving Ft. Stockton Dr. et al., to Fairchilds-Gilmore-Wilton Co., Pacific Electric Bldg., Los Angeles, $39,071. Noted Nov. 2.

Industrial Works

PROPOSED WORK

Mass., Pittsfield—[illegible] Products Corp. plans electric manufacturing plant. $70,000 to $100,000. J. M. Vance, 24 North St., archt.

Mass., Springfield—Springfield Dairy System, 70 Ventura St., plans bottling plant, rein.-con., plain foundation. C. J. Grant, clk.

N. Y., Brooklyn—Brooklyn Edison Co., 360 Pearl St., soon takes bids new power plant, initial capacity, 2 units, 50,000 k.w. each, ultimate total capacity 400,000 k.w., Marshall St. $10,000,000. T. E. Murray, Inc., 55 Duane St., New York, archts. G. L. Knight, 360 Pearl St., engr. This corrects report in Dec. 21 issue.

N. Y., Dunkirk—Amer. Locomotive Co., 30 Church St., New York City, plans brick, addition to plant, here. $50,000. Architect not announced.

N. Y., Troy—Fuller & Warren Co., foot of Monroe St., will rebuild portion of works, on River St., which was recently destroyed by Fire. $55,000. Architect not announced.

N. J., Elizabeth—Amer. Type Fdry. Co., Communipaw Ave., Jersey City, plans administration building, 165 ft. long, and assembling plant, 600 ft. long, 1 and 2 story, West Grand St., here. $750,000. Day & Zimmerman, 611 Chestnut St., Phila., engr.

Pa., Tullytown—Megargee Paper Mills, 16 South 5th St., Phila., does not plan to build plant here. This corrects report in Nov. 30 issue.

Pa., Williamsport—Glosser Motor Car Co., 248 William St., plans 3 story and basement, 43 x 66 ft. rein.-con., brick and steel garage, William and West Church Sts. $50,000.

W. Va., Buckhannon—Belgrade Glass Co. plans 1 story 95 x 315 ft. corrugated iron or brick plant. Architect not selected.

W. Va., Kenova — [illegible] Bros. plan hardwood lumber mill. $60,000. Architect not announced.

W. Va., Logan — Kentucky and West Virginia Power Co., 30 Church St., New York City, having plans prepared by F. R. Weller, engr. Mills Bldg., Wash., D. C., 1 story and basement, 50 x 120 ft., boiler house addition, rein.-con., brick and steel. [illegible]

Ky., Paducah—Paducah Ice Co., [illegible] plans prepared by Pillsbury-Becker Eng. Co., archts., 119 South 11th St., St. Lauis, Mo., 2 story, 75 x 220 ft., ice plant, Soutn 3rd St. $700,000. Noted Nov. 30.

Ind., Evansville—Evansville Packing Co., Morgan Ave., having plans prepared by H. E. Boyle & Co., archts., Furniture Bldg., 3 story and basement, 31 x 42 ft. packing plant, rein.-con. and brick, concrete pile foundation. $45,000.

Ind., Ft. Wayne—Ft. Wayne Box Co., Calhoun and Superior Sts., plans factory, Superior St. $100,000. Architect not announced.

Ind., Indianapolis—Amer. Can Co., 120 Bway., New York City, plans 4 story and basement, 34 x 230 ft. factory, rein.-con., concrete pile foundation, South East St. $300,000. Private plans.

Ind., Lawrenceburg — Johnson & Klare Furniture Co. plans 3 story and basement. 80 x 300 ft. factory, stucco and frame. $58,000. Private plans.

Ind., Marion—Marion Machine and Fdry. Co. plans [illegible] 45 x 100 ft. machine and foundry addition, brick and steel, 3rd St. $100,000. H. Elder, Marion, archt.

Mich., Albion—Service Caster & Truck Co., c/o H. H. Sheldon, 316 East Porter St., soon lets contract 1 story, 50 x 200 ft. brick and steel factory $40,000. Private plans.

Mich., Albion—See "Buildings."

Mich., Grand Rapids — C. J. Litscher Electric Co., 41 Market Ave., plans to rebuild 3 story and basement, 60 x 130 ft., rein.-con. and brick factory, plain foundation, Market St., recently destroyed by fire. $150,000. Owen, Ames & Kimball, Michigan Trust Bldg., may build on cost plus basis.

Ill., Chicago—Electrical Dealers Supply Co., 162 West Randolph St., having plans prepared by S. N. Crowen, archt., 400 North Michigan Ave., 3 story, 100 x 250 ft. factory, rein.-con., brick and steel, Diversey Ave. near Oakley Ave. $150,000.

Ill., Chicago—Griswold & Walker, 1520 South Halsted St., having plans prepared by O. Van Gunten, archt., 26 East Huron St., 6 story, 100 x 126 ft. warehouse, rein.-con., brick and steel, 1525-35 Newberry Ave. $250,000.

Ill., Peoria — Meyer Furnace Co., 1300 South Washington St., plans to rebuild its factory recently 2destroyed by fire. $100,000.

Wis., Cudahy—Milwaukee Vinegar Co., 79 Buffalo St., Milwaukee, having plans prepared by E. R. Leibert, archt., 432 Bway., Milwaukee, 3 story, 100 x 110 ft., yeast factory, brick and steel, here.

Wis., Iron River—See "Waterworks."

Wis., Madison — Capitol City Garage, South Pinckney St., having plans prepared by F. L. Kronenberg, archt., Carroll Bldg., 2 story, 66 x 165 ft., garage and repair shop, brick, rein.-con. and steel, plain foundation, Washington St. $60,000.

Wis., Madison — L. F. Schoelkopf, 210 East Washington Ave., plans 1 story, 66 x 150 ft., garage and automobile supply station, brick, rein.-con. and steel, plain foundation, East Main St. $50,000. Architect not selected.

Wis., Madison—Wisconsin State Hospital Comn., c/o W. F. Lorenz, Mendotta St., having plans prepared by A. Peabody, archt., Capitol Bldg., 1 story, 45 x 124 ft., brick and rein.-con. garage. $40,000.

Wis., Milwaukee — R. L. Clark, 2218 Meinecke Ave., having plans prepared by C. H. Thoringer, archt., 3328 State St., 2 story and basement, 100 x 140 ft., brick and concrete garage, plain foundation, 20th St. $65,000.

Wis., Stetsonville—Ripon Produce Co., c/o A. E. Wells, secy., Ripon, plans 1 story, 50 x 95 ft., brick, rein.-con. and steel dairy, plain foundation, here. $40,000. Architect not selected.

Wis., Stevens Point—Consolidated Water Power & Paper Co., Wisconsin Rapids, having plans prepared by L. A. De Guere, engr., Wisconsin Rapids, 2 story, paper mill and hydro electric generating plant, brick, rein.-con. and steel, plain foundation. $300,000.

Wis., Stratford — Stratford Light & Power Co. plans hydro electric generating plant with steam auxiliary and distribution system, brick, rein.-con. and steel, plain foundation. $65,000. Architect not selected.

Wis., Waunakee—Waunakee Canning Co., c/o A. P. Kenney, Waunakee State Bank, plans 2 story, 60 x 95 ft., brick, rein.-con. and steel factory, plain foundation. $100,000. Architect not selected.

Wis., Waupaca—[illegible] Light & Power Co. had plans prepared hydro electric generating and power plant, brick and steel, plain foundation. $50,000. Private plans.

Minn., St. Paul—L. W. Jordan Co., 118 West 7th St., plans 2 story and basement, [illegible] building, rein.-con. and brick, 118 West 7th St. $65,000. Architect not announced.

Okla., Canton—See "Waterworks."

Okla., Weatherford—Having plans prepared power plant, waterworks and electric light extensions. $114,000. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs.

Wash., Walla Walla—Whitman College plans central heating plant, on Campus. [illegible]

Ore., Astoria—Hammond Lumber Co., Astoria, will build sawmill, planing mill, sash, door and box factory, to replace plant recently destroyed by fire. $700,000. Work will probably be done by day labor.

Ore., Portland—See "Miscellaneous."

Calif., Petaluma—Petaluma Ice & Cold Storage Co., (branch of Natl. Ice & Coal Storage Co., Postal Telegraph Bldg., San Francisco), had plans prepared alterations, additions and installation of equipment in cold storage plant, rein.-con., here. Cost incl. equipment $100,000. Private plans.

Calif., Stockton—H. Cowell Estate, c/o W. H. George, secy., 2 Market St., San Francisco, having plans prepared by H. H. Meyers, archt., Kohl Bldg., San Francisco, 1 or 2 story, 80 x 100 x 150 ft., rein.-con. garage, Hunter and Channel Sts., here. $50,000.

Que., Terrebonne—Limoge & Co., plans 40 x 80 ft. rein.-con. and cement factory. $45,000. Work will probably be done by day labor.

Ont., Port Arthur—Pub. Utilities Comn. requested Hydro Electric Comn. of Ontaria, University Ave., Toronto, to install additional unit in Cameron Falls power plant on Nipigon River. F. A. Gaby, University Ave., Toronto, ch. engr.

Ont., Toronto — Kellogg Toasted Corn Flakes Co., 40 Strachan Ave., purchased site on Victoria Park Ave. and plans to build concrete, brick and steel factory next year. $150,000.

BIDS DESIRED

Pa., Erie — M. Griswold, c/o Griswold Mfg. Co., Erie, taking bids 2 story and basement, 100 x 150 ft. brick garage, 20th and State Sts. $40,000. Private plans. Northwestern Motor Co., Erie, lessee.

S. C., Great Falls — Jan. 15, by R. S. Mebane, pres. Republic Cotton Mills, 1 story, 400 x 4,000 ft., rein.-con. mill. $500,000. J. E. Sirrine, South Main St., Greenville, archt.

Ind., Evansville—Evansville Packing Co., Morgan Ave., taking bids 3 story, 31 x 42 ft. packing plant, rein.-con. and brick, concrete pile foundation. $45,000. H. E. Boyle & Co., Furniture Bldg., archts.

Ill., Chicago—Nelson Bros., c/o O. Van Gunten, archt., 26 East Huron St, receiving bids 3 story, 50 x 125 ft., rein.-con., brick and steel auto sales and repair shop, 6310-14 Bway. $100,000.

Tex., Waco—Jan. 10, by M. W. Scott & Co., archts., 412½ Franklin St., 4 story, 54 x 104 ft., loft and warehouse, rein.-con. and brick, plain foundation, for Weatherred Transfer & Storage Co., 623 Jackson St. $75,000.

Calif., Oakland—California Packing Corp., 101 California St., San Francisco, receiving bids, factory and warehouse, each 1 and 2 story, rein.-con. and brick, 1st and Filbert Sts., here. P. Bush, 101 California St., San Francisco, engrs.

Calif., San Francisco—A. S. Bugbee, archt., 26 Montgomery St., receiving bids 2 story and basement, rein.-con., garage and service station, capacity 300 cars, 2 street frontages 150 ft. and 130 ft., Stevenson St. between Ecker and Jessie Sts., for Stevenson Garage, Inc., c/o architect. To exceed $40,000. Noted Dec. 14.

CONTRACTS AWARDED

Mass., Holyoke—D. O'Connells Sons, 480 Hampden St., will build 2 story, 110 x 120 ft. garage, brick, plain foundation, Dwight St., by day labor. $50,000.

Pa., Monessen—Monessen Fdry. & Machine Co., 1 story, 32 x 100 ft. plant, to Pittsburgh Bridge & Iron Wks., Rochester.

Pa., Phila.—Breyer Ice Cream Co., 8th and Cumberland Sts., 2 story, factory, 43rd and Woodland Sts., to W. F. Kollee & Co., 2601 Oxford Ave., $45,000.

Pa., Pittsburgh — Superior Auto Accessories Co., 1342 Forbes St., 1 story and basement, 100 x 145 ft. and 78 x 120 ft. garage, Baum Blvd. and Woodworth Ave., to Conley & DeMey, 127 North Hiland Ave Archts. est. $50,000. Noted Dec. 14.

Va., Alta Vista—Alta Vista Cotton Mill Co. 3 additions to plant, brick and timber to Palmer-Spivey Co., Elizabeth Ave., Charlotte, N. C., $100,000.

La., Baton Rouge—Bd. Regents of Louisiana State University, 1 story, engineering shop and power plant, 325 ft. long with four 100 ft. wings, concrete and brick, to Estes, Williams & Ragsdale, Scimitar Bldg., Memphis, Tenn., $147,158.

Ind., Indianapolis—Amer. Can Co., 120 Bway., New York City, 1 story and basement, 34 x 230 ft. factory, rein.-con., brick and terra cotta tile, to Ferro-Concrete Constr. Co., 3rd and Elm Sts., Cincinnati, O. Archts. est. $300,000.

Industrial Works (Continued)

Ind., Labanon Cline & Hicks will build 40 x 40 ft. and 60 x 100 ft. machine and service stations, both 1 story, by day labor. $400,000. Private plans.

Mich., Detroit—Michigan Stamping Co., 11631 Mack Ave., 1 story, 140 x 347 ft. rein.-con., brick and steel factory, Mack Ave., to A. A. Albrecht Co., 1130 Penobscot Bldg.

Ill., Chicago—A. S. Alschuler, archt., 28 East Jackson Blvd., 3 story, 125 x 125 ft. printing plant, rein.-con., brick and steel, Congress and Laflin Sts., to J. W. Snyder, 116 South Michigan Ave. Archts. est. $250,000. Owner's name withheld. Noted Oct. 26.

Ill., Chicago—Yellow Cab Mfg. Co., 57 East 21st St., 1 story, 198 x 368 ft. assembling factory, rein.-con., brick and steel, 5801 Dickens Ave., to Buckley & Anderson, 2040 West Harrison St. Archts. est. $350,000.

Wis., Janesville—J. A. Strimple, 219 East Milwaukee St., 2 story, 113 x 190 ft., garage and pump shop, brick, rein.-con. and steel, plain foundation, Milwaukee St., to T. S. Willis, 328 Hayes Blk. Archts. est. $45,000.

Wis., Madison—University of Wisconsin, 4 story, 62 x 68 ft. service station, incl. garage, electric substation, woodworking shop, etc., brick, rein.-con. and steel, plain foundation, to J. H. Findorff, 601 West Wilson St., $78,987. Archts. est. $85,000.

Wis., Madison — Valvoline Oil Co., 815 East Main St., 2 filling stations and warehouse, brick and rein.-con., plain foundation, to A. D. and J. V. Frederickson, 702 East Main St. Archts. est. $40,000. Noted Nov. 30.

Wis., Merrill—Merrill Handle Co. 1 story, 100 x 108 ft., factory and warehouse incl. cupola, brick and rein.-con., plain foundation, to E. Schield, Merrill. Archts est. $40,000.

Wis., Milwaukee—Milwaukee Gas Specialty Co., 2017 Clybourn St., 1 story and basement, 45 x 115 ft., addition to factory, brick and concrete, plain foundation, to H. Danischefsky, 1484 Humboldt Ave. $45,-000. Noted Nov. 30.

Calif., San Jose—De-Hi Food Products Co. will build dehydrating plant, on 5 acre site, Union Ave., here, by day labor. A. P. Marston, of California Prune and Apricot Growers Co., San Antonio and Market Sts., pres. Architect not selected.

Ont., Ford—Ford Motor Co. of Canada, first unit of rein.-con., brick and steel plant here, general contract to Wells & Gray, Confederation Life Bldg., Toronto; steel to Canadian Bridge Co., Walkerville. Total est. $1,000,000. Noted Nov. 30.

Buildings

PROPOSED WORK

N. H., Keene—Theater—D. Latchis, Brattleboro, Vt., plans 2 story, brick, here. $150,000.

Mass., Holyoke — Clubhouse — Aerie of Eagles, c/o D. Mullen, 142 Elm St., plans 3 story. $300,000. Architect not selected.

Mass., Holyoke—Y.M.C.A., 367 High St., plans 4 or 5 story, brick, plain foundation, Appleton St. $200,000-$300,000.

Mass., Northampton — Gymnasium — Smith College having sketches made by J. W. Ames and E. S. Dodge, archts., 15 Exchange St., Boston, 2 story. $300,000.

Mass., Northampton—Music Hall—Smith College having plans prepared by Delano & Aldrich, archts., 126 East 38th St., New York City, music hall. $400,000.

Mass., Springfield—Apartment—N. Nirenstein, 387 Main St., plans 4 story, Maple St. $300,000.

Mass., Springfield—Office—L. W. Besse, 21 Besse Pl., having plans prepared by Brown & Von Beren, archts., Church St., New Haven, Conn., 6 story, 70 x 112 ft., brick, plain foundation. $250,000.

Mass., Springfield—Station—Boston & Albany R.R., South Station, Boston, plans railroad station, Liberty St., here. $4,000,000.

R. I., Providence—Office—Providence Gas Co., Turks Head Bldg., plans large office building, Weybosset and Orange Sts. Architect not selected.

Conn., Bridgeport—Church—St. Stephens Roman Catholic Church, 330 Spruce St., plans 1 story and basement, stone or brick, Fairfield Ave. and Bird St. $200,000. S. F. Chernitzky, pastor. Architect not selected.

N. Y., Brooklyn—School—Bd. Educ., 500 Park Ave., New York, having plans prepared by C. B. Snyder, archt. and engr., Flatbush Ave. extension and Concord St., P. S. 203, brick, steel and stone, plain foundation Ave. M. and East 51st St., here. $600,000.

N. Y., Glenmorris (Jamaica P. O.) — School—Bd. Educ., 500 Park Ave., New York City, having plans prepared by C. B. J. Snyder, archt. and engr., Flatbush Ave. extension and Concord St., Brooklyn, P. S. 121, brick, steel and stone, plain foundation, Shuwanee Ave., here. $500,000.

N. Y., New York — High School — Bd. Educ., 500 Park Ave., soon receives bids George Washington High School, 4 story, 246 x 376 ft., brick, steel and stone, 535-589 Audubon Ave., $2,240,000. C. B. J. Snyder, Flatbush Ave. Extension and Concord St., Brooklyn, archt. and engr.

N. J., Newark—Temple—Salaam Temple A.A.O.N.M.S., 1020 Broad St., rejected bids brick and stone, plain foundation, Broad St. $1,000,000. Will readvertise. F. Grad, 245 Springfield Ave., archt. Noted Dec. 22.

Pa., Harrisburg—Bank—Keystone Bank of Harrisburg, 3rd and Calder Sts., plans 3 story and basement, 110 x 120 ft., brick, steel and stone, 3rd St. $200,000.

Pa., Jersey Shore—High School—Bd. Educ. plans 2 story, brick. $150,000. Architect not announced.

Pa., Kingston—High School—Bd. Educ. plans new brick high school, Wyoming Ave. $200,000. Architect not selected.

Pa., Phila.—Apartment—Stetler & Deysher, archts., 1484 North 52nd St., soon take bids 3 story and basement, 92 x 117 ft. brick, steel and stone, plain foundation, 48th and Walnut Sts. $200,000. Owner's name withheld.

Pa., Phila. — Chapel — Phila. Divinity School, 42nd and Locust Sts., soon takes bids 1 story and basement, rein.-con., brick, steel and stone, plain foundation, 42nd and Locust Sts. $250,000. M. B. Medary, Otis Bldg., archt.

Pa., Phila.—Synagogue—H. H. Kline, archt., Bulletin Bldg., soon takes bids 3 story and basement, 80x95 ft. brick, steel and stone, plain foundation, Hutchinson and Warrnock Sts. $150,000. Owner's name withheld.

Pa., Pittsburgh—High School—Bd. Educ. having plans prepared by W. G. Eckles, archt., New Castle, brick school with 24 class rooms, gymnasium and auditorium, 10th and Pennsylvania Aves. $325,000.

Md., Baltimore—Club—City Club having plans prepared by C. N. and N. Friz, archts., Lexington Bldg., 6 story, ornamental terra cotta and fireproof construction, Saratoga and St. Paul Sts. $500,000. H. F. Doelman, 507 North Charles St., consult. structural engr.

Md., Baltimore — Lodge — Knights of Pythias, 129 North Gay St., having plans prepared by C. N. and N. Friz, archts., Lexington Bldg., 4 story, brick and stone, Charleston and Preston Sts. $600,000. J. M. Hendricks, secy.

W. Va., Morgantown—Hotel—Morgantown Hotel Co., plans hotel, High and Chestnut Sts. $500,000. J. H. Poling, pres. Architect not selected.

N. C., Burlington—School—Jan. 9, to vote on $150,000 bonds for schools.

N. C., Raleigh—Hotel—G. L. Preacher & Co., archts., Raleigh, and Healy Bldg., Atlanta, Ga., preparing plans 8 story and basement, stone, brick and terra cotta, West Martin St. $250,000. Owner's name withheld.

Fla., Frostproof — Station—See "Railways.

Miss., Jackson—Office—Lamar Life Insurance Co. plans 15 story, North Congress St. $750,000. Architect not selected.

Miss., Vicksburg — Schools — Plans 2 schools, brick, plain and concrete pile foundations, Cherry St. $425,000 bonds sold. Architect not selected.

Ky., Frankfort—High School—Plan to vote on $150,000 bonds in January, for high school. A. L. Gordon, member city council.

Ky., Louisville—Home—B. P. O. E. had plans prepared by Joseph & Joseph, archts., Francis Bldg., 8 story and basement, 3rd and Chestnut Sts. $1,000,000.

Ky., Louisville—Station and Office—Louisville Ry. Co., Traction Bldg., plans 2 or 3 story, 200 x 500 ft. J. P. Barnes, pres.

O., Cleveland—Dormitory—Y.W.C.A., c/o A. Ewart, secy., 3105 Franklin Ave., plans 3 story, brick, steel and concrete, Franklin Ave. $200,000. Hubbell & Benes, 4500 Euclid Ave., archts.

O., Cleveland—High School—Bd. Educ. of Mayfield School Dist., c/o G. Gilmore, clk., Chagrin Falls, plans 3 story, brick, steel and concrete, near here. $225,000. Fulton, Taylor & Cahill, 8120 Euclid Ave., Cleveland, archts.

O., Cleveland—Hotel—Ledge Lawn Manor Co., c/o T. Perrin, vice-pres., Cleveland Discount Bldg., plans 2 story, brick and timber hotel, riding academy and golf course, Richfield and Peninsula Rds. $300,000. Architect not selected.

O., Dayton — Office — United Brethren Church, rejected bids opened Dec. 1, 14 story, 60 x 128 ft., and 7 story addition to adjoining structure, rein.-con., tile and brick, 4th and Main Sts. $850,000. Will readvertise. Noted Nov. 30.

O., East Cleveland (Cleveland P. O.)—School—Bd. Educ. plans 3 story, 40 room, brick, steel and concrete, Euclid and Grasmere Aves. $800,000. Architect not selected.

O., Greenville—High School—Bd. Educ. having plans prepared by W. B. Ittner, archt., 911 Locust St., St. Louis, Mo., 3 story, about 150 x 175 ft., rein.-con. and brick, plain foundation. $500,000.

O., Lakewood (Cleveland P. O.)—Apartment—I. Lerman and F. Libman, 3219 East 117th St., Cleveland, having plans prepared by Braneman & Havermaet, archts., 801 Ulmer Bldg., Cleveland, 3 story and basement, 102 x 160 ft., brick and timber, plain foundation, Clifton Blvd., near Cove Ave. $200,000.

Ind., Gary—Store and Office—Minas Furniture Co., 158 State St., Hammond, having plans prepared by W. E. Berry, archt., 212 East Superior St., Chicago, 3 story and basement, 50 x 150 ft., brick, Bway. $160,000.

Ind., Greensburg — Dormitory — I.O.O.F. Lodge of Indiana, Odd Fellows Bldg., Indianapolis, plans 3 story and basement, brick, here. $150,000. C. Brossman, Merchants Bank Bldg., Indianapolis, archt.

Ind., Hammond—Hotel—Hammond Hotel & Improvement Corp., c/o Crane & Franzheim, archts., 127 North Dearborn St., Chicago, having plans prepared 4 story, rein.-con. and brick. $500,000. Noted Oct. 12.

Ind., Huntington—Hotel—J. F. Bippus, 841 North Jefferson St., plans 8 story and basement, 133 x 146 ft., brick and steel. $500,000. Private plans.

Ind., Indianapolis — Apartment — Chadwick Realty Co., 420 Merchants Bank Bldg., plans 3 story and basement, 70 x 205 ft., brick and stone, 1105 North Pennsylvania St. $200,000. Architect not selected.

Ind., Indianapolis—Community—Christamore Settlement Assn., 901 King Ave., plans 2 story and basement, West Michigan St. $150,000. W. E. Russ, Meridian Life Bldg., archt.

Ind., Marion — High School—Bd. Educ. having revised plans prepared by H. G. Bowstead, archt., 2 story and basement, 140 x 220 ft., brick, 36th St. $300,000. Noted July 27.

Ind., Terre Haute—High School—Bd. Educ. had revised plans prepared by Johnson, Miller & Miller, archts., 30 North 5th St., 2 story and basement, 220 x 400 ft., rein.-con. and brick, concrete pile foundation, 25th St. $700,000. Warren & Lewis, Realty Bldg., Louisville, Ky., engrs. Noted Oct. 19.

Mich., Albion — Dormitory, Gymnasium, etc. — Albion College, having preliminary plans prepared by H. K. Ferguson, archt., 6523 Euclid Ave., Cleveland, O., 3 story and basement, rein.-con. dormitory, plain foundation, $150,000; 1 and 2 story and basement, gymnasium and central heating plant, rein.-con. and brick, plain foundation, $250,000.

Mich., Albion—Hospital—J. W. Sheldon Memorial Assn., 316 East Porter St., having plans prepared by A. Wood, archt., 3513 Woodward Ave., Detroit 4 story and basement, 90 x 100 ft. rein.-con., plain foundation, South Superior St. $150,000.

Mich., Detroit Apartment—P. R. Rossello, archt., 406 Congress Bldg., preparing plans 3 story and basement, 110 x 140 ft. brick and steel, plain foundation, Cass Ave. $225,000. Owner's name withheld.

Mich., Detroit—Apartment—J. I. Weinberg, archt., 401 Congress Bldg., preparing plans 4 story and basement, 40 ft. high, 42 x 170 ft., rein.-con., brick and steel, plain foundation, Peterboro St. $200,000. Owner's name withheld.

Mich., Detroit—Bank and Office—First State Bank & Security Trust Co., Griswold St., plans 4 story and basement, 74 x 130 ft. rein.-con., brick and steel, Griswold and Lafayette Sts. $500,000. Architect not selected.

Mich., Detroit — Church — West Grand Blvd., Methodist Episcopal Church, West Grand Blvd. and 12th St., having plans prepared by W. E. N. Hunter, archt., 1436 Washington Blvd., 2 story and basement, brick, steel and stone, plain foundation, West Grand Blvd. and 12th St. $200,000.

Buildings (Continued)

Mich., Detroit—[illegible] W. [illegible] Bldg., M[illegible] [illegible] W. [illegible] Washington [illegible] concrete, brick and steel, plain foundation, [illegible].

Mich., Detroit—[illegible] 2 story and basement, 110x145 ft. rein.-con., brick and steel, plain foundation. Kirby Ave. [illegible].

Mich., East Lansing—[illegible] Pond & Pond, archts., [illegible] Ave., Chicago, and takes bids early in spring, 3 story [illegible] basement 115 x 125 ft. rein.-con. and brick, plain foundation, Grand River Ave. $400,000.

Mich., East Lansing—[illegible]—E. Bowd, archt., 127 West Allegan St., Lansing, preparing plans and takes bids in spring, 3 story and basement, 40x185 ft. rein.-con. and stone, plain foundation, here, for Michigan Agricultural College. $400,000.

Mich., Jackson—[illegible] State Prison having preliminary plans prepared by Smith, Hinchman & Grylls, archts., 800 Marquette Bldg., [illegible] prison, may be built in units at North Farm. $5,000,000.

Mich., Lansing—Hotel—Lansing Hotel Corp., Lansing, having plans prepared by W. S. Holmes Co., archts., Tussing Bldg., 11 story and 2 basements, 110 x 132 ft. rein.-con. and brick, Michigan Ave. $1,000,000.

Mich., Lansing—Temple—E. A. Bowd, archt., 127 West Allegan St., takes bids early in spring, 5 story and basement, 70 x 140 ft. rein.-con. and brick, for Masonic Assn., c/o E. Gibbs, American State Savings Bank. $400,000.

Ill., Chicago—[illegible] A. Lindstrom, c/o C. W. Westerlind, archt., 179 West Washington St., plans 3 story and basement, rein.-con., brick and steel, 4520 Drexel Blvd. $500,000.

Ill., Chicago—Apartment—J. Rosenberg, c/o Rissman & Hirschfeld, archts., 139 North Clark St., having plans prepared three 3 story and basement, 125 x 169 ft., rein.-con., brick and steel, Everrett and 55th Sts. $1,500,000.

Ill., Chicago—Apartment—Yates Building Corp. c/o Leichenko & Esser, archts., 38 South Dearborn St., soon lets contract 4 story, 200 x 250 ft., rein.-con., brick and steel, Yates St., between 71st and 72nd Sts. $600,000.

Ill., Chicago—Church—St. Gregory Roman Catholic Congregation, 1634 Gregory St., having plans prepared by Comes, Perry & McMullen, archts., Renshaw Bldg., Pittsburgh, Pa., 1 story and basement, 60 x 150 ft., brick and stone. $150,000.

Ill., Chicago—Office—C. A. Eckstrom, archt., 5 North La Salle St., preparing plans 4 story, 62 x 197 ft., rein.-con., brick and steel addition to Garland Bldg., Wabash Ave. and Washington St. $500,000. Owner's name withheld.

Ill., Chicago—Hotel—Fullerton Plaza Hotel Co., 508 Fullerton Parkway, having plans prepared by Olsen & Urbain, archts., 155 North Clark St., 5 story, 96 x 179 ft., rein.-con., brick and steel addition. $350,000.

Ill., Chicago—Hotel—Lincoln Square Hotel Co., c/o Olsen & Urbain, archts., 155 North Clark St., having plans prepared 4 story, 130 x 175 ft., rein.-con., brick and steel, 525-29 Arlington Pl. $500,000.

Ill., Chicago—Store and Office—I. M. Mills, c/o Ludgin & Leviton, archts., 53 West Jackson Blvd., plans 2 story and basement, 100 x 120 ft., rein.-con., brick and steel, 6922-28 South Halsted St. $175,000.

Wis., Appleton—[illegible] Masonic Temple Assn., c/o G. Buchanan, pres., 817 College Ave., having plans prepared by [illegible] Jefferson St., Milwaukee, 2 story and basement [illegible].

Wis., Madison—Hotel—Piper Bros. Co., 31 North Pinckney St., having plans prepared by Baech & Lippert, archts., Gay Bldg., 10 story, 101 x 164 ft., brick rein.-con. and steel, plain foundation, Mifflin St. $850,000.

Wis., Madison—[illegible] c/o F. Kessinick, mgr., 26 North Carroll St., plans 2 or 4 story, 60 x 155 ft., brick, rein.-con. and steel, plain foundation. $150,-000. Architect not selected.

Wis., Madison—Store—Apartment—R. A. Phillips, archt., 315 Beaver Bldg., preparing plans 4 story, 75 x 190 ft., brick, rein.-con. and steel, plain foundation. $150,000. Owners name withheld.

Wis., Milwaukee—Apartment—H. [illegible] Schwartz, 482 Van Buren St., having plans prepared by H. G. Lotter, archt., 427 Milwaukee St., 3 story and basement, 46 x 110 ft., brick, plain concrete foundation, Cass [illegible].

Wis., Milwaukee—Church—St. Catherines Congregation, plans, c/o R. L. Kuhn, chn. building com., 548 12th St., 1 story and basement, brick and tile, plain foundation, Center St. $150,000.

Wis., Milwaukee—Club House, etc.—Blue Mound Country Club, c/o G. F. Gregg, secy., 437 East Water St., plans brick and tile, or ordinary construction club house, incl. golf links, Kilbourn and Loomis Rds. $250,000. Architect not selected.

Wis., Milwaukee—Club House and Com-[illegible] N. 137, Plankinton Arcade, plans brick and concrete, plain foundation, to replace one recently destroyed by fire. $150,000-$200,000. Architect not selected.

Wis., Mineral Point—High School—Bd. Educ. having plans prepared by E. Tough, archt., Conklin Bldg., Madison, 2 story, 80 x 110 ft., brick, rein.-con. and steel, plain foundation. $150,000.

Wis., Racine—Store—Lodge—Columbus Bldg. Assn., 1600 Racine St., having plans prepared by Racine Constr. Co., archts., 468 College Ave., 3 story, 60 x 114 ft., brick, rein.-con. and steel, plain foundation. $150,000.

Wis., Rice Lake—High School—Bd. Educ. having plans prepared by E. J. Hancock, archt., Eau Claire, 2 story, 75 x 195 ft., high and vocational school, brick, rein.-con. and steel, plain foundation. $150,000.

Wis., Verona—Asylum—Dane Co., Court House, Madison, plans 4 story, 100 x 140 ft., asylum, incl. cold storage plant, brick, rein.-con. and steel, plain foundation. $150,000. M. Sommers, chn. Architect not selected.

Kan., Kansas City—Office and Store—H. and F. Jennings, 754 Minnesota Ave., plans 2 story and basement, rein.-con. and brick. $[illegible]. Architect not selected.

Kan., Manhattan—Church—Methodist Church Congregation takes bids about Jan. 15, 2 story and basement, 60 x 120 ft., brick and stone. $200,000. T. W. Williamson & Co., 312 Central Natl. Bank Bldg., Topeka, archts.

Kan., Pittsburgh — Temple — Shrine Mosque having plans prepared by J. W. Williams & Co., archts., 312 Central Natl. Bank Bldg., Topeka, 4 story and basement, 140 x 140 ft., rein.-con. and brick. $300,000.

Kan., Topeka—Office—Kansas Life Insurance Co., 701 Jackson St., takes bids about Jan. 15, 4 story and basement, 50 x 120 ft., rein.-con. and brick. $150,000. T. W. Williamson & Co., 312 Central Bank Bldg., archts.

Neb., Falls City—Courthouse—Richardson Co. having plans prepared by W. F. Gernandt, archt., 634 Keeline Bldg., Omaha, 3 story. $200,000.

Mo., St. Louis—School—Bd. Educ., 911 Locust St. having preliminary plans prepared by A. Milligan, archt. and engr., 911 Locust St., 3 story, 12 room, ultimately 24 room school for colored, rein.-con. and brick, plain foundation, 23rd and Walnut Sts. $200,000.

Tex., Dallas — **Club** — Dallas Lodge 44, I. O. O. F., 1821 Young St., having preliminary plans prepared and takes bids early in 1923, club at Cabell and Pearl Sts. $150,-000. S. S. Cochran, chn.

Tex., Dallas—College—St. Marys College, Garrett and Ross Aves., making plans college. $200,000. Architect not announced.

Tex., Dallas—Hotel—H. S. Green, archt., Maverick Bldg., San Antonio takes bids early in 1923, 14 story and basement, 75 x 200 ft., steel, brick and tile, plain foundation, for C. L. Sanger, 2429 South Blvd. and associates. $400,000.

Tex., Dallas — Market — City having sketches made by C. D. Hill & Co., archts. and engrs., Sumpter Bldg., 2 story and basement, 200 x 200 ft. Election in April to vote on $500,000 bonds.

Tex., Ft. Worth—Club—Ft. Worth Club, 106 West 6th St., plans club, about 12 story, at Throckmorten and 7th Sts. $1,-500,000. Engineer not selected.

Tex., Houston—Library—City Comn. takes bids early in 1923 for library. $200,-000. W. A. Dowdy, City Hall, archt. and engr.

Tex., Lubbock—Church—First Baptist Church had preliminary plans prepared church. $150,000. Address Chairman building com. Architect not selected.

Tex., Port Arthur — Grade School — Bd. Educ. having plans prepared by W. B. Ittner, archt., 911 Locust St., St. Louis, Mo., 2 story, 80 x 232 ft., rein.-con. and brick, plain foundation, to contain gymnasium, auditorium, manual training shops, etc., De Queen Blvd. $150,000.

Tex., Port Arthur — High School — Bd. Educ. having preliminary plans prepared by W. B. Ittner, archt., 911 Locust St., St. Louis, and takes bids about Jan. 19, two 2 story, 145 x 160 ft. wings, brick, steel and tile, concrete foundations, one to Manual Training School other to Commercial High School, $200,000 each, also 1 story, 30 x 65 ft. boiler house, concrete stacks, etc., $100,000.

Okla., Okmulgee—Community—Election soon to vote on $175,000 bonds 2 story and basement, 120 x 140 ft., rein.-con., brick and terra cotta, North Alabama Ave. Architect not selected.

Okla., Tulsa—Bank and Office—Central Natl. Bank, 2nd and Boston Sts., having plans prepared by H. H. Mahler Co., archts., 231 Lynch Bldg., 15 story and basement, 50 x 140 ft., rein.-con., brick and terra cotta, 2nd and Boston Sts. $1,000,000.

Wash., Centralia—Hotel—Company being formed to build hotel. $200,000. J. Agnew Chn. Address Secretary of Commercial Club.

Calif., Alameda—Temple—Masonic Temple Assn., c/o C. Werner, archt., Santa Fe Bldg., San Francisco, had plans prepared 2 story, rein.-con., Alameda and Park Sts. $150,000.

Calif., Bakersfield—Hotel and Store—T. J. Coleman, mgr. St. Francis Hotel, San Francisco, interested in company being organized to construct 6 story, 19th and I Sts. $500,000. Architect not selected.

Calif., Berkeley — **Office** — Physicians Bldg., Inc., c/o McWethy & Greenleaf, archts., 505 17th St., Oakland, take bids in January, 4 story, concrete, Channing Way. $150,000.

Calif., Oakland—Administration—Alameda Co. having plans prepared by H. H. Meyers, archt., Kohl Bldg., San Francisco, 2 story, rein.-con. and terra cotta, 14th Ave. and East 27th St. To exceed $150,000.

Calif., Sacramento—Schools—City had plans prepared by E. A. Mathews and H. Simpson, archts., Call Bldg., San Francisco, and takes bids in January, eight 1 and 2 story, brick, steel, concrete and terra cotta buildings, 34th, 35th, U and V Sts. $540,000.

Calif., Oakland — Store — Whitthorne & Swan, 1015 Washington St., had plans prepared by W. Knowles, archt., Hearst Bldg., San Francisco, and Central Bank Bldg., Oakland, 1 and 3 story and basement, rein.-con., Washington and 10th Sts.

Calif., San Francisco—Theatre—A. S. and J. L. Levin, c/o Reid Bros., archts., 105 Montgomery St., having plans prepared theatre, 2,000 seating capacity, Geary St. and 18th Ave. $250,000.

Calif., Santa Barbara—Hotel—Recreation Center had sketches made by J. Morgan, archt., Merchants Exch. Bldg., San Francisco, 3 story, brick, Anacapa and Carrilo Sts. $150,000.

Que., Hull—Schools—Catholic School Bd. takes bids in spring, new schools. $300,000. Architect not selected.

Que., Montreal—University—McGill University, Sherbrooke St. W., plan 3 story 92x242 ft. addition, University St. $328,000. A. Currie, principal.

Ont., London—City Hall—A. M. Piper, building inspector, City Hall, preparing plans and takes bids about March 1, for new city hall, nornamental brick and stone. $300,000.

Ont., Meaford—School—Bd. Educ. plans 2 story and basement, 45 ft. high, 8 room, concrete, brick and steel addition. $150,-000. Architect not selected.

Ont., Pembroke—School—Bd. Educ. having plans prepared by W. C. Keighley, archt., 156 Pembroke St., E., 2 story and basement, 8 room, concrete, brick, steel and stone. $150,000.

Ont., Sandwich—School—Bd. Educ. takes bids in January new school. $266,000. E. R. North, [illegible].

Ont., Toronto—School—Separate School Bd., 477 Jarvis St., had plans prepared by J. P. Hynes, archt., 73 King St. W., 2 story and basement, 44 ft. high, 12 rooms, concrete, brick and steel, Dawson St. $200,000.

Ont., Toronto—Schools—Bd. Educ., 155 College St., plans new schools and additions to old ones, mostly 2 story and basement, concrete, brick and steel, in various sections of city. $1,000,000. W. W. Pearse, 155 College St., archt.

Ont., Toronto—School—Separate School Bd., 477 Jarvis St., having plans prepared by J. M. Cowan, archt., 107 Vincent St., 2 story and basement, 8 room, concrete, brick, stone and tile addition. $150,000.

Ont., Toronto—School—York Twp. School Bd., Sect. 30, having plans prepared by Gordon & Helliwell, archts., Confederation Life Bldg., 2 story and basement, 8 room, concrete, brick and steel. $150,000.

ROAD WORK—ORANGE, TEX.

Bids were opened Nov. 13, by Orange Co., for constructing 11 road projects, (A) F. P. McElwrath, Corsicana, (awarded contract); (B) C. K. Horton, Houston; (C) Houston Constr. Co., Houston. The unit bids were as follows:

	A	B	C
2 acres clearing (light)	$50 00	$50 00	$40.00
2 acres clearing (heavy)	100 00	100 00	100.00
21 91 mi road grader work	225.00	50 00	200.00
29,915 cu yd roadway excavation	32	40	.30
9,000 cu.yd. roadway excavation	35	.40	.30
10,100 cu yd borrow excavation	35	.35	.30
80 cu.yd. borrow excavation	35	.35	1 00
1,000 cu yd borrow excavation	32	.35	.25
1,600 cu.yd. borrow excavation	40	.35	.30
28 546 mi shaping roadbed	75 00	50 00	75.00
160,863 sq yd earth shoulders	03	.01	.03
21,120 sq.yd. concrete pavement	2 50	2.70	2.82
32,728 sq.yd. concrete pavement	2 50	2.60	2.82
53,848 sq.yd. reinforcing mesh	20	.12	14
2,224 lin ft oak headers 3 in x 8 in	.25	.20	.40
352 lin.ft. oak headers 3 in. x 8 in.	.25	.30	.40
168 lin.ft. vitrified drain tile 12 in.	2 00	1.50	1.50
48 lin ft vitrified drain tile, 12 in	2 50	1.50	1.50
144 lin ft vitrified drain tile, 15 in	2.50	2.00	3.00
144 lin ft vitrified drain tile, 18 in	3.00	3.00	3.00
288 lin.ft. vitrified drain tile, 24 in.	3.50	4 00	5.00
24 lin.ft. vitrified drain tile, 24 in.	4.00	4 00	5.00
96 lin.ft. vitrified drain tile, 36 in.	7.50	5.75	6.00
953 14 cu yd concrete class A	22 00	25.00	23.00
47.50 cu.yd. concrete class B	22 00	30.00	23.00
44.71 cu.yd. concrete class B	28 00	20 00	22.00
49 64 cu yd concrete class B	22 00	25.00	22.00
755 cu.yd. structural excavation	2 00	1.50	2.00
59 cu.yd. structural excavation	2 00	2.00	2.00
58,405 lb. reinforcing steel	0 055	0.05	0.07
Cleaning, painting, repairing 312 ft. steel bridge (lump sum)	3,000 00	4,500.00	3,500.00
Cleaning, painting, repairing 360 ft. steel bridge (lump sum)	1,750 00	3,000.00	1,500.00
Extended totals	*$271,558	$396,448	$436,699

*Bid did not include furnishing material for gravel and shell roads.

Buildings (Continued)

BIDS DESIRED

N. Y., Brooklyn — Apartment — J. A. Mears, Inc., 342 Madison Ave., New York City, will build 6 story, 102 x 125 ft., brick, steel and stone, plain foundation, 8th Ave. and Court St., by separate contracts. $160,000. Slee & Bryson, 154 Montague St., archts. and engrs.

N. Y., New York—Loft—Gilbur Corp., Inc., 205 West 37th St., will build 17 story, 98 x 244 ft., 37th St. and 7th Ave., by separate contracts. $1,500,000. A. Quinn, pres. Contract for steel let to Levering & Garrigues Co., 552 West 23rd St. Buchman & Kahn, 56 West 45th St., archts. and engrs.

Md., Baltimore—Church—Jan. 3, by J. C. Heller, 507 Linwood Ave., chn. of building Com., Church of Our Savior, 2 story, brick and stone, 33rd and Taylor Sts. J. A. Dempwolf, Centre Sq., York, Pa., archt.

Md., Baltimore — Engine Houses and Truck Houses—Jan. 3, by City, engine house No. 59, Maryland and Indiana Aves., Westport, C. F. Strohmeyer, archt.; No. 57, Harford Rd. and Fleetwood St., Hamilton, W. H. Emory, Jr., Munsey Bldg., archt.; No. 58, Pennington Ave. and Filbert St., F. H. Thomas, 135 West Kenwood St., archt.; No. 47, Washington Blvd. and 8th St., R. W. Greer, 18 West Saratoga St., archt.; No. 25, R. L. Harris, 12 West Saratoga St., archt.; Engine house No. 55 and truck house 23, 28th St. between Oak and Maryland Aves., W. F. Stone, Jr., Maryland Casualty Tower, archt.; engine house No. 56 and truck house No. 24, Bush and Carroll Sts., W. F. Stone, Jr., Maryland Casualty Tower, archt.; all foregoing brick and rein.-con. Bids will be taken on each individually; also lump sum for five engine houses, and lump sum on two groups of engine and truck houses.

Md., Baltimore—High School—Jan. 10, by Mayor and City Council, 3 story concrete, steel and brick, Hawthorne Rd. and Clarendon Ave. $1,250,000. Parker, Thomas & Rice, Union Trust Bldg., archts. H. Adams, Calvert Bldg., and H. Massart, 324 North Charles St., engrs.

Tex., Houston—Bank—First Natl. Bank, 201 Main St., receiving bids 12 story and basement, 90 x 100 ft., Franklin Ave. $750,000. Sagnuinett, Staats & Gotlieb, Carter Bldg., archts. and engrs.

Calif., Hollywood—Hospital—R. H. Orr, archt., Van Nuys Bldg., Los Angeles, receiving bids 5 story, 40 x 199 ft., with 40 x 60 ft. wing, rein.-con., Vermont Ave., for Hollywood Hospital Assn. $300,000.

Calif., San Francisco—Market and Apartment—W. C. Falch, archt., Hearst Bldg., receiving bids 6 story, rein.-con., Market St. near Gough St., for J. B. Gaffney and R. A. Luce, 1031 Market St. $200,000. A. A. Coddington, Phelan Bldg., mechanical engr. P. Zucco, 166 Geary St., structural engr.

BIDS RECEIVED

N. Y., Binghamton — School — Bd. Educ. opened bids general contract 2 story and basement, 157 x 178 ft., brick, 1st Ward, from D. Kirkpatrick and F. Stento, Binghamton $329,700, Shane Constr. Co., Herald Bldg., Syracuse, $371,382, Felton Constr. Co., Buffalo, $364,369; heating and ventilating, from Johnson Heating Co., New York City, $48,300, Power Efficiency Corp., White Bldg., Buffalo, $55,490; E. G. Woolfolk & Co., Newark, N. J., $49,687. Noted Nov. 23.

CONTRACTS AWARDED

Mass., Springfield—Apartment—W. Zimmerman, 19 Glendell Terrace, will build 4 story, 116 x 180 ft., brick, plain foundation, Bowdin Terrace, by day labor. $175,000. J. W. Foster, 46 Narragansett St., archt.

N. Y., Brooklyn—Apartment—L. Halperin Improvement Co., c/o Cohn Bros., archts. and engrs., 361 Stone Ave., will build 4 story, 100 x 100 ft., brick, steel and stone, plain foundation, Buffalo Ave. and Lincoln Pl., by day labor.

N. Y., Brooklyn—Apartment—S. H. Cutting, c/o Shampon & Shampon, archts. and engrs., 188 Montague St., will build 4 story, 100 x 120 ft., brick, steel and stone, plain foundation, Schenectady Ave., by day labor. $200,000.

N. Y., Brooklyn—Apartment—Grolin Bldg. Corp., c/o C. Schafer, Jr., archt. and engr., 394 East 150th St., New York City, will build 6 story, 100 x 140 ft., brick, steel and stone, plain foundation, Grand Concourse and 173rd St., by day labor. $175,000.

N. Y., Brooklyn—Apartment—Savetta Realty Corp., c/o McCarthy & Kelly, archts. and engrs., 159 Remsen St., will build 6 story, brick, steel and stone, plain foundation, Ocean Ave., by day labor. $225,000.

N. Y., Brooklyn—Apartment—C. and K. Constr. Co., c/o Shampan & Shampan, archts. and engrs., 50 Court St., 6 story, 135 x 210 ft., brick, steel and stone, plain foundation, Ocean Ave. near Church Ave., by day labor. $750,000.

N. Y., New York—Apartment—Five Hundred Eighty Park Ave. Corp., c/o J. E. R. Carpenter, archt. and engr., 598 Madison Ave., 14 story, 75 x 200 ft., brick, steel and stone, plain foundation, 63rd St. and Park Ave., to Dwight P. Robinson & Co., Inc., 125 East 46th St. Archts. est. $3,000,000.

N. Y., New York—Apartment—Hillpin Building Corp., 3420 3rd Ave., 5 story, 15 x 78 ft., brick, steel and stone, plain foundation, Decatur Ave., by day labor. $175,000. J. M. Felson, 1133 Bway., archt. and engr.

N. Y., New York—Apartment—F. McNulty, c/o C. Schafer, Jr., archt. and engr., 394 150th St., will build 5 story, 100 x 100 ft., brick, steel and stone, plain foundation, West 206th St., by day labor. $150,000.

N. Y., New York—Apartment—L. Wolf, c/o Margon & Glaser, archts. and engrs., 2806 3rd Ave., will build 5 story, 80 x 100 ft., brick, steel and stone, plain foundation, University Ave., by day labor. $200,000.

N. Y., New York—Apartment—H. Glick, c/o D. S. Lang, archt. and engr., 110 West 34th St., will build 5 story, 100 x 100 ft., brick, steel and stone, plain foundation, 188th St. and Audubon Ave., by day labor. $250,000.

N. Y., New York — Apartment Morris Ave. Building Corp., c/o Margon & Glaser, archts. and engrs., 2806 3rd Ave., will build brick, steel and stone, plain foundation, Morris Ave., by day labor. $200,000.

N. Y., New York—Hotel I. Feldman, c/o C. B. Meyers, archt. and engr., 31 Union Sq., will build 15 story, 40 x 220 ft., brick, steel and stone, plain foundation, 100th St. and Bway., by day labor.

Pa., Grove City—Hotel—Owsley Co., archts., 1301 Mahoning Bank Bldg., Youngstown, O., 5 story, 89 ft. front, concrete, brick and steel, to Parish Bros., 217 Wick Ave., Youngstown, O., for Grove City Hotel Co., Grove City. Archts. est. $200,000. Noted Nov. 30.

Md., Baltimore — Office — Federal Land Bank, 1 story and mezzanine, stone, St. Paul and 24th Sts., to M. A. Long Co., Guilford Ave. and Fayette St. Archts. est. $150,000.

D. C., Wash.—High Schools—Dist. Comm., 509 Dist. Bldg., for MacFarland and Langley Junior High Schools, to M. Serretto, Main Treas. Bldg., $592,000. Noted Dec. 21.

N. C., Greensboro—School—Bd. Educ., general contract for school, Cedar St., to Palmer-Spivey Constr. Co., Campbell Bldg., Augusta, Ga., $129,450.

Miss., Jackson — Auditorium — General contract for 2 story, 160 x 160 ft., brick and steel, rein.-con. foundation, to I. C. Garber, Jackson, $120,000. Archts. est. $158,000.

O., McComb—Grade and High School—Bd. Educ. 2 story and basement, 114 x 182 ft., brick, rein.-con. and steel, from J. I. Barnes, South Bend, Ind., $222,254; Wood Constr. Co., 427 Holland Bldg., Lima, $226,619; O. M. Green, 325½ North Elizabeth St., Lima, $229,842. Noted Nov. 30.

Ind., Laporte—High School Bd. Educ., 2 story and basement, 165 x 198 ft., rein.-con. and brick, concrete pile foundation, to Lanson & Danielson Constr. Co., Laporte. Archts. est. $400,000. Noted Oct. 19.

Ind., South Bend—Apartment—T. F. Moredock, 315 West Colfax St., 3 story and basement, 87 x 97 ft., Colfax St., to R. Gollitt & Sons, 30 North La Salle St., Chicago. Archts. est. $200,000.

Mich., Lansing—Hospital—St. Lawrence Hospital Assn., 101 Willow St., 4 story and basement, 131 x 183 ft. rein.-con. and brick, to Reniger Constr. Co., 336½ East Michigan Ave., $400,000.

Wis., Milwaukee—Apartment—J. Hunholz, 2310 Vliet St., 6 story and basement, 53 x 104 ft., brick and rein.-con., plain concrete foundation, on Biddle St., to Cutter Constr. Co., 886 46th St. Archts. est. $150,000. Noted Dec. 14.

Wis., Racine—Hotel—New Racine Hotel Co., c/o C. Fowler, secy., Badger Bldg., 8 story, 104 x 240 ft., brick and tile, plain concrete foundation, to Starrett Bros., 8 South Dearborn St., Chicago. Archts, est. $2,400,000. Noted Dec. 21.

Ia., Dubuque—Apartment-Hotel—Cooper Estate will build 4 story and basement, 114 x 129 ft., rein.-con., brick, tile and stone, 2nd and Locust Sts., by day labor. $150,000 J. F. Leitha, Dubuque, archt.

Tex., Amarillo — Hospital — Potter Co., general contract hospital, tubercular cottage and nurses home, to V. E. Ware, El Paso, $145,000. Archts. est. $250,000. Noted Nov. 30.

Tex., Memphis—Courthouse—Hall Co., general contract 2 story, 72 x 106 ft., rein.-and brick, to Walker Constr. Co., Houston Bldg., San Antonio, $121,520. Noted Nov. 23.

Colo., Denver — Administration — Bd. Educ. general contract 2½ story and basement, 115 x 140 ft., 14th and Laramer Sts., to F. J. Kirchoff Constr. Co., 718 Lawrence Bldg., $143,520. Archts. est. $169,000.

Calif., Arrowhead—Hotel and Store—Swasey & McAfee, archts., Hibernian Bldg., Los Angeles, 3 story and basement, to Atwood Constr. Co., San Bernardino, $240,000. Owner's name withheld.

Calif., Los Angeles—Apartment—Lange & Bergstrom, Washington Bldg., will build 8 story, Park View St., by day labor. $650,000. Walker & Eisen, Pacific Finance Bldg., archts.

Calif., Los Angeles—Cathedral and Parish House—St. Pauls Cathedral, constructing brick and steel, Figueroa St. near Orange

Buildings (Continued)

[illegible] South Raymond Ave., Pasadena, $295,000.

Calif., Los Angeles—Theatre—H & H. Circuit, Title Insurance Bldg., rein.-con. [illegible] Constr. Co., 325 South Hill St., $300,000.

Calif., Oakland—School and [illegible] McCrea, archt., 369 Pine St., San Francisco, constructing 1st unit of church buildings, 3 story and basement, rein.-con., to W. G. McGinty & Sons, Federal Realty Bldg., $52,138, for Church of Lady of Lourdes. Bids for other units will be asked later.

Ont., Waterloo—[illegible] story and basement, 8 room, concrete, brick and steel, general contract to Ellert Bros., Park Ave., $101,000; heating, plumbing, etc., to W. Knell & Co., 45 King St. W. Total est. $150,000.

Federal Government Work

PROPOSED WORK

N. Y., Ft. Tilden—Plotting and Switchboard Room—U. S. Engineer, Army Bldg., 39 Whitehall St., New York, plans plotting and switchboard room, here.

Ala., Florence—Displacement tanks, etc.—U. S. Engineer, Florence, plans to purchase displacement tanks, countersights, castings and other parts for regulating gates of Wilson Dam.

O., Cincinnati—Towboats—U. S. Engineer, 405 Custom House, plans to purchase oil-engine, electric driven towboats.

Mich., Battle Creek—Hospital—U. S. War Veterans' Bureau, 1044 Arlington Bldg., Wash., D. C., having plans prepared Neuro-Psychiatric Hospital at Camp Custer, here. C. R. Forbes, dir. Noted Aug. 31.

Calif., San Diego—Garage, Sewer, etc.—[illegible] Bureau Yards & Docks, Navy Dept., Wash., D. C., rejected bids for garage, sewer, pavement and fence, here. Noted Nov. 16.

BIDS DESIRED

Mass., Boston—Remodeling—Jan. 18, by Treas. Dept., Wash., D. C., remodeling Post Office Screen in U. S. Post Office and Sub-Treasury, here. J. A. Wetmore, acting superv. archt.; adv. this issue.

Pa., Phila.—Dredging—Jan. 17 at office U. S. Engineer, 815 Witherspoon Bldg., dredging in Delaware River between here and Trenton, N. J.

Pa., Phila.—Scows—Jan. 15 at office U. S. Engineer, 815 Witherspoon Bldg., 4 steel dump scows.

Del., Wilmington—Scows—Jan. 15 at office U. S. Engineer, for 2 wooden dump scows; adv. this issue.

Virginia—Dredging—Jan. 15 at office U. S. Engineer, Custom House, Norfolk, dredging 50,000 cu.yd. Appomattox River. J. C. Oakes, ch. engr. Virginia Dist.

W. Va., Huntington—Lock Operating Machinery, etc.—Jan. 23 at office U. S. Engineer, lock operating machinery, etc., for Dam 3[illegible] Ohio River; adv. this issue. Noted Nov. 23.

Mo., St. Louis—Levee Work—Jan. 24, at office Secretary Mississippi River Comn., 1[illegible] International Life Bldg., levee work in Sny Island Levee D.D., Illinois., adv. this issue.

Ore., Astoria—Piers—Spec. 4615—Jan. 17 by Bureau Yards & Docks, Navy Dept., Wash., D. C., for piers, here.

Calif., Crescent City—Furnishing Stone, etc.—Feb. 15 at office U. S. Engineer, [illegible] Custom House, San Francisco, furnishing and delivering approximately 8,000 ton stone for repairing and extending present breakwater approximately 100 to 600 lin.ft. Noted Nov. 16.

Alaska—Bridges—Jan. 22 by C. E. [illegible] [illegible] steel highway [illegible] two [illegible] over [illegible] Creek [illegible] U. S. Engineer [illegible] New Post Office Bldg., Portland, Ore., here.

BIDS RECEIVED

Mich., Detroit—Dredging—U. S. Engineer, 837 Federal Bldg., dredging and rock removal in Livingstone Channel, Detroit River (1) 123,000 cu.yd. earth excav. with possible over depth of [illegible] cu.yd. (2) 175,000 cu.yd. rock with [illegible] overdepth 86,000 cu.yd. from M. Sullivan Dredging Co., 853 Iroquois Ave., (1) $[illegible] (2) $3.50; Dunbar & Sullivan Dredging Co., [illegible] Bank Bldg., (1) $0.[illegible] (2) $3.50; Great Lakes Dredge & Dock Co., Williamson Bldg., Cleveland, O., (1) $0.45 (2) $3.70. Noted Nov. 16.

Calif., Livermore—Buildings, Electrical Work, etc.—C. R. Forbes, dir. U. S. Veterans' Bureau, Arlington Bldg., Wash., D. C., opened bids for 29 rein.-con. buildings [illegible] Hospital, here, from J. Walsh, 85 2nd St., San Francisco, (1) $[illegible] (2) $[illegible] (3) $[illegible] (4) $75,740 (5) $69,880 (6) $41,000 (7) $73,600 (8) $95,500 (9) $21,400 (10) $12,080 (11) $12,850 (12) $9,800 (13) $14,540 (14) $12,280 (400 days); unit prices (1) excavation 1.60 (2) concrete $15 (3) rein.-con. $22 (4) reinforcing steel $61 (5) structural steel $109 (6) brick $40 (7) gravel road $1.25, [illegible] San Francisco, (1) $1,568,000 (2) $18,200 (3) $67,000 (5) $56,950 (6) $45,650 (7) $72,900 (8) $94,400 (9) $17,900 (10) $11,900 (12) $11,500 (13) $14,700 (14) $12,400 telegraphic modifications (1) add $202,723 (2) $[illegible] Building [illegible] (4) $18,885 Building 8 (5) $6,320 Building 12 (6) $[illegible] Building 14 (7) $11,[illegible] Building 15 (8) $374 Building 16 (9) $1,043 Building 18 [illegible] Building 19 (12) $1,935 Building 21 (13) $3,150 Building 23 to 25 and 27 to 30 (14) $3,750 Building 31 to 32, (450 days), unit prices (1) $1.50 (2) $12 (3) $[illegible] (4) $70 (5) $110 (6) $45 (7) $0.60 (8) $0.22 Lange & Bergstrom, 722 Sharon Bldg., San Francisco, (1) $1,[illegible] (2) $[illegible] (3) $[illegible] (5) $67,600 (6) $[illegible] (7) $76,7[illegible] (8) $[illegible] (9) $21,700 (10) $12,6[illegible] (11) $12,100 (12) $12,400 (13) $17,400 (14) $15,100, unit prices (1) add $[illegible] deduct $1 (2) add $20 deduct $12 (3) add $29 deduct $23 (4) add $70 (5) add $1[illegible] deduct $10 (6) add $55 deduct $45 (7) add $2.30 deduct $1.20 (8) add $0.30 (400 days); plumbing, heating, ventilating, outside piping, and garage in above hospital, from Latourrette-Fical Co., 2761 Sacramento Blvd., Sacramento, (1) $327,200 (2) $1,900 (3) $8,400 (4) $8,100 (5) $6,700 (6) $5,700 (7) $10,800 (8) $22,000 (9) $2,900 (10) $200 (11) $2,100 (12) $2,200 (13) $1,300 (14) $1,300 ([illegible] days). J. Smyth Plumbing and Heating Co., Spokane, Wash., (street address not available) (1) $358,000 (2) $2,808 (3) $10,027 (4) $10,027 (5) $8,904 (6) $6,165 (7) $16,498 (8) $31,703 (9) $2,688 (10) $2,095 (11) $2,212 (12) $1,131 (13) $1,925 (14) $1,240 (365 days). S. W. Rittenhouse, 1327 Taylor St., Wash., D. C., (1) $394,719 (2) $1,768 (3) $9,240 (4) $9,240 (5) $8,000 (6) $5,663 (7) $12,759 (8) $30,444 (9) $2,243 (10) $4,071 (11) $1,337 (12) $1,075 (13) $1,311 (14) $1,186 (3[illegible] days); electric work, from F. E. Newberry Electric Co., 3[illegible] Sutter St., San Francisco, (1) $181,137 (2) $1,671 (3) $5,287 (4) $5,287 (5) $5,226 (6) $3,243 (7) $3,392 (8) $6,032 (9) $684 (10) $754 (11) $531 (12) $1,009 (13) $1,951 (14) $2,048 (475 days) Butte Electric and Mfg. Co., 534 Folsom St., San Francisco, (1) $183,400 (2) $1,636 (6 days) (3) $6,191 (4) $6,138 (5) $4,960 (6) $3,529 (7) $1,061 (8) $4,684 (9) $2,373 (10) $6,026 (11) $766 (12) $1,344 (13) $1,721 (14) $2,071 telegraphic modification add $3,000 to item (1) (300 days). refrigerating equipment in above from Cyclops Iron Wks., 837 Folsom St., San Francisco, $18,-546. Automatic Refrigerating Co., 536 Munsey Bldg., Wash. D. C., $32,150 modification $20,985. Vulcan Iron Wks., 1849 Kearney St., San Francisco, $21,992; kitchen equipment from L. Ellerbrock, Inc., 2[illegible] South Frederick St., Baltimore, Md., $26,[illegible] (150 days). Mangrum & Otter, Inc., 827 Mission St., San Francisco, $3[illegible] (1[illegible] days). Nathan-Dohrmann Co., Geary and Stockton Sts., San Francisco $40,720, (90 days); laundry equipment from Troy Laundry Mchy. Ltd., 138 Center St., New York City, $23,281 (45 days). Amer. Laundry Mchy. Co., Norwood Sta., Cincinnati, O., $23,771, (90 days) Steck Mfg. and Gear Co., 21[illegible] Folsom St., San Francisco, $[illegible]. Noted Nov. 23.

CONTRACTS AWARDED

Pa., Pittsburgh—Steel Hull—U. S. Engineer, Pittsburgh, for 1 steel dipper dredge hull, to Penn Bridge Co., Beaver Falls, $[illegible]. Noted Dec. 21.

Va., Cape Henry—Power House—U. S. [illegible] Ft. Story [illegible] H. [illegible] Noted Nov. [illegible]

W. Va., Huntington—[illegible] U. S. [illegible] & Sons, [illegible]

Tenn., Memphis—[illegible]

Tenn., Memphis—Machinery—Mississippi River Comn., 1st and 2nd Dists., Custom House, for turbine pumps, feed-water heater, boiler-feed pumps and electric light plant, to T. M. Whitted, Realty Bldg., Charlotte, N. C. $12,257. Noted Nov. 2.

Wis., Milwaukee—Dredge Hull, etc—U. S. Engineer, for 1 dipper dredge hull and house, to Green Bay Dry Dock Co., Green Bay, $58,900. Noted Nov. 2.

Ia., Knoxville—Hospital—Director U. S. Veterans Bureau, at office Quartermaster General, 2306 Munitions Bldg., Wash., D. C., for Neuro-Psychiatric Hospital, here, complete incl. water, lighting and heating systems, etc., to Warner Constr. Co., 730 Waveland Ave., Chicago, $889,974. Noted Dec. 21.

FEDERAL POWER COMMISSION

Applications for Licenses and Permits

Applications

357—Emery Consolidated Mining Co., Deer Lodge, Mont.—Wants license for transmission line from Deer Lodge to Emery.

358—Imboden Hydro-Electric & Manufacturing Co., Imboden, Ark.—Wants license for diversion dam, canal, and power house in Spring River, near here.

359—Kaweah Molybdenum Mines Co., Crocker Bldg., San Francisco, Calif.—Wants preliminary permit for dam, pipe line and power house in **Kaweah River**, Tulare Co.

360—Pigeon River Lumber Co., Wisconsin Rapids, Wis.—Wants preliminary permit for 5 power houses in lower 12 mi. Pigeon River, Cook Co., Minn.

Miscellaneous

PROPOSED WORK

Road Oiling and Distributing Machine—Belmont, N. Y.—Allegany Co. plans purchasing road oiling and distributing machine. $6,000.

Freight Dock—Erie, Pa.—State, Erie Co. and City plan new freight dock at foot of Peach St. $250,000. Address W. Morrison, member Penna. Peninsula Co., Erie.

Memorial Tower — Wilkes-Barre, Pa. — Comrs. Luzerne Co. having plans prepared memorial tower with clock. $100,000. T. Atherton, Wilkes-Barre, archt.

Power Plant Equipment—Memphis, Tenn. —Takes bids about Jan 20, furnishing and installing power plant equipment for new Parkway Pumping Station, incl. miscellaneous piping, feed water heater, feed pumps, boiler breeching, boiler settings, air flow meters, forced draft fans, central oiling system, and miscellaneous gauges and instruments. $140,000. Fuller & McClintock, 879 North Parkway, engrs.

Golf Course, etc.—Cleveland, O.—See "Buildings."

Road Machinery—Wisconsin—Following are county appropriations for road machinery during 1923. Ozaukee Co. $20,000 incl. drag line outfit, W. J. Ubbink, Port Washington, comr.; Chippewa Co. $7,000, incl. small patrol graders, P. O. Lokrantz, Chippewa Falls, comr. Polk Co. 1 large road grader, 12 patrol graders and rock crusher, C. W. Nystrom, Balsam Lake, comr.; Marinette Co. 12 patrol graders and 2 light motor trucks for road work, A. Eklund, Pestigo, comr.; Shawano Co. number of patrol graders, W. F. Meyer, Shawano, comr.

Park Improvements—Dallas, Tex.—Plans election in April to vote on $500,000 bond issue for park improvements, incl. roads, walks, etc. G. D. Fairtrace, city engr.

Traffic Signal System, etc.—Dallas, Tex. —City Comn. takes bids latter part of January, electric traffic signal system, towers, etc. $20,000-$30,000. H. Garrett, supt. Fire and Police Alarms.

Electric Light Extensions—Clinton, Okla. —See "Waterworks."

Electric Light Extensions—Weatherford, Okla.—See "Industrial Works."

Mains, Gas Holder, etc.—Portland, Ore.—Portland Gas and Coke Co., Gasco Bldg., plans to extend mains and erect gas holders, $600,000; extend and renew gas plants, $300,000; erect buildings and purchase miscellaneous equipment, $100,000. H. Pabst, genl. mgr.

Water Power Development — Pushthrough, N. F. — H. J. Crowe, Canadian Pacific Ry. Bldg., Toronto, Ont., had surveys made by H. L. Cooper & Co., engrs., 101 Park Ave., New York City, and Kerry & Chase, Ltd., engrs., 5[illegible] Confederation Life Bldg., Toronto, Ont., developing 100,000 hp. on Bay D'Est River and Bay D'Espoir on south coast. $8,000,000 to $10,000,000.

BRIDGE—SPOKANE, WASH.

Bids were opened by Bd. Pub. Wks., Dec. 8, for constructing West Spokane St. Bridge. Proposition 1, furnishing and erectin complete, (A) Jahn & Bressi, New York Bldg., Seattle, (B) J. A. McEachern Co., Colman Bldg., Seattle, (C) Scrobel Steel Cons r. Co., (D) Penn Bridge Co., Proposition 2, furnishing only, delivered at bridge site, superstructure and machinery, (1) City Plan, (2) Strauss Plan, Bethlehem Shipbuilding Co., (1) $276,871, (awarded contract), (2) $260,863, Union Constr. & Dry Dock Co., (1) $292 670, (2) $282,860 Felix Bridge Co., (1) $306 723, (2) $289,695. Proposition 3, furnishing and installing electrical equipment, (1) City Plan, (2) Strauss Plan, Westinghouse Electric & Mfg. Co., Alaska Bldg., Seattle, (1) $23,215 (awarded contract) (2) $29,030, Butte Electric & Mfg. Co., (1) $24 122 (2) $29,000, Jahn & Bressi, (1) $28,240 (2) $29,000; Proposition 4, erection of superstructure and machinery only, (A) Gerrick & Gerrick (awarded contract for City Plan), (B) E. E. Davis & Co., (C) Jahn & Bressi. The unit bids on Propositions Nos. 1 and 4 are as follows

	Proposition No. 1 — A	B	C	D	Proposition No. 4 — A	B	C
			City Plan				
3,850,000 lb. furnishing and erecting bridge steel	$0 08	$0 08⅓	$0 0894	$0 0993	$0 0135	$0 016	$0.017
320,000 lb. furnishing and erecting machinery steel	22¼	.26	24	25	0175	.02225	.022
890 cu yd. concrete counterweight	12 00	13 00	16 00	18 00	15.00	50 00	12 00
200 cu yd. cinder counterweight	11 50	15 00	18 00	24 00	14.00	50.00	11.50
22,000 lb. steel counterweight	06	06	.06	0485	06	.06	.06
650 sq yd. road floor, bascule leaves	18 00	18 00	17 00	18 30	14 00	13.50	18 00
544 ft. street car track, bascule leaves	2 75	4 00	5.50	4.10	4 50	3.75	2.75
256 sq yd. sidewalk, bascule leaves	2 00	3 00	3 50	1.50	3.50	2 25	2.00
230 sq yd. road on fixed part	17 50	16 00	16 50	17 30	14 00	13 00	17 50
550 sq yd. road on approach spans	17 50	16 00	17 00	17 30	14 00	13 00	17.50
658 ft. street car tracks, spans and approaches	1 75	3 00	2 50	4 00	4 00	3 25	2.75
236 sq.yd. sidewalks, spans and approaches	4 50	4 00	4 80	3.00	3.50	3.50	4.50
86 sq yd. machinery platform	4 80	5 00	4 80	6 00	3.75	4.50	4.80
Electrical equipment (lump sum)	25,000 00	25,000 00	37,800 00	25,700 00			
2 operators' houses	2,000 00	1,000 00	3,750 00	2,300 00	1,800 00	850 00	2,000 00
2 gas engines and clutches	3,000 00	3,000 00	3,500 00	3,450 00	300 00	300 00	500 00
2 machinery houses	500 00	500 00	2,300 00	2,100 00	1,200.00	300 00	1,500.00
Extended totals	$460,700	$482,926	$528,018	$555,562	$106,151	$110,224	$123,366
			Strauss Plan				
3,516,000 lb. furnishing and erecting structural steel	$0 08	$0 0810	$0 0887	$0 919	$0 0135	$0.016	$0 017
315,000 lb. furnishing and erecting machinery steel	22¼	.26	.242	25	0175	.0275	022
1010 cu.yd. concrete counterweight	15 00	16 00	16.00	20 00	15 00	14 00	14.50
32,000 lb. steel counterweight	06	06	.06	0485	.06	06½	.06
674 sq yd. road floor, bascule leaves	18 00	18 00	17.00	18 30	14 00	13.50	18.00
564 ft. street car track bascule leaves	2 75	4 00	5.50	4.10	4.50	3.75	2.75
265 sq yd. sidewalk bascule leaves	2 00	3 00	3.50	1.50	3.50	2.25	2.00
206 sq yd. road, bascule leaves	17 50	16 00	16 50	17 30	14 00	13 00	17.50
550 sq yd. road on approach	17 50	16 00	17.00	17.30	14 00	13.00	17.50
638 ft. street car track on approach	2 75	3.00	5.50	4 00	4 00	3.25	2.75
246 sq.yd. sidewalk on approach	4 50	4.00	4 80	3.00	3 50	3.50	4 50
98 sq.yd. machinery platform	4 80	5.00	4.80	6.35	3.75	4.50	4.80
Electrical equipment (lump sum)	30,650 00	32,000 00	40,000.00	31,400.00			
2 operators' houses	2,000 00	1,000.00	3,750.00	2,300 00	1,800.00	600.00	2,000 00
2 machinery houses	1,500 00	500.00	2,300.00	2,100.00	1,200.00	500.00	1,300 00
Extended totals	$444,923	$458,300	$501,573	$532,367	$105,400	$110,338	$122,977

Miscellaneous (Continued)

Grain Elevator—Ft. William, Ont.—Bole Grain Co. Ltd., plans concrete grain elevator. $500,000.

Subway—Hamilton, Ont.—Plans subway, 66 ft. wide, under Grand Trunk Ry. tracks, Wentworth St., concrete, steel and stone. $100,000. E. R Gray, city engr.

Transmission Lines—Niagara Falls, Ont.—Stamford Twp. plans to extend hydro electric lines through township. $38,000.

Asphalt Plant—Owen Sound, Ont. Plans to purchase and install municipal asphalt plant. $50,000. D. H. Fleming, City Hall, engr.

BIDS DESIRED

Iron Trailer Trucks—Binghamton, N. Y.—Bd. Contract and Supply taking bids 2 iron trailer trucks for use by Bureau of Garbage and Ashes.

Motor Gasoline—New York, N. Y.—Jan. 3, by H Bruckner, pres Bronx Boro, Tremont and 3rd Aves., furnishing and delivering 6,000 gal. motor gasoline. $1,200. Former bids rejected. Noted Dec. 21.

Crusher—Trenton, N. J.—Bd. Freeholders Mercer Co. taking bids new crusher for county workhouse at Glen More. $30,000 to $40,000. H. F. Harris, Court House, engr.

Asphalt, Crushed Stone, Sand, etc. — Phila., Pa.—Dec 30, by F. H. Caven dir. pub. wks., City Hall, furnishing 14,400 cu. yd. sand, $25,000; 20,000 ton crushed stone, $40,000, 2,200 ton asphalt cement $15,000, 80,000 gal. 19@23 degree fuel oil, $12,000; 225,000 gal. 30@36 degree fuel oil, $50,000 T. F. Armstrong, 316 City Hall, purch. agt.

Gravel—Louisiana—Jan. 9, by State Hy. Comn., Reymond Bldg., Baton Rouge, furnishing 13,452 cu.yd. washed gravel for surfacing Sect. C, Federal Aid Project 116, Minden-Arcadia Highway, Webster Parish.

Wharf—Detroit Mich.—Jan 8 by Pub. Lighting Comn., East Atwater St. 1010 ft. rein.-con. wharf, 36 ft. wide, on 50-80 ft. wood piles, intake flume 80 x 94 ft. resting on 50 and 60 ft. piles. Smith, Hinchman & Grylls, 800 Marquette Bldg., engrs.

Portland Cement—Wisconsin—Jan 3 at office State Hy. Comn., Madison, 1,538,000 bbl. Portland cement for delivery during 1923. A. R. Hirst, state highway engr.

Gravel Pit Machinery—Sheboygan, Wis.—Sheboygan Co. taking bids gravel pit machinery, conveyors, etc. G. W. Ubbelohde, Court House, chn.

Rock Crusher and Grader—Minneapolis, Minn.—Jan. 8, by Auditor Hennepin Co., rock crusher, and 1 grader with scarifier attached. E. E. Terrell, co. surv.

Tractor and Snow Plow—Grand Forks, N. D.—Taking bids one 10 ton caterpillar tractor and one snow plow.

Steam Roller — Denison, Tex. — Taking bids 10 ton steam roller. $10,000. J. Field, Denison, engr.

Road Levee and Bridge—Redwood City, Calif.—Jan. 2, by Supervs. San Mateo Co., constructing road levee and bridge over Bean Hollow, 13,000 cu.yd. earth embankment, 175 cu.yd. concrete in bridge, 150 cu.yd. concrete, slope pavement on embankment, 32,400 ft. sheet piling, etc. $25,000. G Kneese, co. surv. Noted Dec. 7.

Quarrying and Stone Crushing Equipment—Montreal, Que. O. Martineau & Fils Ltd., 371 Marie Anne Ave. E., taking bids for quarrying and stone crushing equipment.

BIDS RECEIVED

Facade and Retaining Walls—New Orleans, La.—Bd. Port Comrs., 201 New Court Bldg., opened bids Dec. 14, facade at foot of Canal St., also retaining walls, filling and paving between Iberville and Poydras Sts., from Heary-Oakes Co., Inc., Perrin Bldg., $65,000 (200 days); G. F. Favrot, Canal Commercial Bank Bldg., $66,312 (238 days); T. H. Brockman, 1525 Berna St., $68,400 (270 days).

Traveling Crane—San Francisco, Calif.—City and San Francisco Co. installing electric travel crane in Moccasin Creek Power Plant of Hetch Hetchy Project, from Pawling & Harnischfegar Co., 32 Beale St., $30,475; Cyclop Iron Wks., 837 Folsom St., $32,170 alternate $27,670; Pratt & Whitney, 16 Fremont St., $33,050; Whiting Corp., Call Bldg., $24,675. Noted Nov. 16.

CONTRACTS AWARDED

Portland Cement—New York, N. Y.—H. Bruckner, pres. Bronx Boro, Tremont and 3rd Aves., furnishing and delivering 2,500 bags portland cement, to E. E. Buehler, 103 Park Ave., $1,825. Noted Dec. 21.

Subway — Brooklyn, N. Y. — Transit Comn., 49 Lafayette St., New York, two-track subsurface railroad extending under Bushwick Ave. from Meserole to Boerum Sts. to F. L. Cranford, Inc., 149 Remsen St., $750,983; also subsurface railroad extending along and under 4th Ave. from 87th to 95th Sts. to T. A. Gillespie Co., 7 Dey St., New York, $1,485,151. Noted Dec. 14.

Shaft—Brooklyn, N. Y. Bd. Estimate & Apportionment, City Hall, New York, Shore Rd. shaft, here, for freight and passenger railroad tunnel in Boros of Brooklyn and Richmond, under New York Bay, to McGovern & Co., 50 East 42nd St., New York, $494,000. Noted Nov. 30.

Steel—Flushing, N. Y.—Transit Comn., 49 Lafayette St., New York, furnishing and erecting steel for elevated portion of Rapid Transit R.R., Flushing Route, extending over and along Roosevelt Ave., private property and intersecting streets from Alburtis to Riverside Aves., here, to Phoenix Bridge Co., 132 Nassau St., New York, $615,880. Noted Dec. 21.

Levee—New Orleans, La.—Orleans Levee Bd., New Court House Bldg., new levee on left bank of Mississippi River, to H. Reynolds, Maison Blanche Bldg., $26,801.

Foundation—Beloit, Wis.—Beloit Water, Gas & Electric Co., 429 East Grand Ave., plain concrete foundation for 3 story (ultimately 7 story), 80 x 134 ft., brick and rein.-con., to J. Schneiberg, 945 Bluff St.

Headers and Dykes—Alamosa, Colo.—State Hy. Dept. and Comrs. Alamosa Co. will build headers and dykes in Rio Grande del Norte River near here, by force account. Cost $21,037. L. D. Blauvelt, state highway engr. Noted Dec. 14.

Electroliers—Berkeley, Calif.—Installing 151 electroliers in University Ave. and other streets, to Osborne Electric Co., Turlock, $36,503. Noted Dec. 14.

Ferry Slips—Pittsburg, Calif.—Pittsburg-Sacramento Ferry Co., O. G. Klatt, secy., c/o Golden Gate Ferry Co., foot Hyde St., having plans prepared and soon takes bids 2 ferry slips. $65,000. Dredging, fill and roadway, let to Lanteri Shipyards, Pittsburg, $20,000.

Grandstand — Tanforan, Calif. — Pacific Coast Jockey Club, 1st Natl. Bank Bldg., San Francisco, constructing steel frame and wood grandstand, 5,000 seats, here, to Clinton Constr. Co., 923 Folsom St., San Francisco. $124,212. Noted Dec. 21.

Gas Mains—Montreal, Que. Montreal Light, Heat & Power Co., Craig St. W., will build gas mains as follows [illegible] in. c.i. pipe, from Sta. A Elm Ave. to Hochelaga and Pie IX Aves., $48,136; [illegible] ft. 12 in. c.i. pipe in Davidson St., from Rouen to St. Catherine Sts., $9,347; 540 ft. 8 in. c.i. pipe in Davidson St. from St. Catherine to Notre Dame Sts., $1,550; 3,720 ft. 12 in. c.i. pipe in Bennett St. from Girard to St. Catherine Sts., $24,969; 74 ft. 4 in. c.i. pipe in St. Joseph Blvd., $168. Work will be done by day labor. E. S. Stanton, supt. gas distribution. Noted Nov. 23.

SEARCHLIGHT SECTION

OFFICIAL PROPOSALS

Copy: Official Proposals [illegible] New York Office by 10 A.M. [illegible] be printed [illegible]

Rate:
40 Cents a Line an Insertion

Plans and Specifications for inspection by distant bidders may be filed at any of the Engineering News-Record offices without charge.

THESE ADVERTISEMENTS ARE OFFICIAL NOTICES THAT BIDS ARE WANTED FROM BIDDERS EVERYWHERE.

OFFICIAL PROPOSALS

Bids: Jan. 23.

Intercepting Sewer

Toledo, Ohio.

Sealed proposals will be received by the Director of Public Service, Toledo, Ohio, until twelve o'clock noon, eastern standard time on the 23rd day of January 1923 and then publicly opened and read for the construction of Contract No. [illegible] of the Intercepting Sewer System, consisting of

[illegible] feet of 87 in. Circular Sewer
2,25[illegible] feet of 84 in. Circular Sewer
2,640 feet of 78 in. Circular Sewer

all of which will be built in tunnel, together with manholes and appurtenances.

Bidders are invited to submit prices on monolithic concrete, vitrified segment block and brick.

Plans, specifications, contract and bond forms can be secured at the office of the Director of Public Service upon deposit of twenty dollars ($20.00) for each set, which will be refunded provided they are returned in good order on or before February 2[illegible], 1923.

Information regarding the work can be obtained through the following offices of our consulting engineers, Fuller & McClintock: 170 Broadway, New York, 319 Summit-Cherry Building, Toledo, 421 Produce Exchange Building, Kansas City Mo., 879 N. Parkway, Memphis, Tenn., and 1001 Chestnut Street, Philadelphia, Pa.

Each proposal must be accompanied by a bond executed by the bidder and a surety company satisfactory to the Director of Public Service in the sum of Ten Per Cent (10%) of the amount of the bid, or in lieu of a bond the bidder may deposit with the Director of Public Service, a certified check on a solvent bank, payable to the order of the Director of Public Service, in amount equal to such bond, said bond or certified check being required as a guarantee that if the bid be accepted, a contract will be entered into and its performance properly secured.

The contract bond will be Fifty Per Cent (50%) of the amount of the contract. Labor and material bids must be separately stated with the price therefor.

The Director of Public Service reserves the right to reject any or all bids or to accept any bid which he may deem advantageous to the City of Toledo.

W. T. JACKSON,
Director of Public Service.

GEORGE F. LASKA,
Secretary.

Bids: Jan. 8.

Pumping Station Equipment

White Hall, Ill.

Sealed bids will be received by the Hillview Drainage and Levee District at White Hall, Ill., up to the hour of 1 o'clock p.m. of January 8, 1923, for certain drainage pumping station equipment, the same to be furnished f.o.b. cars, Hillview, Ill., and to consist of one 15 in. vertical submerged centrifugal pump, one 30 in. horizontal centrifugal pump, one 150 hp. motor, one 50 hp. vertical motor, two switchboards, oil switches, starting apparatus, etc.

Detailed information may be obtained from the engineers by depositing check for $15.00, which will be returned providing said plans, etc., are returned in good condition before date of opening bids.

CALDWELL ENGINEERING CO.,
Engineers,
Jacksonville, Ill.

OFFICIAL PROPOSALS

Bids: Jan. 16.

Sewers

Richmond, Va.

Sealed proposals will be received at this office until 12 oclock noon, Tuesday, January 16, 1923, for the building of Reinforced Concrete, Precast Concrete, Segment Block, Brick and Vitrified Pipe sewers, at various places within the limits of the City of Richmond.

The approximate cost of the work is $700,000.00. Of this amount $250,000.00 will be for various contracts for materials, to be furnished by the City, at the site of the work, and $450,000.00 for various contracts for construction.

A deposit of $10.00 per set is required for plans and specifications before they are delivered to bidder, which amount is returnable after bidder's proposal is received.

Forms of proposals can be obtained on application.

A certified check for amount stated on proposals must accompany each bid as a guaranty of execution of contract. Director of Public Works reserves the right to reject any and all bids.

ALLEN J. SAVILLE,
Director of Public Works.

Bids: Jan. 11:

Road Improvement

Atlantic City, N. J.

Sealed bids for the improvement of portions of Fairmount and other Avenues in Atlantic City, N. J., will be received by the Board of Commissioners at a meeting to be held in the City Hall at 3 p.m., Thursday, January 11, 1923.

The work includes approximately 63,200 sq.yd. sheet asphalt pavement; 7,200 sq.yd. vitrified fire clay block pavement and 1,150 sq.yd. granite block pavement, all upon concrete foundations; 12,860 lin.ft. granite curbing; 1,056 lin.ft. bluestone curbing; and incidental work (for City Engineer's estimate by which the bids will be tested see "Notice to Contractors").

The board reserves the right to reduce the work to be done by striking out any streets or sections thereof, but not below [illegible] if the bid amounts to this much.

Certified check is required in the sum of $5,000.

The board reserves the right to reject any or all bids as provided in the "Notice to Contractors."

Blank forms of proposal and printed envelopes, as well as Notice to Contractors, specifications and forms of contract and bond will be furnished upon application to the City Engineer, Room 6, City Hall Annex, Atlantic City, N. J.

LOUIS A. STEINBRICKER, Director,
Dep't Street and Public Improvements.
J. W. HACKNEY, City Engineer.

Bids: Jan. 15.

Mechanical Equipment for Sewage Screening Plant

St. Petersburg, Fla.

Sealed proposals for mechanical equipment for sewage screening plant will be received at the office of the Director of Finance of the City of St. Petersburg, Florida, until 7:30 p.m., January 15, 1923. Specifications [illegible] the director of finance. Certified check for $500 to accompany bid.

[illegible]
Director of Finance.

OFFICIAL PROPOSALS

Bids: Jan. 23.

Paving

Laredo, Texas.

Sealed proposals will be received by the City Council of Laredo, Texas, at the office of the Mayor, City Hall, until 4:45 p.m., January the 23rd, 1923, for approximately one hundred and twenty thousand (120,000) sq. yds. of paving.

Bids will be received on the following types of paving:

Bitulithic, Limestone Rock Asphalt, Sheet Asphalt, Vitrified Brick and Two Course Concrete.

Plans and specifications may be seen at the office of S. F. Crecelius, Paving Engineer, Puig Building, Laredo, Texas, after January the 1st, 1923.

Bids will be publicly opened and read at 5 p.m., January the 23rd, and the award, if any, will be made after considering bids in connection with the relative values of the different types of paving.

Payment for the city's share of the work will be made monthly in cash for eighty-five (85%) per cent of the work done. Payment for the amount assessed against abutting property will be one-sixth (1/6) cash on completion and balance in five (5) annual payments on improvement certificates bearing interest at seven per cent (7%) per annum.

L. VILLEGAS, Mayor.

Bids: Jan. 2.

Sewer

Wilkes-Barre, Pa.

Sealed proposals will be received by Fred H. Gates, City Clerk, Wilkes-Barre, Pennsylvania, for constructing a four and six-foot circular brick or segmental block sewer, about seventeen hundred feet in length. Bids close Tuesday, January 2nd, 1923, at 12 o'clock noon, and will be opened by City Council on the same day at three o'clock P.M. Plans and specifications may be had from B. K. Finch, City Engineer, upon making a deposit of $10.00, said deposit to be refunded upon receipt of bid or upon return of specifications to City Engineer on or before January 15th, 1923. Each bid must be accompanied by a certified bank check of bidder in the sum of $1,000.00 made payable to the City of Wilkes-Barre. Successful bidder must furnish to said city a surety company bond in the full amount of contract. Proposals to be endorsed "Proposals for Sewer" and addressed to Fred H. Gates, City Clerk, City Hall, Wilkes-Barre, Pennsylvania. The City Council reserves the right to reject any or all bids received.

Bids: Jan. 8.

Team Grading Work

White Hall, Ill.

Sealed bids will be received by the Hillview Drainage and Levee District up to 1 o'clock p.m. on Monday, the 8th day of January, 1923, at White Hall, Illinois, for the raising of the levee. The work is divided into 8 sections with a total yardage of 21,000 cu.yd. Each section is approximately one mile in length. This work is suitable as team work only. Detailed information may be obtained from the engineers by depositing check for $15.00, which will be returned providing said plans, etc., are returned in good condition before date of opening bids.

CALDWELL ENGINEERING CO.,
Engineers,
Jacksonville, Ill.

OFFICIAL PROPOSALS

Bids: Jan. 13.

Draw Bridge

Cambridge, Mass.

Sealed proposals will be received at this office until 12 o'clock noon of Saturday, Jan. 13, 1923, for furnishing and erecting a single leaf movable draw span for the First Street Bridge over Broad Canal in Cambridge, Mass.

The draw span will be of trunnion bascule type, according to plans of the Strauss Bascule Bridge Company, and will be about 51½ ft., long about 54 ft. wide with two main plate girders, overhead counterweight and electric motors and operating machinery complete. The draw bridge will be erected on foundation now being constructed under another contract.

Plans and specifications may be examined after Wednesday, Dec. 27 1922, and any further information may be obtained at the office of the City Engineer.

Copies of the plans and specifications may be obtained of the City Engineer by the payment of ten dollars ($10), which will be repaid to any one returning the plans and specifications in good order to the office of the City Engineer, Cambridge, Mass.

All bids must be upon the form furnished and must state price both in writing and in figures, and must be signed by the bidder with full name and address. Each bid is to be accompanied by a properly certified check for five hundred dollars ($500), payableable to the City of Cambridge, said check to be returned to the bidder, unless forfeited as specified below.

A satisfactory bond will be required for the faithful performance of the contract. The person or persons to whom the contract may be awarded will be required to appear at the office of the City Engineer with the sureties offered by him or them and execute the contract within four days (not including Sunday) from the date of notification of such award, and the preparation and readiness for signature of the contract; and in case of failure or neglect to do so, he or they will be considered as having abandoned it, and the check accompanying the proposal shall be forefeited to the City of Cambridge. The City Engineer reserves the right to reject any and all bids in accordance with and as provided by the City Ordinances. It is understood that the parties in presenting their proposals thereby agree that the same are offered subject to the terms, conditions and limitations, hereinbefore specified.

Proposals to be addressed to the City Engineer and endorsed "Proposal for furnishing and erecting movable draw span for the First Street Bridge over Broad Canal, Cambridge, Mass."

L. M. HASTINGS, City Engineer.
Cambridge, Mass.,
December 21, 1922.

Bids: Jan. 5 (Date of closing extended).

Reservoir Dam

Bluefield, W. Va.

Sealed proposals or bids for the construction of a clay or earthen dam, containing about 40,000 cubic yards of material, to be sluiced into place, will be received at the office of the BLUEFIELD WATER WORKS & IMPROVEMENT COMPANY, at Bluefield, West Virginia, until three o'clock P.M., on the 5th day of January, 1923, when they will be publicly opened and read. All proposals shall be enclosed in an envelope furnished by the above styled company and shall be accompanied by a certified check on some national bank, in the sum of five (5%) per cent of the amount of the proposed bid. The contractor to whom the award is made will be required to furnish surety company bond in the sum of thirty five (35%) per cent of the amount of the contract, within thirty days after official notice of the award of contract and in accordance with the terms of the specifications. The right is reserved to reject any or all bids. Drawings, specifications and blank forms of proposals may be consulted at the office of company, 601 Princeton Avenue, Bluefield, West Virginia, or they will be forwarded by mail upon request if $4.00 accompanies the order. This amount will be refunded upon return of the plans and specifications in reasonably good order.

BLUEFIELD WATER WORKS & IMPROVEMENT COMPANY.
WM. McCARTHY,
Superintendent.
November 23rd, 1922.

OFFICIAL PROPOSALS

Bids: Jan. 11.

Waterworks Improvements

Albemarle, N. C.

Sealed proposals will be received by the Mayor and Board of Commissioners of the Town of Albemarle, N. C., at the Town Hall in Albemarle, N. C., until 12 o'clock, noon, January 11, for Waterworks Improvements.

The work will consist of:
- Brick and concrete addition to Filter House.
- Concrete Filter Tubs.
- Concrete Coagulation Basin.
- Brick and Concrete Chemical House.
- Filter Plant Equipment.

Proposals must be marked, "Proposal for Waterworks Improvements."

All bids must be upon blank forms provided in the "Proposal, Specifications and Contract."

Each bid must be accompanied by a certified check for not less than five per cent of the amount of the bid, as evidence of good faith.

Plans and specifications will be on file at the Clerk's office in Albemarle, and at the office of the Engineer in Durham, N. C.; and copies of specifications, form of proposal, etc., will be mailed upon application to the Engineer at Durham, N. C., accompanied by payment of ten dollars ($10) for each set of plans and specifications, which will be refunded to those who submit bonafide bids.

The right is reserved to reject any or all bids.

O. J. SIKES, Mayor.
ELI KENDRICK, Clerk.
GILBERT C. WHITE CO., Engineer,
Durham, N. C.

Bids: Jan. 11.

State Highway Work

Richmond, Va.

Bids will be received at the Office of the Virginia State Highway Commission, corner 10th and Marshall Streets, Richmond, Va., until 10:30 o'clock a.m., Thursday, January 11th, 1923, for the construction of:

1. Project F-186A, Route 12—From Sandy River, west, in Pittsylvania County, approximately 6.28 miles of 8 in.-6 in.-8 in. x 18 ft. concrete pavement, involving approximately 3 acres clearing and grubbing 27,965 cu.yds. excavation; 646 lin.ft. cast iron pipe; 378 lin.ft. vitrified clay pipe encased in concrete; 39 cu.yds. Class "B" concrete; 850 lin.ft. wooden guard rail.
2. Project S-185, Route 7—From Wilderness to Lignum, 8.44 miles of gravel roadway, involving approximately 38,100 cu.yds. unclassified excavation; 556 lin.ft. pipe; 111 cu.yds. Class "B" concrete; 185 cu.yds. Class "A" concrete; 14,500 lbs. reinforcing steel; 2100 lin.ft. standard wooden guard rail.
Alternate bids are requested for soil roadway.
3. Project S-256. Route 11, Burks Garden Siding to Tazewell, in Tazewell County, 1.98 miles of 16 ft. bituminous and surface treated macadam roadway, involving approximately 13,508 cu.yds. of excavation, 56 lin.ft. of pipe, 234 cu.yds. Class "B" concrete, in headwalls, 2,296 lin.ft. wooden guard rail.
4. Project F-205B, Route 1—Bridges over Massaponax Cr. and Ny River, having a total length of 76 ft. 10 in., involving approximately 102 cu.yds. Class "A" concrete; 374 cu.yds. Class "B" concrete; 1,540 lbs. reinforcing steel.
5. Project F-32, Route 6, from Chantilly towards Fairfax Court House, 0.84 mile of 8 in. x 16 ft. bituminous macadam roadway, involving approximately 7,924 sq.yds. bituminous macadam.
6. Project S-208, Route 11, from Claypool Hill, 11.53 miles toward Tazewell Court House, with the exception of the bridges at Sta. 640 and Sta. 702, and Section C between 670 00 and 694 00, 10.83 miles of 8 in. x 16 ft. surface treated macadam, involving approximately 2 acres clearing and grubbing; 131,236 cu.yds. of excavation; 1,850 lin.ft. of pipe; 200 cu.yds. retaining wall; 7,000 lin.ft. wooden guard rail; 265 cu.yds. Class "A" concrete; 331 cu.yds. Class "B" concrete; 19,477 lbs. reinforcing steel.
7. Project SR 298, Route 7—Repairs to the bridges over the north and south forks of the Shenandoah River, in Warren County, involving repairs, new stringers, floors and painting.

A certified check or bidder's bond must accompany each bid. Amount of certified check as follows:

Project F-186A, $5,000.00. Project F-185, $3,000.00. Project F-256, $2,500.00. Project S-205B, $500.00 Project F-32, $350.00. Project S-208, $5,000.00. Project SR-298, $2,000.00. Amount of bidder's bond 20 per cent in excess of check.

Plans and specifications are on file at the office of the Virginia State Highway Commission, corner 10th and Marshall Streets, Richmond, Va., and at the offices of the following District Engineers: Project 186 at Lynchburg. Project F-185 and S-205 at Fredericksburg. Project S-256 and S-208 at Bristol, Va. Project S-298 at Staunton, Va. Project 32 at Culpeper, Va.

Additional plans for bidders for the above projects can be obtained upon application to the State Highway Commissioner, upon receipt of five dollars ($5.00) payable to Mr H. G. Shirley, chairman, $2.50 of which will be refunded if plans are returned in good condition within two weeks after bids are opened, and bridge plans from W. F Hobart, 805½ E. Franklin, Richmond, Va., on Project S-205 for $1.08. No plans on Project S-298.

Engineers will be at the following places to show prospective bidders over the work:

Project F-186A. Burton Hotel, Danville, Va., 10 a.m., Wednesday, Dec. 27th, 1922.

Projects S-185 and S-205B, District Engineer's Office. Fredericksburg, Thursday, December 28th, 1922, at 10 a.m.

Projects S-256 and S-208, County Engineer's Office, Tazewell Court House, 12 noon, Friday, January 5th, 1922.

Project F-32, Fairfax Court House, 10 a.m., Friday, December 29th, 1922.

Project S-298, Afton Inn, Front Royal, Va., 12 noon, Thursday, Jan. 4th, 1922.

The State Highway Commission reserves the right to reject any or all bids.

VIRGINIA STATE HIGHWAY COMMISSION.
H. G SHIRLEY, Chairman.
G. P. COLEMAN,
Commissioner.
December 21, 1922.

Bids: Jan. 15.

Bulkhead

Jersey City, N. J.

Sealed proposals will be received by the Hudson County Park Commission at its office, 1 Exchange Place, Jersey City, N. J., on Monday, January 15th, 1923, at 11 o'clock a.m., for the construction of a Bulkhead at West Side Park, Jersey City, N. J., and work connected therewith in accordance with plans and specifications on file at the office of the Hudson County Park Commission.

Blank form of bid showing estimate of quantities must be obtained at the office of the Hudson County Park Commission.

Each bidder must accompany his bid with a certified check drawn to the order of the Hudson County Park Commission to the amount of 5% of his bid.

The successful bidder will be required to furnish a surety company's bond to be approved by the Hudson County Park Commission in the full amount of his bid with satisfactory security conditioned for the faithful performance of his contract.

There shall be two contracts ,the original and copy which shall first be signed and executed by the successful bidder and presented to the Hudson County Park Commission for signature.

Bids must be enclosed in sealed envelopes indorsed "Proposals for Bulkhead and Reclamation West Side Park, Jersey City, N. J.," directed to the Hudson County Park Commission and delivered to the Secretary of the Commission at or before the hour above specified. The Commission reserves the right to reject any or all bids.

Dated: December 18, 1922
Hudson County Park Commission.
BY JOSEPH FILORAMO, JR.,
Secretary.

OFFICIAL PROPOSALS

Bids: Jan. 10.

Paving, Water and Sewer Lines

Albemarle, N. C.

[illegible] Hall in Albemarle, N. C., until 12 o'clock noon, January 10, 1923, for street improvements, water and sewer lines.

[illegible] will [illegible] about:

50,000 to 70,000 sq.yd. of asphalt or other pavement.
28,000 lin.ft. of curb and gutter.
2,500 lin.ft. of granite curb.
800 sq.yd. of concrete gutter.
26,000 cu.yd. of grading.
3,500 ft. storm water drains.
17,700 lin.ft. of 6 and 8-in. case iron water mains.
16,000 lin.ft. of 8-in. terra cotta sewer laterals.

Proposals must be marked, "Proposal for Street Improvements."

All bids must be upon blank forms provided in the Proposal and Contract and Specifications.

[illegible] certified check for $5,000, as evidence of good faith.

Plans and specifications will be on file at the clerk's office in Albemarle, and at the office of the Engineer in Durham, N. C., and copies of the specifications, form of proposal, etc., will be mailed upon application to the Engineer of Durham, N. C.

The right is reserved to reject any or all bids.

O. J. SIKES, Mayor.
ELI KENDRICK, Clerk.
GILBERT C. WHITE CO., Engineer,
Durham, N. C.

U. S. GOVERNMENT

COMMISSIONERS, D. C., Washington. December 18, 1922.—Sealed proposals for constructing about six hundred sixty feet of sewer will be received at Room 509 District Building until 2 o'clock p.m., January 15, 1923. For detailed information, apply to Room 427 District Building. CUNO H. RUDOLPH, JAMES F. OYSTER, CHARLES KELLER, Commissioners, D. C.

U. S. GOVERNMENT

U. S. ENGINEER OFFICE, Florence, Alabama. Sealed proposals will be received here until 11 a.m., December 30, 1922, and then opened, for the construction and delivery of one 15-inch dredging pump for dredge Pettus. Further information on application.

U. S. ENGINEER OFFICE, CINCINNATI, O. Sealed proposals will be received here until Jan. 5, 1923, and then opened for the construction of one 24-inch pipe line dredge. Further information on application.

U. S. ENGINEER OFFICE, HUNTINGTON, W. VA., Nov. 29, 1922. Sealed proposals will be received here until 11 a.m. (Eastern time) December 30, 1922, and then opened, for constructing a Fireproof Powerhouse at Dam No. 30, Ohio River. Further information on application.

SEALED PROPOSALS will be opened by the Supt. of Lighthouses, Key West, Fla., 2 P.M., January 15, 1923, for furnishing and delivering f.o.b. shipping point, metal work complete for ten (10) light towers. Information upon application.

U. S. ENGINEER OFFICE, NASHVILLE, TENN. Sealed proposals will be received here until 11 A.M., January 16, 1923, and then opened, for steel hull for dipper dredge Watauga. Further information on application.

U. S. ENGINEER OFFICE, HUNTINGTON, W. VA., Dec. 23, 1922.—Sealed proposals will be received here until 11 a.m. (Eastern Time), January 23, 1923, and then opened, for furnishing and delivering lock-operating machinery, etc., for Dam No. 30, Ohio River. Further information on application.

U. S. ENGINEER OFFICE, WILMINGTON, DEL.—Sealed proposals will be received here until 12 o'clock noon, January 15, 1923, and then opened, for constructing and delivering two wooden dump scows. Further information on application.

U. S. GOVERNMENT

PROPOSALS FOR LEVEE WORK.—Office of the Secretary, Mississippi River Commission, 1311 International Life Building, St. Louis, Mo.—Sealed proposals will be received here until 11 a.m., Jan. 24, 1923, for constructing about 900,000 cubic yards of earthwork by the hydraulic method in the Sny Island Levee Drainage District, Ill. Further information on application.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., December 22, 1922.—Sealed proposals will be opened in this office at 3 p.m., January 18, 1923, for remodeling Post Office Screen in the U. S. Post Office and Sub-Treasury, Boston, Mass. Drawings and specifications may be obtained, in the discretion of the Supervising Architect, at this office, or at the office of the Supervising Chief Engineer, Room 1703 Custom House Building, Boston, Mass. Jas. A. Wetmore, Acting Supervising Architect.

SEALED PROPOSALS will be received and publicly opened by the Director, U. S. Veterans' Bureau, in the Office of the Quartermaster General, 2306 Munitions Building, Washington, D. C., at 11 A.M., January 16, 1923, for construction of a Neuro-Psychiatric Hospital at American Lake, Tacoma, Washington, for the Veterans' Bureau. Work will include construction of twenty-eight buildings of reinforced concrete, tile and brick, complete with water, lighting, heating and sewer systems, roads and walks. Plans and specifications may be obtained after December 9, 1922, from the Quartermaster General, Room 2306, Munitions Building, Washington, D. C., upon deposit of $100. One set of plans and specifications will be on exhibition at each of the following stations: Constructing Quartermasters at 39 Whitehall St., New York City, and Fort Mason, California, and Quartermaster Supply Officers at 1819 West Pershing Road, Chicago, Ill., Second and Arsenal Sts., St. Louis, Mo., Stacy Street Terminal, Seattle, Washington, and New Post Office Building, Portland, Oregon. If bidders on the coast will wire the Quartermaster General's Office, date they are mailing check for deposit, this will be taken as evidence of good faith and plans and specifications will be mailed them at once.

SEARCHLIGHT SECTION

EMPLOYMENT—BUSINESS OPPORTUNITIES

Positions Wanted 4 cents a word minimum charge 75 cents an insertion.
Positions Vacant and all other classifications, 8 cents a word, minimum $2.

Box Numbers in care of any of our offices count as 10 words in addition to classified copy.

Replies are forwarded each day as received at all of our offices without additional charge.

Discount of 10% is allowed if one payment is made in advance for 4 consecutive insertions.

THE ABOVE RATES ARE FOR ADVERTISEMENTS SET UNDISPLAYED. FOR DISPLAY RATES SEE "EQUIPMENT" HEADING.

E. N. R.

POSITIONS VACANT

AN experienced railroad draftsman wanted in the chief engineer's office, Pittsburgh. State age, education, experience, references, salary expected, and submit a small sample of work. R. P. Forsberg, Principal Assistant Engineer, P. & L. E. R.R., Pittsburgh, Pa.

ASPHALT inspector capable of controlling mix for sheet asphalt and asphaltic concrete paving mixtures. P-428, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

BRIDGE foremen wanted by Illinois company. Men with experience who can read blue prints and handle men. Civil engineers preferred. References required. P-426, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

DRAFTSMAN, experienced, wanted for structural steel buildings; apply by mail only, giving age, nationality, education, experience and salary expected. Post & McCord, 101 Park Ave., New York.

DRAFTSMAN wanted, familiar with steam and street railway special track work. State salary, experience, etc. P-410, Eng. News-Record, Old Colony Bldg., Chicago, Ill

DRAFTSMAN, preferably with designing experience on engines or air compressors. Location Ohio. Apply, giving full particulars, P-348, Eng. News-Record, 10th Ave. at 36th St., New York City.

ENGINEER wanted, familiar with street railway special track work, to work into sales organization. Give full details in first letter. P-409, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

POSITIONS VACANT

ESTIMATOR and salesman. Structural steel and ornamental iron. Cleveland firm. Engineering experience desired. Good chance for right man. State age, experience and salary expected. All replies strictly confidential. P-414, Eng. News-Record, Leader-News Bldg., Cleveland, Ohio.

EXPERIENCED plane table man wanted by city in middlewest for several months survey. Send references, experience and name salary. P-408, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

EXPERIENCED engineer wanted to handle 2,000 H.P. power plant and mechanical equipment of manufacturing company; must have technical education. P-427, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

EXPERIENCED structural detailers and checkers; state age, experience, nationality, education and salary expected, in first letter. Indiana Bridge Company, Muncie, Indiana.

FIRST class structural steel detailers and checkers with experience on mill buildings, office buildings, etc. Position in Pittsburgh district. State experience and salary desired. P-525, Eng. News-Record, Leader-News Bldg., Cleveland, O.

GENERAL superintendent, thirty-five to forty years old, to take charge of construction work on a number of large building projects; must have had extensive experience in this line, possess unquestionable ability and integrity and be willing to travel; good opportunity for high grade man who can qualify. P-432, Eng. News-Record, 10th Ave. at 36th St., New York City.

POSITIONS VACANT

ONE concrete engineer, experienced in preparing complete designs and estimates for reinforcing materials. One engineering salesman familiar with fireproof building materials. Give age, education, references, detailed experience, salary desired, and earliest reporting date. P-350, Eng. News-Record, Leader-News Bldg., Cleveland, Ohio.

SEVERAL first class structural draftsmen to make and check shop drawings. None but competent and experienced men are desired. Reply giving full information, Whitehead & Kales Company, Detroit, Mich.

STRUCTURAL steel draftsmen and checkers wanted. Apply Hay Foundry & Iron Works, Newark, N. J.

SUPERINTENDENT wanted on road job near New York City. Heavy rock excavation. Large amount dry rubble walls. Long job. P-401, Eng. News-Record, 10th Ave. at 36th St., New York City.

WANTED—By a large fireproof building products company, located in the Middle West, a number of 1922 technical graduates for training in the design of reinforced concrete. This is a fine opportunity for wideawake young men who want to make progress and who are willing to work. Apply by letter, giving age, education, experience if any and notice required by present employer. P-429, Eng. News-Record, Leader-News Bldg., Cleveland, Ohio.

WANTED—Writer in Civil Engineering subjects; must be a college graduate with practical experience as well as experience in technical writing. Position requires residence in eastern city of 150,000. State education and experience, also initial salary expected in first letter. New York or Philadelphia interview. P-415, Eng. News-Record, 10th Ave. at 36th St., New York City.

YOUNG engineer with several years' experience in structural design, wanted by contracting firm in China. In applying, give complete particulars of education and experience and furnish references. State whether married or single. Interviews can be arranged in San Francisco, Chicago, Detroit or New York during January. Reply to P-411, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

EMPLOYMENT AGENCIES

[illegible]

EMPLOYMENT SERVICE

[illegible] upward; executive, technical, administrative, engineering, manufacturing, professional, managing, financial, etc., all lines. If you are qualified and receptive to [illegible] you are invited to communicate in strict confidence with the undersigned, who will conduct preliminary negotiations for such positions. A method is provided through which you may receive overtures in confidence without jeopardizing present connections and in a manner conforming strictly to professional ethics. Send name and address only. Preliminary particulars will be sent without obligating or compromising you in any way. R. W. [illegible] Bldg., Buffalo, N. Y.

POSITIONS WANTED

Civil Engineers

CIVIL engineer, graduate, 37, broad construction experience in Spanish America and U. S. A., railroad, highway, irrigation and general construction, speak Spanish fluently. PW-347, Eng. News-Record, 10th Ave. at 36th St., New York City.

CIVIL engineer, 31, Graduate, seven years highway and bridge construction, four years railroad and hydro-electric construction. At present employed with [illegible] concrete road construction, desires change. Location immaterial; salary $275. PW-390, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

CIVIL engineer, ten years' experience in economical location, design, and construction of Federal Aid Highways. Thoroughly capable of handling either office or field work, or supervising both. Difficult location, design or construction preferred. At present completing 50 mile Federal Aid Project through difficult country. Available about Jan. 15. PW-406, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

CIVIL engineer, graduate, age 30, married, 10 years' experience municipal executive design and construction, 6 years specialist [illegible] ing firm or city doing city planning work. PW-416, Eng. News-Record, Leader-News Bldg., Cleveland, Ohio.

CIVIL engineer, age 29, technical education, seven years' experience, school buildings, industrial plants, available Jan. 1st, desires position as civil engineer, resident engineer or superintendent. PW-407, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

CIVIL engineer, graduate, fourteen years design and construction, railroads, sewerage systems, steam, electric and indus[illegible] docks, water front and hydro-electric de[illegible] Eng. News-Record, 10th Ave. at 36th St., New York City.

CIVIL and municipal engineer; age forty; specialized on city and public improve[illegible] Society Civil Engineers, American Society Mechanical Engineers, American Associa[illegible] PW-[illegible] Record, Leader-News Bldg., Cleveland, O.

EXECUTIVES

[illegible]

THE NATIONAL BUSINESS BOURSE, Inc.

[illegible]

POSITIONS WANTED

Surveying

TRANSITMAN, levelman, concrete highway inspector, married, age 28, four years' experience, wishes position with construction company, or highway department. Location immaterial. Available immediately. State salary and condi[illegible]

TRANSITMAN, high school graduate, five years' experience, twenty-five years of age, will go anywhere. Address PW-403, Eng. News-Record, 10th Ave. at 36th St., New York.

Estimator

ESTIMATOR; fifteen years' building construction, as estimator and superintendent. Organize, purchase materials, close contracts, interview clients. Familiar with work in Southern states. PW-357, Eng. News-Record, 10th Ave. at 36th St., New York City.

Draftsmen and Designers

DRAFTSMAN, twenty years' experience sugar machinery and general engineering, thorough knowledge Spanish and Portuguese, desires position, home or abroad. PW-435, Eng. News-Record, 10th Ave. at 36th St., New York City.

ENGINEER — EXECUTIVE — SALESMAN

Member Am. Soc. Civ. Eng.

Over twenty years' experience in General Engineering, [illegible] Salary, $[illegible],000.
PW-[illegible] News-Record,
[illegible] Old Colony Bldg., Chicago, Ill

POSITIONS WANTED

ENGINEER draftsman desires immediate connection, 11 years' experience. PW-405, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

LADY, experienced in drafting room, desires position. Location anywhere; salary moderate. Address PW-349, Engineering News-Record, Old Colony Bldg., Chicago, Ill.

Superintendents

CONSTRUCTION superintendent, college graduate, twenty years' experience, twelve years manager of erection on steel bridges and industrial buildings. Familiar with foundations, falsework, concrete and plant layouts. Free after January 15. PW-425, Engineering News-Record, Real Estate Trust Bldg., Philadelphia, Pa.

Miscellaneous

ACCOUNTANT—General and cost man desires permanent position with contracting or construction company; best references. PW-430, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

GENERAL MANAGER

Large steel fabricating and warehousing plant. Has handled all details of the business. Engineering, sales, shops, erecting, finances, etc. Released thru outside purchase. Available immediately.

PW-382, Engineering News-Record
10th Ave. and 36th St., N. Y. C

The Erie Employment & Supply Co.

8701 Union Ave., Cleveland, Ohio

Boarding Camps and Commissaries operated for Railroads, Manufacturers, Contractors, Coal Mines [illegible] classes of skilled help. Employment offices at Cleveland, O., Cincinnati, O., Toledo, O., Columbus, O., St. Louis, Mo., Indianapolis, Ind., Chicago, Ill., Danville, Ill., and Buffalo, N. Y.

Wanted—Correspondents

for Engineering News-Record

If you want to earn some extra money and are a resident in one of the cities named below;

If you can spare an hour or two a day *during business hours* for calling upon architects, contractors, engineers and city departments;

Then write me concerning your qualifications and present connection, if you live in

ALABAMA
Anywhere

ARIZONA
Bisbee
Globe
Tuscon

ARKANSAS
Little Rock

CALIFORNIA
Los Angeles

CONNECTICUT
Hartford

INDIANA
Evansville
South Bend

IOWA
Dubuque

KANSAS
Leavenworth

KENTUCKY
Louisville

MISSOURI
St. Joseph

MONTANA
Butte

NEBRASKA
Lincoln

NEVADA
Carson City

NEW JERSEY
Except Trenton

NEW YORK
Binghamton
Schenectady

OREGON
Astoria
Medford
Salem

SOUTH CAROLINA
Except Columbia

SOUTH DAKOTA
Sioux Falls

VIRGINIA
Norfolk

WASHINGTON
Walla Walla

ALBERTA
Calgary

MANITOBA
Winnipeg

Alden W. Welch

Engineering News-Record, 10th Ave. at 36th St., New York

POSITIONS WANTED

CALIFORNIA construction capable, office man, twenty-six and single, available March 1, nine years' experience on marine, business and industrial projects in Eastern states and tropics. PW-431, Eng. News-Record, 10th Ave. at 36th St., New York City.

ENGINEER as executive, practical inventive, on derricks, cranes or steel construction requiring development, desires position with progressive concern. Open about January, 1923. PW-373, Eng. News-Record, 10th Ave. at 36th St., New York City.

EXPERIENCED and skillful operator on locomotive crane, clam-shell or drag-line. Available immediately for long job. Age 34, married. PW-388, Eng. News-Record, Rialto Bldg., San Francisco, Calif.

HYDRAULIC engineer, at present responsible charge design and construction, hydro-electric and waterworks projects, thirteen years in charge projects of magnitude, Member Am. Soc. C. E., graduate C. E., age forty, desires change. PW-420, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

MAN having 18 years' experience on waterworks, heavy rock excavation, hydro-electric and transmission lines construction as general foreman and superintendent. A-1 mechanic on pumps, meters, motors and steam. Would like to connect with municipal plant. PW-356, Eng. News-Record, 10th Ave. at 36th St., New York City.

MUNICIPAL engineer and waterworks superintendent desires employment in a city of 25,000 or over; salary $5,000. PW-236, Eng. News-Record, Real Estate Trust Bldg., Philadelphia, Pa.

SALES manager, broad technical education, extensive experience, design, construction and production. Now employed as sales manager. Available Jan. 1st for bigger opportunity. PW-381, Eng. News-Record, 10th Ave. at 36th St., New York City.

YOUNG man, age 27, desires position as general foreman on concrete and brick work. Have technical education and can handle men. PW-423, Eng. News-Record, 10th Ave. at 36th St., New York City.

TRAINED executive, now employed, seeks position of greater responsibility and of harder work. Foreign service acceptable. Spanish speaking country preferred. Experience: Graduate civil engineer, seven years pioneer engineering in tropics, six years contractor's superintendent of construction on public improvements. Qualifications Skilled in all clerical and manual labor of contracting and engineering; especially recommended for attention to details and skilful organization. PW-424, Eng. News-Record, Leader-News Bldg., Cleveland, Ohio.

Notice to Advertisers!

Owing to the holiday — New Years — the *"Searchlight" pages* of the January 4th issue of *Engineering News - Record* will close for press earlier than usual. Copy should reach us for

Display and Want Ads
by 10 A.M., Saturday, December 30th.

Proposal Ads
Copy received as usual up to 11 A.M., Tuesday, Jan. 2nd.

REPRESENTATION WANTED

Representatives Wanted

We want live representatives in all large cities for the sale of steel reinforcement and accessories for reinforced concrete, etc. We are an old established concern. Liberal commissions paid to live sales engineers who are willing to enter into yearly contracts. Sales engineers with established business preferred. RW-431, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

REPRESENTATIVES AVAILABLE

Sales Representative

Civil and architectural engineer, with office at 219 North American Building, Philadelphia, wants to represent the product or products in this vicinity of some established manufacturer. D. C. Finston.

AGENCIES AVAILABLE

Manufacturer's Agent

Iron, steel and contractor's equipment; established offices in Philadelphia; would like to take on additional line to follow up inquiries or leads and do some missionary work. A-436, Eng. News-Record, Real Estate Trust Bldg., Philadelphia, Pa.

WANTED

A POWER SHOVEL SALES ENGINEER

to sell the products of a Company well known throughout the country for over thirty years

To qualify, the candidate selected must be entirely familiar with the application of power shovels, dragline and trench excavators.

He must have a knowledge of gasoline engines and vision to see the tremendous possibilities when used on dirt moving machinery.

A wide acquaintance among contractors in New York City and State is essential as immediate results will be expected.

A two-fisted, hard hitting, business producing salesman, fully conversant with modern sales methods, is the man we want.

Headquarters: New York City

Address AS-422, Engineering News-Record
10th Ave. at 36th St., New York City.

ADVANCE AGENT WANTED

A well established concern of engineers and builders, who have developed a type of fireproof construction specially adaptable to industrial buildings, are seeking representatives to forward information as to industrial buildings under contemplation in their section of the country. Manufacturer's Agents already engaged in a well founded business along industrial lines can have a profitable side line by representing us.

AS-421, Engineering News-Record
Old Colony Bldg., Chicago, Ill.

WANTED

Conveyor

About five hundred feet of used gravity conveyor wanted. What have you to offer? Philadelphia Storage Battery Co., Ontario & C Streets, Philadelphia, Pa.

Wanted to Buy

A 2½ yard or 3 yard Hayward type Orange Peel Bucket. Must be in first class working order. McWilliams Dredging Company, 1537 McCormick Building, Chicago, Illinois.

BOOKS AND PERIODICALS

Complete Set For Sale

Of U. S. Geological Survey Water Supply publications of nearly 500 copies, to highest bidder for next thirty days, perfect condition. Gurley Light Mountain transit with straight standards, reversion level, with complete Burt Solar equipment; mountain tripod. Excellent condition, $285.00. BP-413, Eng. News-Record, 10th Ave. at 36th St., N. Y. C.

PATENT ATTORNEYS

PATENTS — Send for form "Evidence of Conception" to be signed and witnessed. Form fee schedule, information, free. Lancaster and Allwine, 262 Ouray Bldg., Washington, D. C.

WANTED

CEMENT GUN OUTFIT

for re-finishing concrete building. State price and capacity. With or without compressor.

W-332, Engineering News-Record
10th Ave. at 36th St., New York City.

EXCAVATION

Steam Shovels for rent with crews or work taken by contract

Dinkeys and cars or teams furnished.

H. C. AMBLER
3717 Old York Road, Philadelphia, Pa.

Second-Hand Transits and Levels

Guaranteed in Good Order and Adjustment.
Write for New Bargain List
WILLIAMS, BROWN & EARLE, INC.
918 Chestnut St., Philadelphia, Pa.
Department D

NEW AND USED SURVEYING INSTRUMENTS AT FACTORY PRICES

Satisfaction guaranteed or money refunded. Write for complete list and catalogue of our high grade instruments and supplies for civil engineers, surveyors, mining, builders, contractors, etc.; 40 years' experience in repairing instruments of all makes at reasonable prices. Prompt service.

WISSLER INSTRUMENT CO.
607 N Broadway, St Louis, Mo.

LOCOMOTIVE CRANE

Industrial 10-ton, 8 wheel Steam Crane, 48-ft boom, bucket handling drums, standard gauge, good condition Immediate shipment. F O B Milwaukee, $3800 cash

H. Y. SMITH COMPANY, Milwaukee, Wis.

LAND FILLING · CLEAN STEAM

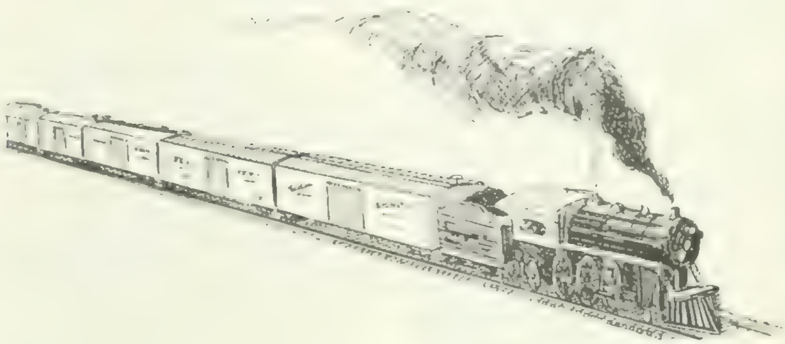
CINDERS

ROAD BUILDING · SCOW LOAD QUANTITIES

500 to 2000 cu. yds. daily output

Phone: Mulberry 2670 **HENRY B. COOKE CO., Inc.** 810 Broad St., Newark, N. J.

Railway Equipment



Contractors enter your bids before January 16th

Industrial and Standard Gauge Rolling Stock

- Push Cars
- Motor Cars
- Locomotives
- Box Cars
- Flat Cars
- Dump Cars
- Powder Cars
- Passenger Cars
- Tank Cars

SEALED bids for any or all of the equipment listed below will be received in the Office, Chief of Engineers, Room 2830 Munitions Bldg., Washington, D. C., before 3 p.m., Jan. 16. This equipment is in general good condition and may be inspected upon application to the commanding officer, point of storage. Send for proposal of sale which gives all information concerning equipment and terms of sale. Address, as above.

Ordnance Reserve Depot, Tullytown, Pa.—1 gasoline motor car stand. gauge; [illegible] 36-in. gauge, 15 flat cars, 36-[illegible] 15 [illegible] powder cars 36-in. [illegible] 1 camp car stand. gauge.

Watertown Arsenal, Watertown, Mass.—1 camp cars stand. gauge 11 flat [illegible] wheels.

Morgan Gen. Ordnance Depot, South Amboy, N. J.—1 box car, stand. gauge, [illegible] stand. gauge 12 [illegible] cars stand. gauge.

Ordnance Reserve Depot, Toledo, Ohio.—[illegible] box cars stand. gauge.

Camp Dix, N. J.—[illegible] 4 flat cars [illegible] 18 box [illegible]

Curtis Bay, Md.—[illegible] No [illegible]

The Government reserves the right to reject any or all bids.

U.S.

WAR DEPARTMENT

SEARCHLIGHT SECTION

USED EQUIPMENT AND NEW

Offered for Re-sale

Space for these advertisements [illegible] the advertising inch [illegible] 30 inches to a page. The price per inch is based on total [illegible] multiply ad space by number of [illegible]

RATE PER INCH.
1 to 3 inches .. $5.00 an inch
4 to 7 inches . 4.80 an inch
8 to 14 inches.. ... . 4.70 an inch

An inch is measured vertically on one column three columns to a page. Any space may be used measured by the even inch in height by 1, 2, or 3 columns in width.

RATES FOR LARGER SPACES, OR SPACE ON A YEARLY BASIS, FURNISHED ON REQUEST.

E. N. R.

LET GEORGE DO IT! **FOR SALE OR RENT** LET GEORGE DO IT!

PUMPS

3 in. Diaphragm, gas and electric.
3 to 8 in. Centrifugals.
6 in. Centrifugal, dir. conn. to gasoline engine.

MIXERS

1—¾-yd. Ransome, electric.
2 ½-yd Ransome, electric.
1 15-ft. Lansing, gasoline
2 10 ft. Eureka Power Loaders, gas. & elec
2 10-ft. Ideal, gasoline and electric

SAW TABLES

2—No. 7 Knickerbockers, gas or electric.

TRACK TOOLS

1—Electric Track Drill and Tools.

COMPRESSORS

1—7 x 10 Chicago Pneumatic, gasoline, portable.
1—8 x 8 Clayton, belt driven.
1 No. 3 Schramm, gasoline, portable.

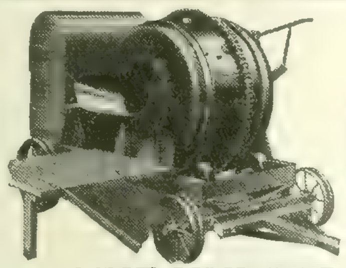
TOWERS

500 ft. Standard Size Wood Tower.

All equipment may be inspected at Brooklyn Yard.

Write for George's Red Book.

E. GEORGE & CO., 407-409 Broadway, New York City
Established 1873



FOR SALE OR RENT
Rebuilt Mixers and Hoists
From our New York Warehouse

5—7 S Knickerbocker Mixers, gasoline driven
3 4 S Standard Mixers, low charging. Novo engines.
4 Mortar Mixers, continuous type, gasoline driven.
1 11 S Ransome Mixer, batch hopper, elec. drive.
1—14 S Smith Mixer, tilting drum, steam driven.
1 28-S Ransome, batch hopper, steam engine.
1 7-in x 10 in. Lidgerwood D.D., D.C. hoist with boiler and swinger.
1—6¼-in. x 8-in. Lidgerwood D.D.,D.C. hoist with boiler.
1—9 in. x 12-in. National Three-Drum Hoist with boiler and swinger
Gasoline Hoists, 6 to 10 hp., single or double drum.

THE HUBBARD-FLOYD CO., INC.
MAIN OFFICE: Grand Central Palace, New York, N. Y., Vanderbilt 1465
BOSTON OFFICE: Old South Building, Main 4233.

CRANES

1—O. & S 15-ton, 8-wheel Crane, full M. C. B.
1—20-ton McMyler, 8 wheel Crane, full M. C. B.
1—Little Giant Traction Crane.
1—Brand new gasoline, on caterpillar.
1—Model 3 Keystone with skimmer scoop.

SHOVELS

1—21 Marion Caterpillar with shovel and Crane booms.
1—36 Marion Traction, 1½-yd. Dipper.
1—No 0 Thew with clam shell attachment.

CRUSHERS

1—No. 10 McCully, manganese fitted.
1—No. 9 Gates, Style K almost new
1—No. 8 Austin, chilled iron fitted.
1—No 6 McCully, manganese fitted.
1—No. 5 McCully, chilled iron fitted.
1—No. 3 Gates, manganese fitted.
1—28 x 36 Traylor Jaw Crusher.

CARS

30—100 000 capacity, std. gauge, all steel, double hopper gondola cars.

MIDWESTERN CO.
140 South Dearborn Street, Chicago
Telephone State 8356

DERRICK BOAT FOR SALE

Two hulls 90 ft. x 16 ft. each, clearance over all 35 ft., fully equipped locomotive type return tube boiler, triple drum 9 x 12 National hoist, swing engine, necessary spud hoists and spuds, etc., boom 55 ft. long	$7500
1—10 x 16 Vulcan Locomotive, 36 in. gauge	1200
7—12-yd. Oliver Dump Cars (entirely rebuilt and not since used), each	1000
1—65-ton Bucyrus Shovel	7500
1—70-ton Bucyrus Shovel	5000
1—1-yd. Hayward Orange Peel Bucket	550
1—3-yd. Hayward Orange Peel Bucket	1500

Also other construction equipment at low prices.

James H. Dawes, General Contractor, Tonawanda, N. Y.

NEW TRACTION CRANES

Full Revolving Road Cranes; 7-ton capacity with ¾ yd bucket

ASPHALT PLANT

1—Iroquois 1250 yd., 3 unit Road Asphalt plant, complete

PAVER

1—Austin Semi Caterpillar, 21 E Paving Mixer 5 Bag Machine with boom and bucket, fine condition, low price

ROAD ROLLER

1—Kelly Springfield, 10-ton, 3-wheel double cylinder steam road roller

STEAM SHOVELS

1—Marion Model 28 ⅝ yd. dipper; on traction wheels first class condition
1—Marion, Model 31 on caterpillars, 1 yd dipper

LOCOMOTIVES

American 6 wheel Switcher, Cylinders 18 x 24 in drivers 44 in wheel base 11 ft 6 in weight 60 tons

LOCOMOTIVE CRANE

1—20-ton McMyler 8 wheel M C B bucket drums, 40-ft boom.

We carry in stock concrete mixers, air compressors, hoisting engines, boilers, buckets, pipes, cars and other equipment.

F. MAYER
737 Monadnock Bldg., Chicago, Ill.

New Structural Steel

200 tons (4700 pieces) 5 in. 9¾ lb. I Beams 9 ft. 0 in. To complete shipments from this point $22. net ton, f.o.b. New Cumberland, Pa.

Henry A. Hitner's Sons Co.
4501 Richmond St., Philadelphia, Pa.

FOR RENT AND SALE

11—4 yd., 36-in gauge, heavy duty Western dump car
20—12 yd Western air dump cars std gauge
50 60,000 lb capacity flat and box car
1 Western std gauge [illegible] used sixty days
1—Osgood 18 revolving shovel, traction wheels, No. 791, [illegible] bucket, built 1920
1 Marion 76 steam shovel, No. [illegible], std gauge, weight 110 tons, [illegible] 10 months
1—Class 14 Bucyrus Erie [illegible] on caterpillars, 70 ft. boom, 2 yd bucket, built in 1921.
2—Foote 10 S 1 yd side discharge concrete mixer, with steam engine and boiler
32 NEW 20 in. I beams 80 lb per ft., 19 ft long not drilled
1—NEW Lakewood concrete chuting [illegible] tow.

LOCOMOTIVES

1 50-ton, 18 x 24 in., 6 wheel switcher
1 40 ton, 17 x 24 in., 4 wheel switcher
2 NEW 24 ton, 6 wheel Porter, separate tender, 36-in. gauge.
2—18, 14 and 10-ton Vulcans, 36 in gauge.

INDUSTRIAL EQUIPMENT CO.
McCormick Building, Chicago, Ill

FOR SALE OR RENT

STEAM SHOVELS

1—[illegible]

1—[illegible]

1—[illegible] with ¾-yd. Page dragline bucket.

1—[illegible]

1—[illegible] Delivery Jan. 15th.

1—[illegible]

1—[illegible]

1—[illegible]

1—[illegible]

SPREADER CARS

1—[illegible]

1—[illegible]

DRAGLINE EXCAVATORS

1—[illegible]

1—[illegible] 2-yd. [illegible]

2—[illegible] 3115 [illegible]

1—[illegible] truck mounting.

LOCOMOTIVES

[illegible]

[illegible] Shop No. 719 [illegible] 1908

[illegible] 170 lb. steam [illegible] 860 and 861 New [illegible]

[illegible] Shop Nos. 1226, [illegible]

1—[illegible] American 4-wheeled Saddle Tank Locomotive, Shop No. [illegible]

LOCOMOTIVE CRANES

1—[illegible] Crane (Shop No. [illegible]

1—Pintle Type Crane, built by Variety Iron & [illegible]

R. R. PILE DRIVER

1—Track Pile Driver, Industrial Type No. 2, [illegible] 140,000 lb.

DUMP CARS

21—16 yd. Western air dump cars.

10—12 yd Western Std Gauge Dump Cars; air brakes and air dump, full M.C.B., 19-ft. beds, steel underframes, box girder doors.

20—12 yd Western Std Gauge Dump Cars, air brakes and hand dump, full M.C.B., steel underframes, 19-ft. beds, box girder doors, 60,000-lb. capacity trucks.

[illegible]—12 yd Western [illegible] dump cars, 19-ft. beds; steel underframes, truss rod doors.

5—12 yd Oliver dump cars, hand dump, steel underframes, full M.C.B.

2—4 yd K & J 36 in gauge side dump cars.

20—1½ yd 24 in gauge Western dump cars.

HOISTING ENGINES

3—7 x 10, D.C., D.D. American Hoisting Engine, complete with boiler and swinging attachment.

1—7 x 10 D.C., D.D. Lambert Hoisting Engine, without boiler.

1—7 x 10, D.C., 3-Drum Lambert Hoisting Engine, complete with boiler.

1—7 x 10 D.C., D.D., Clyde Hoist with A.S.M.E. boiler.

1—7 x 10, D.C., D.D. Lidgerwood Hoisting Engine with [illegible] boiler.

MISCELLANEOUS

1—Williams [illegible] yd heavy digging clam shell bucket [illegible]

20—Sets Standard Chain Tug Harness, with collars, [illegible]

1—Stiff leg Derrick, wood, 55-ft. boom, 39-ft. mast, bucket handling sheaves.

1—No. 2 Vulcan Steam Hammer.

1—Industrial Steam Pile Driver Hammer, Serial No. 324.

1—Pair steel Pile Driver Guides for derrick, 42 ft. long.

1—60 hp. Boiler, Locomotive type, 125 lb. pressure, [illegible] complete with fittings.

2—Stubo [illegible] 30 ft. x 50 ft.

CLAPP, RILEY & HALL EQUIPMENT CO., 14 So. Canal St., Chicago

(Successors to Clapp, Norstrom & Riley Equipment Co.)

TRANSMISSION

New and Used Dodge Equipment for Immediate Delivery

Shafting—Cold rolled steel—All sizes and lengths.

Shaft Hangers—All types and sizes.

Bearings—Capillary, Ring and Standard Oiling.

Pillow Blocks

Friction Clutches—Dodge Split, Solid and Jaw.

Collars—Solid, Split and Thrust

Pulleys—Split and Solid—Cast Iron, Steel and Wood.

Bushings

Grease Cups

[illegible]

Nashville Industrial Corporation
Jacksonville, Tennessee.

FOR SALE

3—6-ton Whitcomb Locomotives.

1—6-ton Plymouth Locomotive.

2 Miles 20 lb., 24 gauge Portable Track.

1 Mile 25-lb. 24-gauge Portable Track.

Switches and turnouts for the above.

20—Lakewood Roller Bearing Batch Box Cars.

15—Atlas Roller Bearing Batch Box Cars.

70—Western Wooden Dump Bottom Batch Boxes.

With separate compartments for sand, gravel and cement.

1—Holt, 10-ton Caterpillar Tractor.

[illegible]

SHEA & COMPANY
Hammond, Indiana.

IMMEDIATE DELIVERY

Send Us Your Steam Shovel Inquiries

[illegible] TRAYLOR JAW CRUSHER.

[illegible] GATES CRUSHER

[illegible] CRUSHERS.

[illegible] SULLIVAN COMP. [illegible]

[illegible] SYMONS [illegible] ELECTRIC SHOVEL

[illegible] 25-ft. Eng. drive. [illegible] electric drive comp. JAW AND ROLL CRUSHERS.

[illegible] Locomotive Cranes.

[illegible] 10 x 18 in., 9 x 14-in. JAW CRUSHERS.

[illegible] UNDERWRITERS' STEAM PUMP.

[illegible] McLANAHAN ROLL CRUSHER.

[illegible] Steam Engines, Cent. Pumps, [illegible] Contrs. Equip., etc.

ROSS POWER EQUIPMENT COMPANY
[illegible], Ind.

PAVERS—ROLLERS

1—10-E [illegible] steam Paving Mixer, Wheel [illegible] 2-bag Size, 192 Model, [illegible]

1—[illegible] Paver, 2 bag [illegible]

3—Austin [illegible] 3 wheel, good condition, [illegible] each $1100

H. Y. SMITH CO., Milwaukee, Wis.

FOR SALE OR RENT

STEAM SHOVELS

1—14B Bucyrus [illegible] 1921 [illegible]

1—[illegible]

1—[illegible]

1—[illegible]

1—[illegible]

LOCOMOTIVES

1—American [illegible]

3—11 x [illegible]

[illegible]

TRACTOR AND TRAILERS

1—[illegible] rebuilt at [illegible]

3—[illegible]

10—[illegible]

DRAGLINES

1—[illegible] 36 Marion steam operated caterpillars 50 ft. boom. 1½ yd. bucket.

1—[illegible] Bucyrus steam operated caterpillars 45 ft. boom. 1½ yd. bucket.

1—[illegible] Bucyrus; skids and rollers; 60-ft. boom; 2 yd bucket.

1—Class 14 Bucyrus steam operated shop Nos. 3691 and 3692, [illegible] 60 ft. booms [illegible] Page buckets.

1—Class 14 Bucyrus truck mounting 60 ft boom new 2 yd [illegible]

1—Class 20 Bucyrus steam operated skids and rollers 75-ft boom, 15 ft. extension, 3 yd bucket.

[illegible] Bucyrus steam operated shop Nos. 3445 and 3500 [illegible] 100 ft. boom [illegible] Page buckets.

1—Class 24 Bucyrus Electric skids and rollers 100 ft boom. [illegible]

1—[illegible] A-1 steam; traction wheels: 40 ft boom; 1 yd [illegible]

1—[illegible] Monighan, Steam skids and rollers 60 ft boom 2-[illegible]

The above list is constantly changing. No matter what your machinery requirements are, write us—we may have it.

BECK & BABB, 29 La Salle Street, CHICAGO, ILL.

Increase In Price—After Jan. 1st, 1923, $1,800

(On account of expense in the removal of remaining equipment from Hog Island to Primos, Pa.)

Primos, Pa. is 8 miles west of Philadelphia on the P. B. & W. R.R.

HOISTS DERRICKS

Where else can you save at least $2,000 on an Electric Hoist and Derrick?

We defy you to duplicate this SAVING!

THINK of it! Hoists and Derricks that are *standard late models*, made by the American Hoist & Derrick Co., St. Paul, Minn. Not old, used-up equipment. No sir! Almost NEW—every one GUARANTEED to be in A-No. 1 running order.

The Hoists have two drums and swingers, and are complete with Starting and Control Equipment. Either side or bank control, and rated 6000 pounds, single line on each hoisting drum. Slewing rope 36 ft. per minute, and hoisting rope speed 160 ft. per minute. The MOTORS are Otis 37 H.P. A.C., 60 cycle, 3 phase, 440 volt, intermittent duty slip-ring induction type and, if desired, may be changed to suit the individual current requirements of purchasers at cost.

You can see these hoists and Derricks easily—at any time. We sell as a set—or in Units of a Hoist or a Derrick. We can make quick shipment anywhere—but it is up to you to take QUICK ACTION to get yours. These tremendous bargains are selling fast—so get in touch with us at once if you want to save.

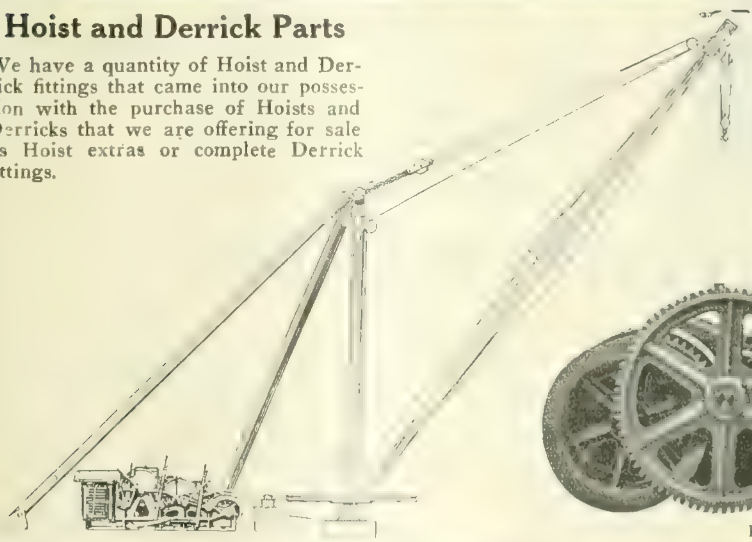
DIMENSIONS OF DERRICKS

Mast......16 in. square, 40 ft. high.
Boom......Made of (2) 14 in. sq. timber 48 ft. long spliced to lengths of 80 ft. with (2) ⅞ in. and (2) 1⅛ in. truss rods.
Stiff Legs..14 in. sq., 60 ft. long or 16 in. sq., 50 ft. long, will furnish either length desired, capacity 5 to 12 tons. Bull wheel 16 ft. dia. Principal sheaves 16 in. dia. and 14 in. single blocks.

The Cable which was formerly used will be given with each purchase of a Hoist and Derrick.

Hoist and Derrick Parts

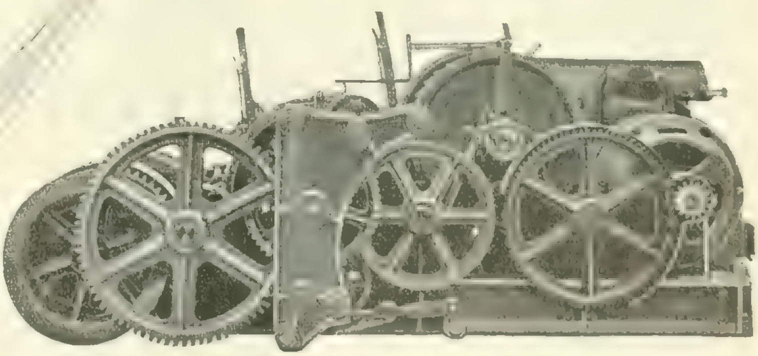
We have a quantity of Hoist and Derrick fittings that came into our possession with the purchase of Hoists and Derricks that we are offering for sale as Hoist extras or complete Derrick fittings.



Wire Phone or Write

for Detailed Information, Folder, etc.

The Electric Hoist & Derrick Co.
Primos, Penna.



Reproductions from Photos of Hoists

GUARANTEED REBUILT EQUIPMENT **SELL OR RENT** OUR PRICES ARE RIGHT —TRY US

DERRICKS

[illegible]

1—[illegible]

HOISTS

5—[illegible]

1—[illegible]

HAMMERS

[illegible]

LOCOMOTIVES, CARS AND TRACK

[illegible]

1—36-in. Ga., 8-Ton Whitcomb Gas.

[illegible]

1½ miles, 24-in. Ga. Portable Track.

STEAM SHOVELS AND DRAG LINES

5—Traction and Caterpillar Shovels, including Erie, Bucyrus, Thew and Osgood.

[illegible]

1—Bucyrus 70-C Std. Ga.

1—Monighan Walker Type Dragline, 40-ft. Boom.

[illegible]

CRANES

1—O & S 15-Ton Std. Ga.

1—Type B Erie Traction Wheels.

1—31 Marion Traction Wheels.

1—Byers Auto Crane Traction Wheels.

1—Industrial 20-Ton, Std. Ga.

STEAM SHOVELS AND DRAGLINES

1—P & H No. 206

1—Marion 60 [illegible]

1—Marion 221 combination shovel and dragline.

STEEL TOWERS AND MISCELLANEOUS

1—¾-yd. Blaw-Knox Clam Shell Bucket.

1—Telsmith Jaw Crusher, 9 x 18 in. Trucks with 22 ft. Bucket Elevator.

1—Eureka 7 x 8 Jaw Crusher.

1—Insley 110-ft. Steel Tower with Spouting.

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5—Centrifugal Pumps from 5 in. to 12 in.

1—Austin Rip Shutter

1—Lakewood Tamping Machine.

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RENNOLDS EQUIPMENT CO.

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2—McMyler 25-ton, 8-wheel, 50-ft. booms, bucket operating, 7½ kw. generators, located Youngstown and Cincinnati.

1—McMyler 20-ton, 8-wheel, 40-ft. boom, bucket operating, located Youngstown.

1—Brownhoist 15-ton, 8-wheel, 50-ft. boom, single drum, 5 kw. generator, located Chicago Heights.

2—Ohio 20-ton, 8-wheel, 50-ft. booms, bucket operating.

1—Browning 15-ton, 8-wheel, 38-ft. boom, bucket operating.

1—Brownhoist 15-20-ton, 8-wheel, 42-ft. boom, hook block.

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1—Browning 4-wheel electric.

Hoisting Machinery Co.
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FOR SALE OR RENT

1—40-ton 8-wheel Brown Hoist 60-ft boom.

1—30-ton 8-wheel Browning 50-ft boom

1—25-ton, 8-wheel Industrial, 50-ft. boom.

2—20-ton 8-wheel Ohio 50-ft booms

1—15-ton 8-wheel Industrial 40-ft. boom

100—50-ton, standard gauge, all steel, hopper bottom self-clearing, first-class condition, meeting M.C.B. requirements, ready for immediate service.

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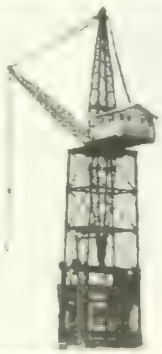

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Terry Gantry Crane

(New)

Electrically operated

Boom 74 ft. Long. Capacity 40,000 lbs.

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1—[illegible] M.C.B. [illegible]

1—[illegible]

2—20-ton [illegible] booms, 8-wheel M.C.B., built 1918.

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1—20-ton Brownhoist, single drum, 70-ft. boom, 8-wheel M.C.B., built 1915.

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1—10-ton Byers, full-revolving, double drums, 40-ft. boom, traction wheels, built 1921.

All [illegible] a first-class crane mechanic and [illegible] and are ready for work.

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58—Concrete Mixers, Sizes 28S, cap 1 yd., 21S cap ¾ yd., 14S, cap ½ yd., and 10S, cap 1/3 yd. With steam or electric power, with side loader or batch hopper. Following makes: Marsh Capron, Koehring, Milwaukee, Ransome, Smith, Smith Chicago, Rex, Lakewood, Foote, Cube, or Oshkosh.

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3—Byers Auto Cranes. One on caterpillar, 2 on traction wheels, with 30-ft. boom, with ½ or ¾-yd. clam shell buckets.

1—15-ton, 8-wheel O. & S.; 40-ft. boom.

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Large number of American double drum Hoists, with attached swinger, with 37-hp. AC Motor, 60 cy., 3 ph., 220 or 440 v.

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25—Three-drum Hoists, with or without boilers. Size 10 x 12, 9 x 10, 8¼ x 10, and 7 x 10 with separate swinger for derrick work. All makes.

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6—Swinging Engines.

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Erie B, ¾-yd. high-lift, Mass. boiler, also extra dragline attachments.
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Other Revolving Shovels, ¾, 1 and 1½-yd.
Railroad Shovels, all sizes and makes.
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Caterpillar Traction, 1-yd. bucket. Equipped with boom hoist. First class condition.

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½ and ¾ cu. yd. Rental $22 per cal. week
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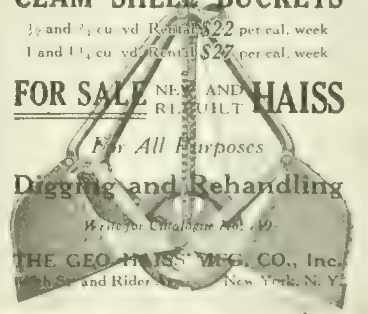

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1—25 Ton Browning Crane No [illegible] 8-wheel, Standard Gauge, 50 ft. Boom [illegible] Drum, Mass. Boiler Equipped with [illegible]

2—25 Ton Industrial Crane, 8-wheel, Standard Gauge, 50 ft. Boom, Double Drum, ASME Boilers.

1—20 Ton Browning Crane, No. [illegible], 8-wheel, Standard Gauge, 50 ft Boom, Mass. Boiler, Single Drum.

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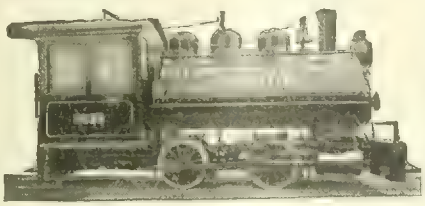

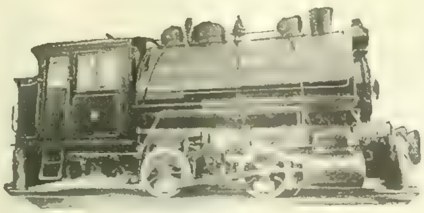

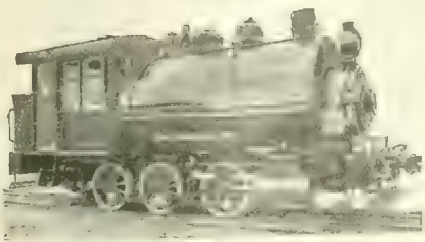

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At the beginning of the present year, 97% of the paving higher than waterbound macadam was of the bituminous types.

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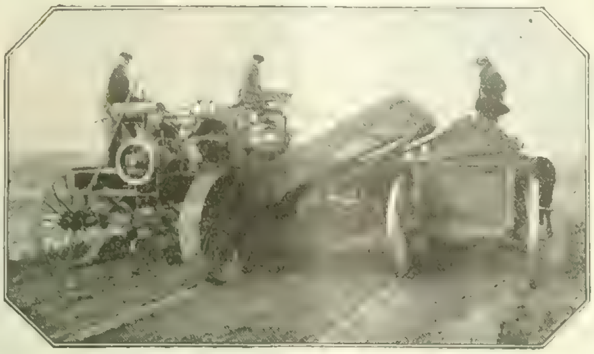

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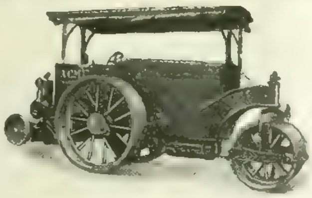

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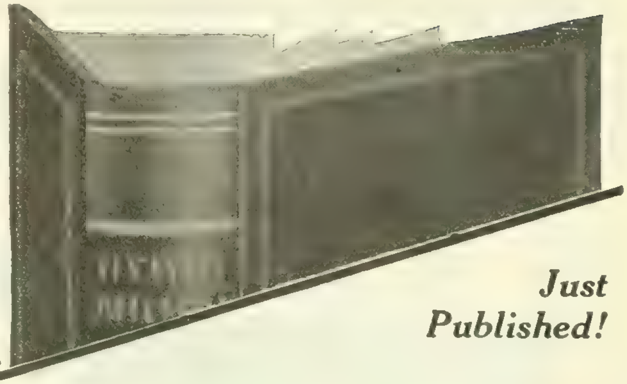

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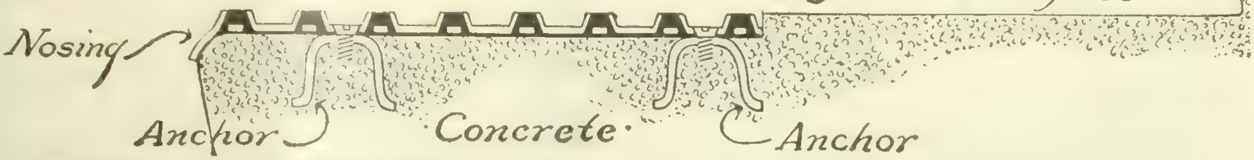

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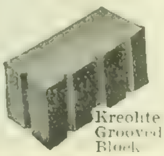

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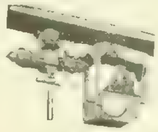

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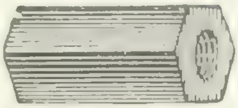

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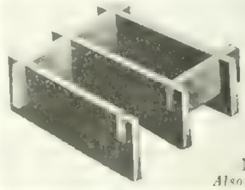

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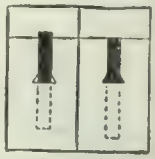

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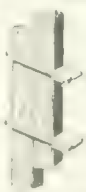

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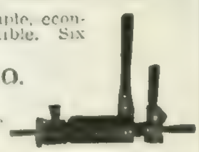

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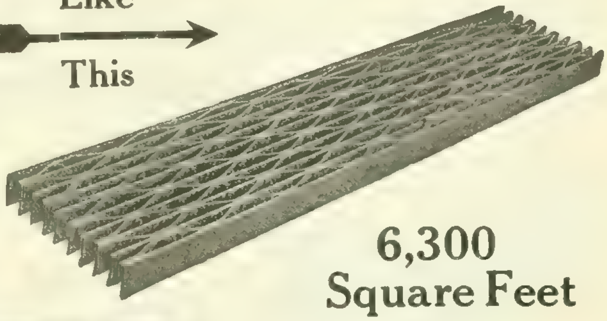

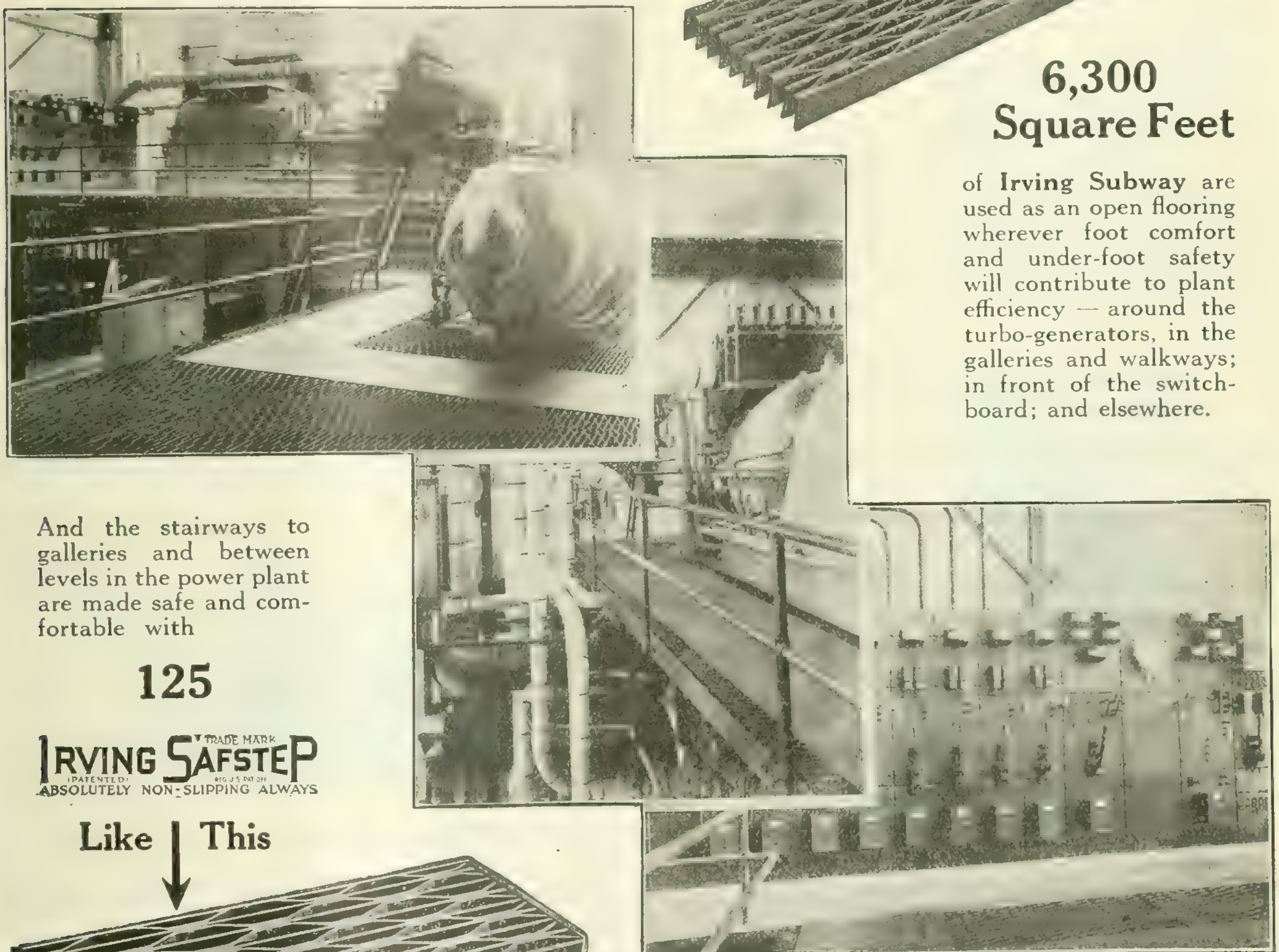

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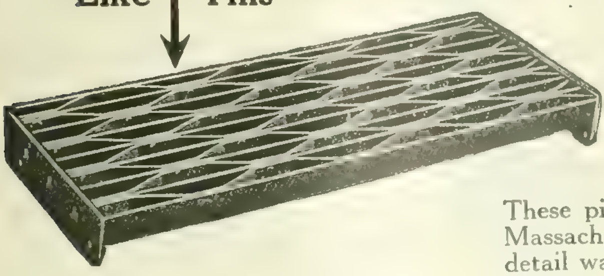

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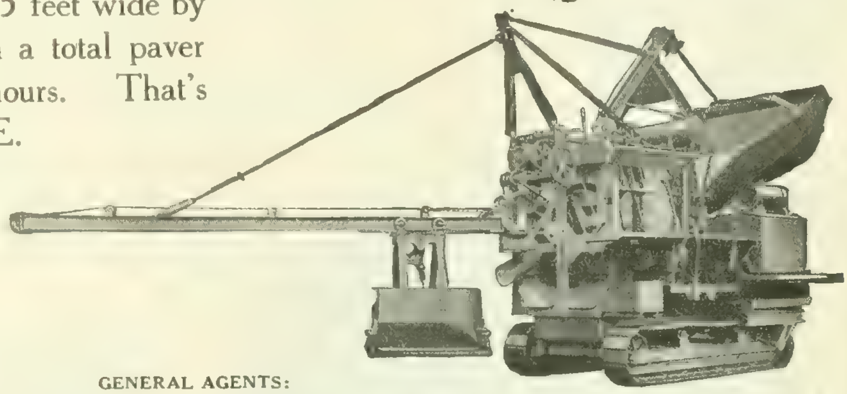

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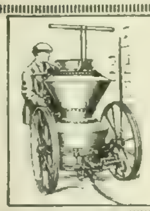

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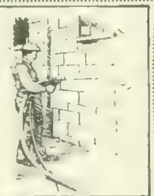

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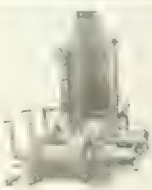

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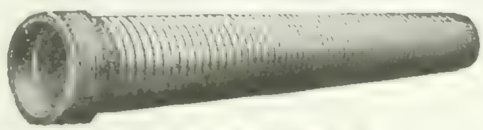

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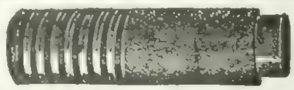

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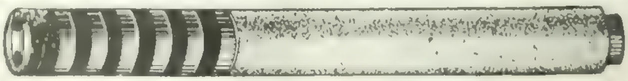

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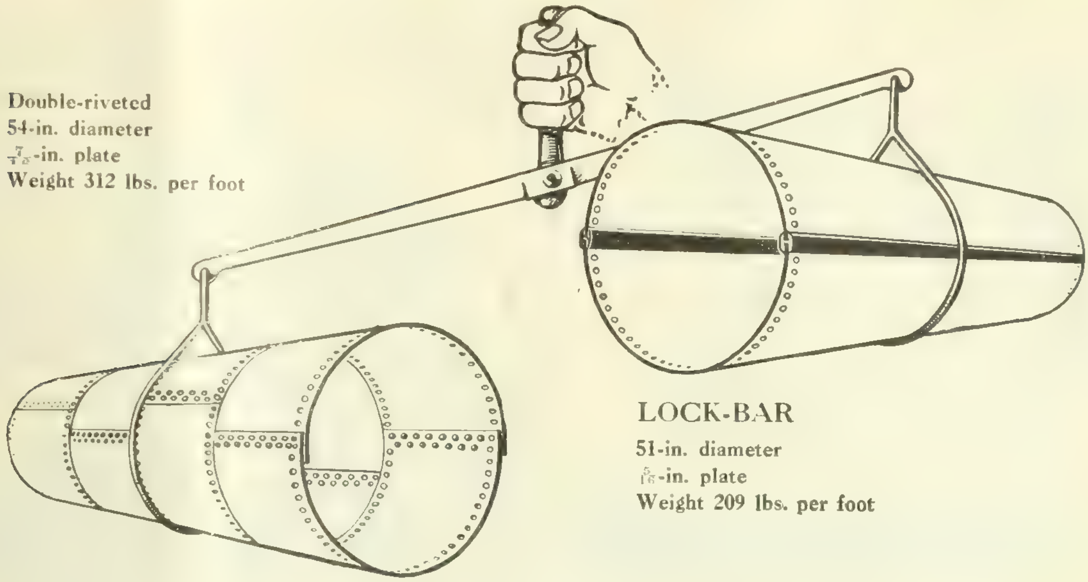

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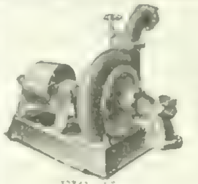

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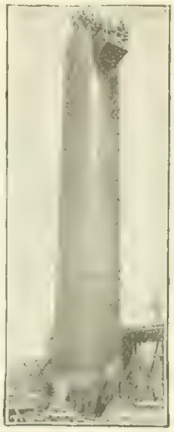

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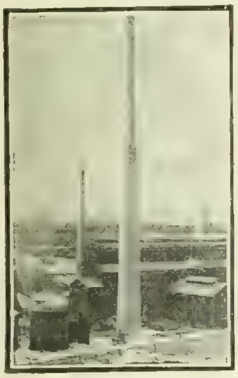

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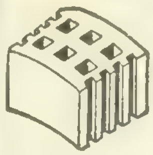

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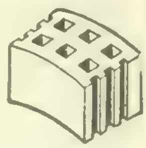

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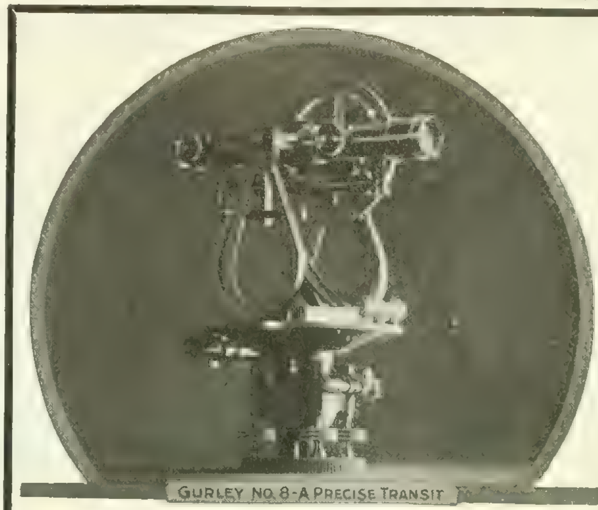

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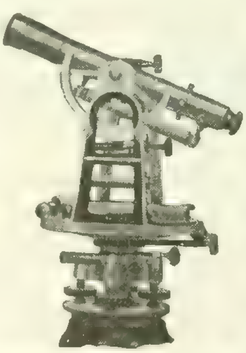

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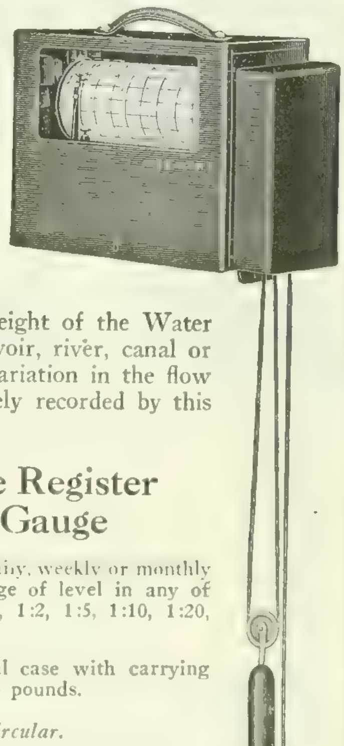

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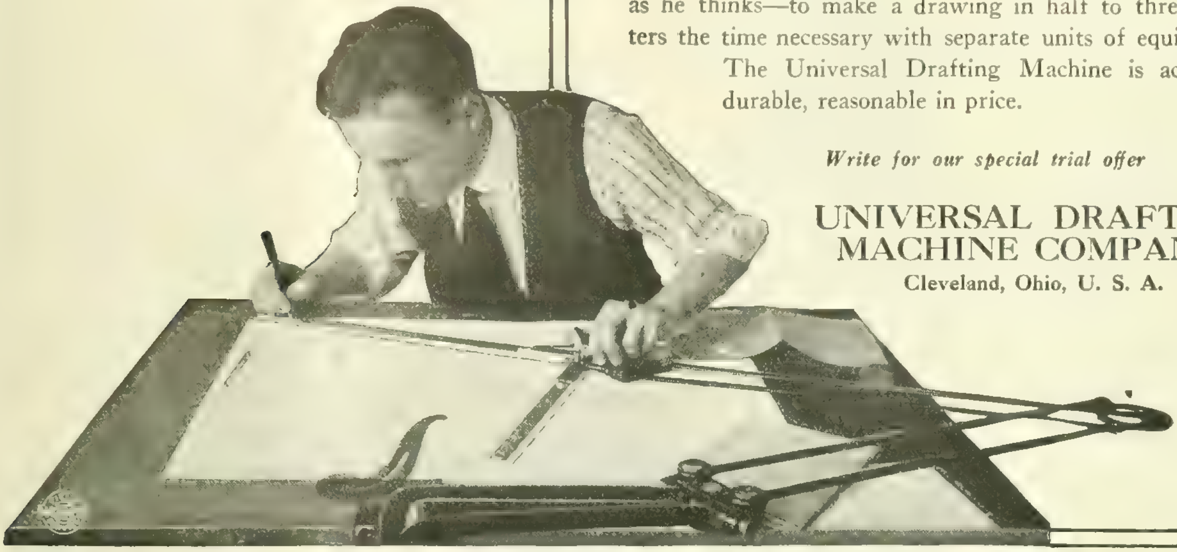

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Sewage Disposal.

Drainage.

[illegible]

Power Generation.

Chicago [illegible]

The Arnold Company

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Locomotive Terminals

Maintenance Shops

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Chicago, 208 S. La Salle Street

New York Tacoma

Condron Company

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Kelker, De Leuw & Co.

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Chicago, Ill. 1445 Monadnock Bldg.

Pearse, Greeley & Hansen

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Reports, Designs, Supervision, Appraisals, Water Supply, Sewerage, Water Purification, Sewage Treatment, Refuse Disposal.

[illegible]

Stern, I. F.

[illegible]

Bridges, Buildings and other Structures, Engineering Projects.

[illegible]

Chicago, Ill., First Natl. Bk. Bldg.

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Authoritative Reports and Valuations Covering Public Utility, Municipal, Mineral, Industrial, Commercial and Residence Properties.

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A. P. Learned J. F. Brown
E. H. Dunmire

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Burns & McDonnell

S. Burns. R. E. McDonnell.

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Jackson, Michigan

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M.Am.Soc.C.E.

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Kiersted & Stringfellow

Consulting Engineers

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Kansas City, Mo.

Luten, Daniel B.

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Reinforced Concrete Bridges exclusively.

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Meyer, Adolph F.

M. Am. Soc. C. E. & M. E.

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M. Am. Soc. C. E.

Associate Structural Engineer

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N.Y. 1705 Equitable Trust Bldg

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M. Am. Inst. Cons. Engrs.

M. Am. Soc. C. E.

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G H KNUTSON Financial Engr

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Southern States

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Dredges of all types Designed and Built for every service. Municipal Fire, Ice and Ferry Boats, Harbor and Terminal Development. Plans, Specifications, Report, Etc

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Billingsley, James W.

Preliminary Investigations, Detailed Plans, and Construction Supervision. For Industrial Developments, Docks, Roads, Bridges, Drainage and Municipal Improvements.

New Orleans, Louisiana

WHAT AND WHERE TO BUY INDEX

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Adding Machines
Monroe Calculating Mach. Co.

Asbestos & Asbestos Prods.
Carey Co., The Philip

Ash Handling Machinery
Haiss Mfg. Co., Inc., Geo
Jeffrey Mfg. Co.
Portable Machy. Co.
Webster Manufacturing Co.

Asphalt
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Standard Oil Co. of Ind.
Standard Oil Co. of N. Y.
Texas Company

Asphalt Plants
Austin Machinery Corp.

Back Fillers
Austin Machinery Corp.
Northwest Engineering Co.
Parsons Co.

Banks
Coal & Iron National Bank

Bar Benders & Cutters
Koehring Co.
Ransome Concrete Mchy Co.

Bar Chairs, Reinforcing
Universal Clamp Co.

Barges, Concrete
Ambursen Construction Co.

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Bethlehem Steel Co.
Ryerson & Son, Joseph T.

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Blaw-Knox Co.
Heltzel Steel Form & Iron Co.

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Mitchell-Tappen Co.

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Metaline Co.

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Texas Co.

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Link-Belt Co.
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Berger Mfg. Co.
Blaw-Knox Co.
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Riter-Conley Co.

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Pease Co., C. F.
Weber Bros

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N. Y. Blue Print Paper Co.

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Abendroth & Root Mfg. Co.
Babcock & Wilcox Co.

Bolts, Nails, Nuts, Rivets & Spikes
Bethlehem Steel Co.
Ryerson & Son, Joseph T.

Books, Engineering and Technical
[illegible]
McGraw-Hill Book Co
Wiley & Sons, Inc., John

Bonding Companies
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Boxes, Annealing
Blaw-Knox Co.

Brakes, Air
Westinghouse Traction Brake Co.

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Belmont Iron Works
Berlin Constr. Co.
Bethlehem Steel Co.
Blaw-Knox Co.
Boston Bridge Works
Brown Hoisting Mchy. Co.
Eastern Bridge & Struc. Co.
Fort Pitt Bridge Works
Independent Bridge Co.
Kenwood Bridge Co.
Louisville Bridge & Iron Co.
McClintic-Marshall Co.
Milwaukee Bridge Co.
Morava Construction Co
Mount Vernon Bridge Co
Parsons, Klapp, Brinckerhoff & Douglass
Penn. Bridge Co. (Pa.)
Phoenix Bridge Co.
Pittsburgh-Des Moines Steel Co.
Raymond Concrete Pile Co.
Riverside Bridge Co.
Shoemaker-Satterthwait Bridge Co.
Strobel Steel Constr. Co
Virginia Bridge & Iron Co.
Wisconsin Bridge & Iron Co.

Bridges, Bascule
Strauss Bascule Bridge Co.
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Bridge Operating Mchy.
Earle Gear & Machine Co
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Lakewood Engineering Co.
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Williams Co., G. H

Buckets, Concrete
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Union Iron Works

Buckets, Dragline
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Hayward Co.
Marion Steam Shovel Co.
Smith Co., T. L.

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Marion Steam Shovel Co.
Osgood Co.
Owen Bucket Co
Union Iron Works
Williams Co., G. H.

Buckets, Electric Motor
Hayward Co.

Buckets, Elevator
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Owen Bucket Co.
Vulcan Iron Works of N. J.

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National Hoisting Eng. Co.
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Wickwire-Spencer Steel Corp

Cableway Excavators
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Air Reduction Sales Co

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Monroe Calculating Mach Co.

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Easton Car & Constr. Co.
Ransome Concrete Mchy Co

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Easton Car & Constr. Co
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[illegible]
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Insley Mfg. Co.
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Fox & Co., John
Jeffrey Mfg. Co.
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Marion Malleable Iron Wks.
Marion Steam Shovel Co
U. S. Cast Iron Pipe & Foundry Co.
Vulcan Iron Works of Wilkes-Barre, Pa
Warren Fdry. & Mach. Co.

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Cement-Gun Co.

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Worthington Pump & Machy Corp.

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Webster Manufacturing Co.

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Sullivan Machinery Co.

Chimneys, Concrete
General Concrete Constr. Co.
Heine Chimney Co.
Rust Engineering Co.
Summerhays & Sons Co., Wm.
Weber Chimney Co.
Wiederholdt Construction Co.

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Custodis Chimney Construction Co., Alphons
Heine Chimney Co.
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Kellogg Co., M. W.
Rust Engineering Co
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Wallace & Tiernan Co., Inc.

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Coal-Storage Systems
Brown Hoisting Mchy. Co.
Haiss Mfg. Co., Geo
Jeffrey Mfg. Co.
Lidgerwood Mfg. Co.
Link-Belt Co.

Cofferdams, Steel
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Column Clamps
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Universal Form Clamp Co

Column Forms
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Heltzel Steel Form & Iron Co

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Allis-Chalmers Mfg. Co.
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Willsea Works, The

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Berger Mfg. Co
Bethlehem Steel Co.
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Keystone Gypsum Fireproofing Co.
Laclede Steel Co.
Mitchell-Tappen Co.
National Steel Fabric Co.
Northwestern Expanded Metal Co.
Ryerson & Son, Joseph T.
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Ingersoll-Rand Co.
Manistee Iron Wks.
Worthington Pump & Machy. Corp.

Conveyors, Belt
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Jeffrey Mfg. Co.
Link-Belt Co.
Portable Machy. Co.
Robins Conveying Belt Co.
Smith Engineering Works
Webster Manufacturing Co.

Conveyors, Bucket
Brown Hoisting Mchy. Co.
Gifford-Wood Co.
Haiss Mfg. Co., Inc., Geo.
Jeffrey Mfg. Co.
Link-Belt Co
Webster Manufacturing Co

Corner Bead Metal
Consolidated Expanded Metal Cos.

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Bay City Dredge Works
Brown Hoisting Machy. Co.
Browning Co.
Byers Mach. Co.
Clyde Iron Works Sales Co.
Erie Steam Shovel Co.
Industrial Works
Link-Belt Co.
McMyler Interstate Co.
Marion Steam Shovel Co.
Moore Bros.
Northwest Engineering Co
Ohio Locomotive Crane Co.
Orton & Steinbrenner Co.
Osgood Co.
Thew Shovel Co.

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Brown Hoisting Machy Co.
Chesapeake Iron Works
Cleveland Crane & Eng. Co.
Link-Belt Co.
Toledo Crane Co.

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Industrial Works

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Amer. Creosoting Co. (N.Y.)
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Eppinger & Russell Co.
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Allis-Chalmers Mfg. Co
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Austin-Western Road Machy Co.
Brown Hoisting Mchy. Co
Buchanan Co., Inc., C. G.
Jeffrey Mfg. Co.
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Culverts, Corrugated
Austin-Western Road Mchy. Co
Canton Culvert & Silo Co.
Newport Culvert Co.

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Armco Culvert & Flume Mfrs. Assn.
Austin-Western Road Mchy. Co
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Electro Bleaching Gas Co
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Snare Corp., Frederick

Drafting Machines
Universal Drafting Mach Co.

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Dietzgen Co., Eugene
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Pease Co., C. F.

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Northwest Engineering Co.

Drawing Materials
Dietzgen Co., Eugene
Hamilton Manufacturing Co.
Keuffel & Esser Co.
Weber Co., F.

Drawing Tables
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Dredges
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Flory Manufacturing Co., S.
Hayward Co.
Lidgerwood Mfg. Co.
Marion Steam Shovel Co.
Osgood Co.

Dredges, Dipper
Austin Machinery Corp.
Erie Steam Shovel Co.
Osgood Co

Dredges, Hydraulic
Atlantic Gulf & Pacific Co
Marion Steam Shovel Co.
Morris Machine Co.

Drills, Core
Acker Drilling Co.
Ingersoll-Rand Co.
Keystone Driller Co
McKiernan-Terry Drill Co
Sullivan Machinery Co.

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Chicago Pneumatic Tool Co.
General Electric Co.
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Ingersoll-Rand Co.
McKiernan-Terry Drill Co
Sullivan Machinery Co

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Hayward Co.
Mundy Hoist. Eng. Co.

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Vulcan Iron Wks of Wilkes-Barre, Pa

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Austin Mfg. Co.
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Gifford Wood Co.
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Hendrick Mfg. Co
Link-Belt Co.
Ohio Locomotive Crane Co.
Smith Engineering Wks
Webster Manufacturing Co.

Elevators; Contractors' Material
Austin Mfg. Co.
Austin Western Road Mchy Co.
Byers Mach. Co.
Haiss Mfg. Co., Inc., Geo.
Insley Manufacturing Co.
Ransome Concrete Mchy Co.
Smith Co., T. L.
Smith Engineering Wks

Elevators, Factory
Ridgway & Son Co., The Craig

Engineers, Roofing
Federal Cement Tile Co.
Marks Corp., The H. E.

Engineers and Contractors
Atlantic Gulf & Pacific Co.
Cement-Gun Constr. Co.
Parsons Klapp Brinckerhoff & Douglas
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(See Directory of Engineers)

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Ingersoll-Rand Co.
National Hoisting Eng. Co.
Smith Co., T. L.
Wisconsin Motor Mfg. Co.
Worthington Pump & Mchy Corp.

Engines, High Duty Water-Works
Morris Machine Co.

Engines, Hoisting
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Engines, Portable
Cushman Motor Works

Engines, Steam
Chicago Pneumatic Tool Co.

Excavators, Cableway
Clyde Iron Wks. Sales Co.
Lidgerwood Mfg. Co.
Mundy Hoist. Eng. Co., J. S.
Sauerman Bros.

Excavators, Ditch & Trench
Austin Machinery Corp.
Bay City Dredge Works
Erie Steam Shovel Co.
Keystone Driller Co.
Marion Steam Shovel Co.
Northwest Engineering Co.
Osgood Co.
Parsons Co.
Potter Mfg. Co., The
Thew Shovel Co.

Excavators, Dragline
Austin Machinery Corp.
Bay City Dredge Works
Byers Mach. Co.
Erie Steam Shovel Co.
Hayward Co.
Marion Steam Shovel Co.
Monighan Machine Co.
Northwest Engineering Co.
Osgood Co.
Sauerman Bros.
Smith Co., T. L.

Expanded Metal
Berger Mfg. Co.
Consolidated Expanded Metal Cos.
Northwestern Expanded Metal Co.

Expansion Bolts
National Lead Co.

Filters, Water, Municipal and Industrial
American Water Softener Co.
California Filter Co.
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International Filter Co.
N. Y. Continental Jewell Filtration Co.
Roberts Filter Mfg. Co.
Simplex Valve & Meter Co.

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Dickey Clay Mfg. Co.

Fireproofing Material & Construction
Berger Mfg. Co.
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Robertson Co., H. H.

Floor, Asphalt Mastic
Standard Oil Co. of Ind.
Standard Oil Co. of N. Y.
Texas Company

Floor Hardener, Concrete
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Floor, Wood Block
Jennison-Wright Co.

Flooring, Fireproof
Kerlow Steel Flooring Co.
Irving Iron Works
Marks Corp., H. E.
Universal Safety Tread Co.

Flumes, Iron & Steel
Armco Culvert & Flume Mfrs. Asn.
Blaw-Knox Co.

Forgings
Bethlehem Steel Co.

Form Clamps
Insley Mfg. Co.
Pyle Rogers Corp.
Universal Form Clamp Co.

Form Tighteners
Marion Malleable Iron Wks.

Forms, Culvert, Road, Sewer, Tunnel, etc.
Blaw-Knox Co
Foote Concrete Machy. Co.
Heltzel Steel Form & Iron Co.
Metal Forms Corp.

Forms for Curb and Gutter
Blaw Knox Co
Metal Forms Corp.

Forms for Walls, Building Construction, etc.
Berger Mfg. Co.
Blaw-Knox Co.
Heltzel Steel Form & Ir. Co.
Metal Forms Corp.

Foundations
MacArthur Concrete Pile & Foundation Co.
New England Fd. Co., Inc.
Raymond Concrete Pile Co.
Spencer, White & Prentis.
Underpinning & Found. Co.

Frogs and Switches, Railway
Bethlehem Steel Co.
Easton Car & Constr. Co.
Ramapo Ajax Corp

Garbage Disposal Apparatus
Jeffrey Mfg. Co.

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Electro Bleaching Gas Co.

Gas Producers
Blaw-Knox Co.

Gates, Sluice
Coffin Valve Co.
Coldwell-Wilcox Co.
Crane Co.
Ludlow Valve Mfg. Co.

Gauges, Loss of Head
Simplex Valve & Meter Co.

Gauges, Rates of Flow
Simplex Valve & Meter Co

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Earle Gear & Mach. Co.

Generators, Electric
Allis-Chalmers Mfg. Co.
General Electric Co.

Glass, Fireproof
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Governors, Waterwheel
Woodward Governor Co.
Worthington Pump & Mchy Corp

Graders, Road
Austin Mfg. Co.
Austin-Western Rd Mchy Co.
Erie Steam Shovel Co.
Koehring Co.
Smith Co., T. L.
Stroud & Co.
Western Wheeled Scraper Co.

Granite
Granite Paving Block Mfrs' Assoc. of the U. S., Inc.

Gratings, Subway
Irving Iron Works
Kerlow Steel Flooring Co.
Mitchell-Tappen Co.
Universal Safety Tread Co.

Gravel Washing Plants
Link Belt Co
Sauerman Bros

Gypsum
Keystone Gypsum Fireproofing Co.
Marks Corp., H. E.

Hammers, Pneumatic
Chicago Pneumatic Tool Co.
National Hoisting Eng. Co

Hammers, Steam Pile
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Heaters, Concrete Water
Cement Gun Constr. Co.

Heaters Tar & Asphalt
Honhorst Co., The Jos.
Littleford Bros.

Hoists, Concrete Tower
Insley Manufacturing Co.

Hoists, Contractors' Electric
Allis-Chalmers Mfg. Co.
Bay City Dredge Works
Byers Mach. Co.
Clyde Iron Wks. Sales Co.
Dobbie Foundry & Mach.Co.
Flory Mfg. Co., S.
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Mundy Hoist. Eng. Co., J. S.
Monighan Machine Co.
National Hoisting Eng. Co.
O. K. Clutch & Machy. Co.
Ransome Concrete Mchy Co.
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Vulcan Iron Works of Wilkes-Barre, Pa

Hoists, Contractors' Gasoline
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Mundy Hoist. Eng. Co., J. S.
National Hoisting Eng. Co.
O. K. Clutch & Machy. Co.
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Byers Mach. Co.
Clyde Iron Wks. Sales Co.
Ingersoll-Rand Co
Lidgerwood Mfg. Co.
Mundy Hoist. Eng. Co., J. S.
National Hoisting Eng. Co.
Stroudsburg Engine Works
Vulcan Iron Wks of Wilkes-Barre, Pa.

Hoists, Electric
Yale & Towne Mfg Co

Hoists, Hydraulic Head Gates
Dilts Machine Wks Inc

Hoists, Motor, Truck
Wood Hydraulic Hoist & Body Co.

Hoists, Pneumatic
Chicago Pneumatic Tool Co.
Ingersoll Rand Co.
Stroudsburg Engine Works
Sullivan Machinery Co.

Hoppers, Concrete
Insley Manufacturing Co.
Ransome Concrete Mchy Co.

Hoppers, Steel
Heltzel Steel Form & Iron Co.
Honhorst Co., The Jos.

Hose, Air
Chicago Pneumatic Tool Co.

Hydrants
Ludlow Valve Mfg. Co.
Rensselaer Valve Co.
Smith Mfg Co., A. P.
Wood & Co., R. D.

Incinerators
Power Specialty Co.

Inspecting Laboratories
(See Directory of Engineers)

Instruments, Drawing
Keuffel & Esser Co.
N Y Blue Print Paper Co.

Instruments, Surveying
Ainsworth & Sons, Wm.
Berger & Sons, C L.
Buff & Buff Mfg. Co.
Gurley W. & L. E.
Keuffel & Esser Co
Lietz Co., A.
N. Y. Blue Print Paper Co.
White Co., Inc., David

Insulation, Misc.
Texas Company

Iron Work, Structural and Ornamental
Hendrick Mfg. Co.
Irving Iron Works
Kerlow Steel Flooring Co.
Ryerson & Son Co., Jos
Snead Architectural Iron Works
Universal Safety Tread Co.

Jacks, Lifting
McKiernan-Terry Drill Co.
Norton, Inc., A. O.

Joints, Expansion Paving
Carey Co., The Philip
Servicised Products Co.
Truscon Steel Co.

Joints, Filler Paving
Servicised Products Co.
Standard Oil Co. of N. Y.

Joints, Flexible Pipe
Central Foundry Co
Crane Co.
U. S. Cast Iron Pipe & Foundry Co.

Kilns, Rotary
Vulcan Iron Works of Wilkes-Barre

Lamps, Arc, & Incandescent
General Electric Co.

Lamps, Flood
General Electric Co

Lath, Expanded Metal
Armco Culvert & Flume Mfrs. Asn.
Berger Mfg. Co.
Mitchell-Tappen Co
Northwest'n Exp. Metal Co.
Waring-Underwood Co.

Leadite
Leadite Co., Inc., The

Lights, Contractors'
Carbic Manufacturing Co.
Milburn Co., Alexander

Loaders, Wagon
(See Wagon Loaders)

Locomotives, Compressed Air
Baldwin Locomotive Co.
Porter Co., H. K.

Locomotives, Electric
Baldwin Locomotive Co
General Electric Co.
Jeffrey Mfg. Co.

Locomotives, Fireless Steam
Porter Co., H. K.

Locomotives, Gasoline
Baldwin Locomotive Co
Fate Root Heath Co.
Hadfield-Penfield Steel Co
Lakewood Engineering Co.
Milwaukee Loco. Mfg. Co.
Vulcan Iron Wks of Wilkes-Barre, Pa.
Whitcomb Co., Geo. D.

Locomotives, Steam
Baldwin Locomotive Co.
Davenport Locomotive Wks.
Porter Co., H. K.
Vulcan Iron Wks of Wilkes-Barre, Pa.

Locomotives, Storage Battery
General Electric Co.
Whitcomb Co., Geo. D.

Lubricants
Greene, Tweed & Co.
Texas Co.

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Exchange Sawmills Sales Co
Lawson & MacMurray

Manhole Covers
Central Foundry Co.

Manometers
Simplex Valve & Meter Co

Meter Boxes
Pittsburgh Meter Co.

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Hersey Mfg. Co.
Pittsburgh Meter Co.

Meters, Boiler Feed Water
Builders Iron Foundry

Meters, Current
General Electric Co.
Gurley W. & L. E.

Meters, Gas and Steam
Builders Iron Foundry
General Electric Co
Wallace & Tiernan Co., Inc.

Meters, Venturi
Builders Iron Foundry

Meters, Water, Oil, etc.
Builders Iron Foundry
Gamon Meter Co.
General Electric Co
Hersey Mfg. Co.
Neptune Meter Co
Pittsburgh Meter Co
Simplex Valve & Meter Co.
Worthington Pump & Machy Corp

Mixers, Asphalt
(See Mixers, Hot)

Mixers, Concrete
Austin Machinery Corp.
Cement-Gun Co.
Foote Concrete Machy. Co.
Koehring Co.
Lakewood Engineering Co
Ransome Concrete Mchy Co.
Smith Co., T. L.

Mixers, Grout
Austin Machinery Corp
Ransome Concrete Mchy Co
Union Iron Works

Mixers, Hot
Austin Machinery Corp.
Koehring Co.

Mixers, Mortar
Austin Machinery Corp.
Ransome Concrete Mchy Co

Mixers, Paving
Austin Machinery Corp.
Foote Concrete Machy. Co.
Koehring Co
Lakewood Engineering Co
Ransome Concrete Mchy Co
Smith Co., T. L.

Mixers, Pneumatic
Ransome Concrete Mchy Co

Mortar
Carney Cement Co.

Motors, Electric
Allis-Chalmers Mfg. Co
General Electric Co
Westinghouse Traction Brake Co.

Motors, Gasoline
Wisconsin Motor Mfg. Co

Motor-Truck Bodies
Wood Hydraulic Hoist and Body Co.

Motor Trucks
(See Trucks, Motor)

Nitrogen
Air Reduction Sales Co.

Oil Lubricating
Texas Co

Oxy-Acetylene Process
Air Reduction Sales Co.
Blaw-Knox Co.
Oxweld Acetylene Co.

Oxygen
Air Reduction Sales Co.

Packing, Water Pipe
Greene, Tweed & Co.
Jenkins Bros.

Paints, Graphite
Truscon Laboratories

Paints, Light Reflecting
Cheesman & Elliot Co
Truscon Laboratories

Paints, Metal Protective
Carey Co., The Philip
Cheesman & Elliot Co.
National Lead Co.
Protexol Corp.
Servicised Products Co.
Truscon Laboratories

Partitions
Keystone Gypsum Fireproofing Co.

Paving Asphalt
Carey Co., Philip
Standard Oil Co. of Ind
Standard Oil Co. of N. Y.
Texas Co

Paving Blocks, Creosoted Wood
See Creosoted Block, Timber Posts, Cross Arms, Lumber etc.

Paving Blocks, Granite
Granite Paving Block Mfrs Assoc. of the U. S., Inc

Paving Breakers
Ingersoll-Rand Co.

Paving, Cold Patching
Standard Oil Co. of Ind
Standard Oil Co. of N. Y.
Texas Company

Paving Guards, Steel
International Steel Tie Co.

Paving Joint Filler
Servicised Products Co.
Texas Co.

Penstocks
Blaw-Knox Co.

Pile Drivers
Industrial Works
McKiernan-Terry Drill Co
McMyler Interstate Co.
Union Iron Works

Pile Hammers, Steam
Industrial Works
McKiernan-Terry Drill Co.
National Hoisting Eng. Co
Union Iron Works Chicago
Vulcan Iron Works of

Piles, Concrete
MacArthur Concrete Pile & Foundation Co.
New England Fd. Co. Inc
Raymond Concrete Pile Co

Piles, Creosoted Wood
Jennison-Wright Co.

Piling, Interlocking Steel
Bethlehem Steel Co

Pipe Bends
East Jersey Pipe Co.

Pipe, Cast Iron
Amer. Cast Iron Pipe Co
Central Foundry Co.
Fox & Co., John
Glamorgan Pipe & Fdry Co.
McWane Cast Iron Pipe Co
U. S. Cast Iron Pipe & Foundry Co
Warren Fdry & Mach Co
Wood & Co., R. D.

Pipe Coils
Superheater Co.

Pipe, Concrete
Independent Conc. Pipe Co
Lock Joint Pipe Co
Standard Concrete Pipe Co

Pipe, Corrugated
Austin-Western Road Mchy Co.
Canton Culvert & Silo Co
Newport Culvert Co.

Pipe Covering, Asbestos
Carey Co., The Philip

Pipe Covering, Wood
Michigan Pipe Co
Standard Wood Pipe Co
Wyckoff & Son Co., A.

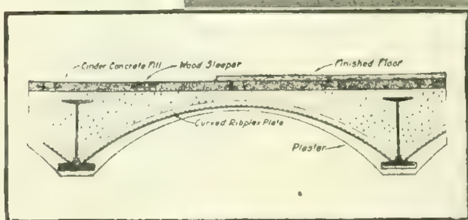
Pipe, Dredge
Macnold & Riddell

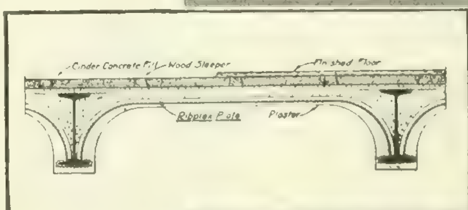
Pipe Fittings
Builders Iron Foundry
Central Foundry Co

IN THE R. H. MACY ADDITION

50,000 Square Feet
3/4-inch Ribplex Reinforcement

In the addition to the R. H. Macy Store in New York now being erected by Marc. Eidlitz & Son, Inc., Mooney Construction Co. handling the fire-proofing, 24-gauge Berloy ¾-in. Ribplex, curved to specifications, is being placed between deep girders, as forms and reinforcement for the concrete.





This means a big saving in concrete and dead load, without lessening the efficiency of the slab. The Architect, Robert D. Kohn, is well pleased with the results.

The use of this curved Ribplex concrete floor construction merits careful consideration by every architect, engineer, and contractor.

Ribplex is also used extensively in solid slab construction for roofs and floors.

Write our nearest office for Bulletin K-24 and sample of ¾-in. Riplex.

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BERLOY

Ribplex & Diamond Mesh Lath

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Leadite Co., Inc., The

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East Jersey Pipe Co

Pipe, Lock Joint
[illegible] Pipe Co.
Lock Joint Pipe Co.

Pipe, Reinforced Concrete
[illegible] Corp.

Pipe, Riveted Steel
American Spiral Pipe Wks.
Blaw-Knox Co.
East Jersey Pipe Co.
[illegible]
[illegible] Iron Wks. Co.
Tippett & Wood

Pipe Shoes
Marion Malleable Iron Wks.

Pipe, Spiral
Abendroth & Root Mfg. Co.
American Spiral Pipe Wks
Blaw-Knox Co.
Robertson Bros. Mfg. Co.

Pipe, Tap Welded
American Spiral Pipe Wks.

Pipe, Vitrified Clay
Dickey Clay Mfg. Co.

Pipe, Wood
American Wood Pipe Co.
Continental Pipe Mfg. Co.
Michigan Pipe Co.
Pacific Tank & Pipe Co.
Standard Wood Pipe Co.
Wyckoff & Son Co., A.

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Keystone Gypsum Fireproofing Co.

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Amer. Creosoting Co. (Ky.)
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Georgia Creosoting Co.

Poles, Steel Structural
Blaw-Knox Co.

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Blaw-Knox Co.
International Steel Tie Co.

Pulverizers
Jeffrey Mfg. Co.

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Chicago Pneumatic Tool Co.
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Sullivan Machinery Co.
Traylor Engr. & Mfg. Co.

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Earle Gear & Machine Co.
Ingersoll-Rand Co.
Lea-Courtenay Co.

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De Laval Steam Turbine Co
Earle Gear & Machine Co.
Erie Pump & Engine Co.
Ingersoll-Rand Co.
Keystone Driller Co.
Lea-Courtenay Co.
Manistee Iron Works
Morris Machine Works
Smith Co., T. L.

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Edson Manufacturing Corp.
Ingersoll-Rand Co.
Pulsometer Steam Pump Co
Smith Co., T. L.

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Cook, A. D.
Keystone Driller Co.

Pumps, Diaphragm
Boston & Lockport Block Co.
Edson Manufacturing Corp.
Manistee Iron Works
Smith Co., T. L.

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Erie Pump & Engine Co.
Marion Steam Shovel Co
Morris Machine Works
Worthington Pump & Machy. Corp.

Pumps, Power
Cook, A. D.
Lea-Courtenay Co.
Manistee Iron Works

Pumps, Underwriters' Centrifugal
Allis-Chalmers Mfg. Co.
Earle Gear & Machine Co.
Lea-Courtenay Co
Manistee Iron Works

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Marion Steam Shovel Co.
Osgood Co.

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International Steel Tie Co

Recorders, Water Stage
Gurley, W. & L. E.

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Reinforcing, Concrete
(See Conc. Reinforcement)

Reinforcing Metal for Concrete Work
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Berger Mfg. Co.

River and Harbor Work
Raymond Concrete Pile Co.

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Allen, John F.
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Road Oilers, Pressure
Austin-Western Road Machy. Co.

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Standard Oil Co. of N. Y.
Texas Co.
Universal Road Machy. Co.

Road Rollers, Gasoline and Steam
Acme Road Machy. Co.
Austin Machy. Corp.
Austin-Western Rd. Mchy Co.
Buffalo-Springfield Roller Co.

Rolls, Crushing
Allis-Chalmers Mfg. Co.
Jeffrey Mfg. Co.
Buchanan Co., Inc., C. G.

Roofing, Asbestos Protected
Robertson Co., H. H.

Roofing, Gypsum
Marks Corp., The H. E.

Roofing, Metal
Amer. Sheet & Tin Plate Co.
Berger Mfg. Co.

Roofing, Prepared
Carey Co., The Philip
Texas Co.

Roofing, Tile
Federal Cement Tile Co.
Keystone Gypsum Fireproofing Co.
Truscon Laboratories

Rope, Wire, Transmission Hoisting or Haulage
American Steel & Wire Co
Leschen & Sons Rope Co.
Roeblings Sons Co., J. A.
Wickwire-Spencer Steel Corp.

Sash Operating Apparatus
Allison Steel Products Co.
Drouve Co., G.

Sash Steel, Window
(See Window Sash)

Saw Rigs, Portable
Industrial Works

Schools & Colleges
See Directory of Engineers

Scrapers, Scarifiers, Plows.
Austin Mfg. Co.
Austin Western Rd Mchy Co.
Western Wheeled Scraper Co.

Screens, Revolving
Buchanan Co., Inc., C. G.
Smith Engineering Works

Screens, Sand, Gravel and Coal
Austin Mfg. Co.
Austin Western Road Mchy Co.
Haiss Mfg. Co., Inc., Geo.
Hendrick Mfg. Co
Link-Belt Co.
Webster Mfg. Co.
Wickwire-Spencer Steel Corp.

Screens, Water Intake
Link Belt Co.

Searchlights
General Electric Co.

Separators, Magnetic
Buchanan Co., Inc., C. G.

Sewage Disinfection
Electro Bleaching Gas Co
Wallace & Tiernan Co. Inc.

Shafting
Ryerson & Son, Joseph T.

Sharpening Machines, Drill Bit
Ingersoll-Rand Co.

Sheaves
Haiss Mfg. Co., Inc., Geo.

Sheets, Iron and Steel
Amer. Sheet & Tin Plate Co.
Armco Culvert & Flume Mfrs. Assn.
Bethlehem Steel Co.
Ryerson & Son, Joseph T.

Sheets, Roofing and Siding
Amer. Sheet & Tin Plate Co
Armco Culvert & Flume Mfrs. Assn.
Robertson Co., H. H.
Ryerson & Son, Joseph T.

Shelving, Steel
Berger Mfg. Co

Shovels, Electric
Erie Steam Shovel Co
Keystone Driller Co.
Marion Steam Shovel Co
Thew Shovel Co.

Shovels, Gasoline
Marion Steam Shovel Co.
Northwest Engineering Co.
Thew Shovel Co.

Shovels, Picks, Crowbars,
Pittsburgh Shovel Co.

Shovels, Steam
Erie Steam Shovel Co.
Hoar Shovel Co., The
Keystone Driller Co.
Marion Steam Shovel Co.
Osgood Co.

Skips, Stone
Insley Manufacturing Co
Thew Shovel Co.

Skylights
Allison Steel Products Co.
Drouve Co., G.
Robertson Co., H. H.

Slabs, Cement Roofing
Federal Cement Tile Co.

Slate, Structural
Structural Slate Co

Sprinklers and Sweepers Street
Austin Machinery Corp.
Austin Mfg. Co.
Austin-Western Rd. Mchy Co.

Standpipes
Blaw-Knox Co.
Caldwell Co., W. E.
Chicago Bridge & Iron Wks.
Pacific Tank & Pipe Co.
Pittsburgh-Des Moines Steel Co.
Tippett & Wood

Steam Specialties
Jenkins Bros.

Steel
Ryerson & Son, Joseph T.

Steel Plate Construction
Bethlehem Steel Co.
Blaw-Knox Co.
Chicago Bridge Iron Wks.
East Jersey Pipe Co
Heltzel Steel Form & Ir. Co.
Hendrick Mfg. Co.
[illegible] Co., The Jos.
Littleford Bros.
Petroleum Iron Wks. Co.
Pittsburgh-Des Moines Steel Co.
Riter-Conley Co.
Union Iron Works
Vulcan Iron Wks. of N. J.
Williams Co., G. H.

Steel, Structural
Belmont Iron Works
Berlin Construction Co.
Bethlehem Steel Co.
Blaw-Knox Co.
Boston Bridge Works
Chesapeake Iron Works
Eastern Bridge & Struc. Co.
Eichleay Jr. Co., John
Fort Pitt Bridge Works
Kenwood Bridge Co.
Louisville Bridge & Iron Co.
McClintic Marshall Co.
Milwaukee Bridge Co.
Minneapolis Steel & Mchy Co.
Morava Construction Co.
Mount Vernon Bridge Co.
Penn Bridge Co. (Pa.)
Phoenix Bridge Co.
Pittsburgh-Des Moines Steel Co.
Riverside Bridge Co.
Shoemaker-Satterwait Br. Co
[illegible]
Snead Architect. Iron Wks.
Strauss Bascule Bridge Co.
Virginia Bridge & Iron Co.
Wisconsin Bridge & Iron Co.

Steel, Tool
Bethlehem Steel Co.
Ingersoll-Rand Co.
Ryerson & Son Co., Jos. T.

Stokers
Babcock & Wilcox Co.

Strainers, Well
Cook, A. D.

Superheaters
Babcock & Wilcox Co
Power Specialty Co
Superheater Co.

Switchboards
General Electric Co.

Tables and Boards, Drawing
Dietzgen Co., Eugene
Hamilton Mfg. Co.
[illegible] Co., C. F.
Weber Co., F.

Tanks, Air Compressor
Chicago Pneumatic Tool Co.
East Jersey Pipe Co.
Westinghouse Traction Brake Co.

Tanks, Oil
Blaw-Knox Co
Riter-Conley Co.

Tanks, Elevated Steel
Caldwell Co., W. E.
Chicago Bridge & Iron W[ks]
Graver Corp.
Littleford Bros
Petroleum Iron Wks. Co.
Pittsburgh-Des Moines Steel Co.

Tanks, Elevated, Wood
American Wood Pipe Co.
Caldwell Co., W. E.
Continental Pipe Mfg. Co
Pacific Tank & Pipe Co

Tapes, Steel and Metallic
[illegible]
Hamilton Mfg. Co.
Keuffel & Esser Co.
Lufkin Rule Co.
[illegible], Ltd.

Testing Laboratories
(See Engineers' Directory)

Thermometers
Taylor Instrument Cos.

Ties, Creosoted Wood
Amer. Creosoting Co. (Ky.)
Colonial Creosoting Co.
Georgia Creosoting Co.
Jennison-Wright Co.

Ties, Steel
International Steel Tie Co.

Tile, Concrete Bldg.
Federal Cement Tile Co.
Keystone Gypsum Fireproofing Co.
Truscon Laboratories

Tile, Roof Cement
Federal Cement Tile Co.
Truscon Laboratories

Tin Plate
Amer. Sheet & Tin Plate Co.
Bethlehem Steel Co.

Tools, Pneumatic
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Towers, Concrete
(See Hoists, Conc. Tower)

Towers, Radio
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Riter-Conley Co.

Towers, Transmission
Blaw-Knox Co.
Riter-Conley Co.

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Bethlehem Steel Co
Easton Car & Constr. Co.

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Minneapolis Steel & Mchy Co.

Trailers
Watson Products Corp.

Transformers, Electric
General Electric Co.

Transits and Levels
Ainsworth & Sons, Wm.
Berger & Sons Co., C. L.
Buff & Buff Mfg. Co.
Gurley, W. & L. E.

Transmission Machinery Power
Link-Belt Co.

Treads, Safety
Irving Iron Works
Kerlow Steel Flooring Co.
Universal Safety Tread Co.

Trolleys, I-Beam
Brown Hoisting Machy. Co.

Trucks, Motor
Watson Products Corp.

Tunnel Liner Plates
Blaw-Knox Co.

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Allis Chalmers Mfg. Co.
Pelton Water Wheel Co.
Smith Co., S. Morgan
Worthington Pump & Machy. Corp.

Turbines, Steam
Allis-Chalmers Mfg. Co.
De Laval Steam Turbine Co.

Turbo Generators, Steam
General Electric Co.

Turntables
Blaw-Knox Co.
Easton Car & Constr. Co.

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Spencer White & Prentis
Underpinning & Found. Co.

Unloaders
Erie Steam Shovel Co.

Unloaders, Car
Haiss Mfg. Co., Geo.
Heltzel Steel Form & Ir. Co.

Valves, Air, Water, Steam and Gas
Chapman Valve Mfg. Co.
Coldwell-Wilcox Co
Coffin Valve Co.
Crane Co.
Golden-Anderson Valve Specialty Co.
Ludlow Valve Mfg. Co
Powell Co., Wm
Rensselaer Valve Co.
Simplex Valve & Meter Co.
Smith Mfg. Co., A. P.

Valves, Altitude
Golden-Anderson Valve Specialty Co.
Ludlow Valve Mfg. Co.

Valves, Angle, Check, Gate and Globe
Chapman Valve Mfg. Co.
Coffin Valve Co.
Golden-Anderson Valve Specialty Co.
Jenkins Bros.
Ludlow Valve Mfg. Co.
Powell Co., Wm
Simplex Valve & Meter Co
Westinghouse Traction Brake Co

Valves, Automatic
Golden-Anderson Valve Specialty Co.
Ludlow Valve Mfg. Co.
Westinghouse Traction Brake Co.

Valves, Control, Electric
Dean, Ltd., Payne

Valves, Float
Golden-Anderson Valve Specialty Co.

Valves, Regulating
Golden-Anderson Valve Specialty Co.
Ludlow Valve Mfg. Co.
Simplex Valve & Meter Co

Valves, Return
Golden-Anderson Valve Specialty Co.

Valves, Safety
Golden-Anderson Valve Specialty Co.
Ludlow Valve Mfg. Co.

Valves, Sewage
Chapman Valve Mfg. Co.

Valves, Sluice
Chapman Valve Mfg. Co.
Coffin Valve Co.

Ventilators
Allison Steel Products Co
Drouve Co., G.
Robertson Co., H. H.

Wagons, Asphalt
Watson Products Corp.

Wagons, Dump, Auto
Austin Mfg. Co.
Austin-Western Road Mchy. Co.

Wagons, Dump
Austin Mfg. Co.
Austin-Western Road Mchy. Co.
Stroud & Co.
Watson Products Co.
Western Wheeled Scraper Co

Wagon Loaders
Austin Machinery Corp.
Austin Mfg. Co.
Austin-Western Road Mchy. Co.
Erie Steam Shovel Co.
Gifford Wood Co.
Haiss Mfg. Co., Inc., Geo.
Jeffrey Mfg. Co.
Link-Belt Co.

Washers, Cut, Cast Malleable
Portable Machy. Co.
Smith Engineering Wks.

Water-Main Cleaning
Nat'l Water Main Cleaning Co.

Waterproofing Compounds and Materials
Anti-Hydro Waterproofing Co.
Carey Co., The Philip
General Chemical Co.
Sonneborn Sons, L.
Texas Co.
Truscon Laboratories

Water Purification
Electro Bleaching Gas Co
Wallace & Tiernan Co., Inc

Water Softeners
Amer. Water Softener Co.
California Filter Co.
Graver Corporation
International Filter Co.
N. Y. Continental Jewell Filtration Co.
Roberts Filter Mfg. Co

Water Sterilization
Electro Bleaching Gas Co.
Wallace & Tiernan Co., Inc.

Water Wheels, Impulse and Reaction
Pelton Water Wheel Co.
Smith Co., S. Morgan

Welding and Cutting Apparatus
Air Reduction Sales Co.
Blaw-Knox Co.
General Electric Co.
Milburn Co., Alexander
Oxweld Acetylene Co.

Wheelbarrows
Sterling Wheelbarrow Co.

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Brown Hoisting Mchy. Co.
Dobbie Frdy. & Mach. Co
Lidgerwood Mfg. Co.
Mundy Hoisting Eng. Co., J. S.
National Hoisting Eng. Co

Window Sash Putty
Truscon Laboratories

Window Sash Steel
Allison Steel Products Co.

Wire Glass
Mississippi Wire Glass Co

Wire Mesh, Reinforcing
Wickwire-Spencer Steel Corp

Wire Rope
(See Rope, Wire)

Wire and Cable, Electrical
American Steel & Wire Co
General Electric Co.

Wood Casings
Michigan Pipe Co., The

Wood Preservatives
Protexol Corp.
Truscon Laboratories

Wrenches
Greene Tweed & Co.

For Railroads — Bridge and Trestle Timbers, Flooring, Roofing, Siding, Lining, Sills, Framing, Sawn Ties, Grain Doors. We make a specialty of bridge stringers.

For Factory Builders—Close Grained Virgin Long Leaf Timbers and heavy lumber for slow combustion construction.

Unquestioned Supremacy

	Long Leaf Pine	Short Leaf Pine	Loblolly Pine	Coast Type Douglas Fir
Strength as beam or post........	100.0	84.0	83.5	85.0
Compressing ⊥ grain (flatwise)...	100.0	80.0	92.0	88.5
Shearing // grain..............	100.0	83.0	84.0	85.0
Shock-resisting ability	100.0	90.0	91.0	77.0
Stiffness	100.0	82.0	85.5	100.0
Hardness	100.0	85.5	80.0	78.0
Weight (green)................	100.0	100.0	108.0	80.0
Weight (air dry)........... ..	100.0	90.5	90.5	80.0

Summary of results, Testing Laboratories, Department of Civil Engineering, Columbia University.

Industrial users of lumber and timbers are interested in the durability and strength of the products they use and the service these products give. In other words, they demand only the best. Long Leaf Southern Pine demonstrates convincingly its place among the competing woods in the above concise chart.

Add to this, the fact that the holdings of Exchange Sawmills Sales Company are all in that belt in Louisiana where Long Leaf Southern Pine grows to its best; that lumber and timbers for all industrial purposes are special products of our eight mills, made from especially selected trees and subjected to special care at our mills—and the user of ESSCO products knows he is getting the best that can be produced.

"Long Leaf Southern Pine showed a much greater ability to resist shock, which is a required characteristic for car construction material."—Report of Testing Laboratories.

EXCHANGE SAWMILLS SALES CO.

Long Building, Kansas City, Mo.

R. B. WHITE, President and General Mgr.

F. R. WATKINS, Sec'y and Mgr. Yard Sales

R. S. PRICE, Mgr. Railroad and Timber Sales

ALPHABETICAL INDEX TO ADVERTISEMENTS